Electronic Poster

Diffusion: In Vivo & Ex Vivo Applications: CNS

Exhibition Hall	Monday 8:15 - 9:15

3075	Computer 1	2-year-old human brain DTI atlas with comprehensive gray and white matter labels
		Limei Song[1,2], Yun Peng[3], Qinmu Peng[2], Lei Feng[1], Minhui Ouyang[2], Huiying Kang[3], Shuwei Liu[1], and Hao Huang[2,4]
		[1]Shandong University School of Medicine, Jinan, China, [2]The Children's Hospital of Philadelphia, Philadelphia, PA, United States, [3]Beijing Children's Hospital Affiliated to Capital Medical University, Beijing, China, [4]Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States
		2-year-old, marking the end of infancy, is critical for understanding not only precisely organized normal brain development but also serving as clinical anatomical references for neurodevelopmental disorders such as autism. The 2-year-old brain labels transformed from adult atlases lead to relatively large offsets due to dramatic and nonlinear neuroanatomical differences of the brains between these two populations. With DTI data from nineteen healthy 2-year-old subjects, we created a 2-year-old brain DTI atlas with comprehensive labels of 124 gray and white matter structures. The test results suggested the established atlas can be applied to label 2-year-old brain images automatically and accurately.

3076	Computer 2	Children with Sickle Cell Disease treated with Hydroxyurea show increased CVR and White Matter Integrity: a quantitative MRI study
		Daniel Kapustin[1,2], Jackie Leung[1], Isaac Odame[1], Suzan Williams[1], and Andrea Kassner[1,2]
		[1]SickKids Hospital, Toronto, ON, Canada, [2]University of Toronto, Toronto, ON, Canada
		Sickle cell disease (SCD) is a devastating genetic blood disorder leading to chronic anemia and cerebral infarctions. We sought to assess microstructural properties in the WM using diffusion tensor MRI and compare them to measures of cerebrovascular reactivity (CVR). Specifically, we investigated the effect of hydroxyurea (HU) treatment in SCD. Our results show that non-HU patients had increased skew and kurtosis of mean diffusivity in the WM compared to HU patients and healthy controls, and these parameters were correlated to WM CVR in this group. This suggests HU may have beneficial effects on WM microstructural integrity in patients with SCD.

3077	Computer 3	Feasibility and benefits of 3-tissue constrained spherical deconvolution for studying the brains of babies
		Thijs Dhollander[1], Julien Zanin[2,3], Bryony A. Nayagam[2], Gary Rance[2,3], and Alan Connelly[1,4]

[1]The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia, [2]Department of Audiology and Speech Pathology, University of Melbourne, Melbourne, Australia, [3]The HEARing Cooperative Research Centre, Melbourne, Australia, [4]The Florey Department of Neuroscience, University of Melbourne, Melbourne, Australia

When studying white matter in baby brains with diffusion-weighted imaging, we face a range of challenges, including larger water-content, lower anisotropy, differentiated maturation and a (relatively) larger proportion of the brain being comprised of grey matter. We attempt to apply **single-tissue, 2-tissue and 3-tissue constrained spherical deconvolution (CSD)** to single-shell data of two 5 month old babies. **3-tissue CSD** still worked successfully. The nature of benefits was in line with those obtained previously in adults, but they were greater in the babies, mostly due to a much larger presence of GM-like tissue.

3078 | Computer 4

Location-wise Harmonization along White Matter Tracts on Neonatal Brain from Multiple Acquisition Protocols

Simin Liu[1,2,3], Xianjun Li[1], Miaomiao Wang[1], Chao Jin[1], Hua Guo[3], and Jian Yang[1,2]

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In this work, we proposed white matter location-wise harmonization of DTI measurement on neonatal brain based on tract quantification from multiple acquisition protocols. A total of 120 term neonates examined by two DTI acquisition protocols, including 38 neonates with punctate white matter lesions and 82 without MRI abnormalities, were enrolled. Two methods, Scaling and ComBat, were adopted, each carried out also on global-wise and ROI-wise in addition to location-wise. We also proposed an evaluation framework to systematically compare the adopted harmonization approaches, which suggests the way to select the utmost harmonization level and the specific method.

3079 | Computer 5

DTI Assessment of Regional White Matter Changes in the Cervical and Thoracic Spinal Cord in Pediatric Subjects

Sona Saksena[1], Devon M Middleton[1], Laura Krisa[2], Mahdi Alizadeh[1,3], Chris C Conklin[1], Adam Flanders[1], MJ Mulcahey[2], Feroze B Mohamed[1], and Scott H Faro[4]

[1]Radiology, Thomas Jefferson University, Philadelphia, PA, United States, [2]Occupational Therapy, Thomas Jefferson University, Philadelphia, PA, United States, [3]Neurosurgery, Thomas Jefferson University, Philadelphia, PA, United States, [4]Radiology, Johns Hopkins School of Medicine, Baltimore, MD, United States

		Synopsis: Prior adult studies have shown that DTI allows for noninvasive assessment of the severity of spinal cord injury (SCI). The aim of this study was to determine whether DTI at sites cephalad and caudal to the injury provides measures of injury severity in pediatric subjects with chronic SCI and compared these data with normative DTI data of typically developing subjects. ROIs were drawn on whole cord and spinal cord white matter (WM) areas: ventral, dorsal, and both right and left lateral regions along the entire cervical and thoracic SC. For each SCI subject, DTI parameters for each WM region were measured at the levels cephalad and caudal relative to MR injury. We demonstrated changes in FA and AD in WM regions at levels both cephalad and caudal to the injury site. This suggests that FA and AD has the potential to be sensitive marker of true extent of cord injury and might be useful in detecting remote injuries.

3080	Computer 6	Application of Reduced Field-of-View Diffusion-Weighted Imaging in Evaluation of Normal Pituitary Glands and Pituitary Macroadenomas
		Miaomiao Wang[1], Heng Liu[1], Congcong Liu[1], Ting Liang[1], Xianghui Zhang[1], Xianjun Li[1], Chao Jin[1], and Jian Yang[1]
		[1]Department of Diagnostic Radiology, the First Affiliated Hospital of Xi’an Jiaotong University, Xi’an, China
		Field-of-view optimized and constrained undistorted single-shot (FOCUS) imaging provides relatively high resolution images with few artifacts. However, application of this technique for evaluation of normal pituitary glands and pituitary macroadenomas has not been reported to date. The study aims to evaluate the image quality and value of FOCUS DWI in evaluation of normal pituitary glands and pituitary macroadenomas. Our results suggest that FOCUS DWI exhibited obviously superior image quality both in normal pituitary glands and macroadenomas in a clinically feasible scan time. Moreover, it might be helpful for evaluating the consistency of pituitary macroadenomas.

3081	Computer 7	Apparent diffusion coefficient for molecular subtyping of non-Gadolinium-enhancing WHO grade II/III glioma
		Laura Mancini[1,2], Sara Hassanein[2,3], Sotirios Bisdas[1,2], Jeremy H Rees[2,4], Harpreet Hyare[2,3], John A Maynard[3], Sebastian Brandner[5], Carmen Tur[6], H Rolf Jager[1,2,3], Tarek Yousry[1,2,3], and Steffi C Thust[1,2,3]
		[1]Lysholm Department of Neuroradiology, National Hospital for Neurology & Neurosurgery UCLH NHS FT, London, United Kingdom, [2]Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom, [3]Imaging Department, University College Hospital UCLH NHS FT, London, United Kingdom, [4]Neurology Department, Natl Hosp for Neurology & Neurosurgery UCLH NHS FT, London, United Kingdom, [5]Department of Neurodegenerative Disease, UCL Institute of Neurology and Division of Neuropathology, London, United Kingdom, [6]Department of Neuroinflammation, Queen Square MS Centre, UCL Institute of Neurology, London, United Kingdom

		A proportion of non-enhancing intrinsic presumed low-grade-gliomas(LGG), rapidly progresses. Hypothesis: ADC can predict glioma molecular subtypes of the revised 2016 World_Health_Organization brain tumours classification. Methods..44 non-Gadolinium-enhancing LGG divided in three molecular subgroups. 2D and 3D T2-derived tumour and normal-appearing-white-matter (NAWM) masks co-registered to ADC_maps(b=1000s/mm^2). Linear-regression, ROC-analysis and logistic-regression compared ADC_values with tumour type. Results..ADCmean and ADCratio(tumour/NAWM) were lowest ($p<0.001$) in the most malignant tumour type (IDHwt). An ADCmean(ADCratio) threshold of 1201*10^{-6}mm^2/s(1.65) identified IDHwt with sensitivity=83%(80%) and specificity=86%(92%) (AUC=0.9-0.94). Between-observers (2D-versus-3D) intraclass-correlation-coefficient=0.98(0.92). Conclusions..ADC measurements can support the distinction of non-enhancing glioma subtypes. 3D and 2D measurements were both accurate.

3082	Computer 8	Thalamic nuclei segmentation on dementia using tractography and population-specific priors
		Carla Semedo[1], M. Jorge Cardoso[1,2], S. B. Vos[1,3,4], Carole H. Sudre[1,2], Martina Bocchetta[2], Annemie Ribbens[5], Dirk Smeets[5], Jonathan Rohrer[2], and Sebastien Ourselin[1,2]
		[1]Translational Imaging Group, UCL, London, United Kingdom, [2]Dementia Research Centre, UCL, London, United Kingdom, [3]MRI Unit, Epilepsy Society, Chalfont St Peter, United Kingdom, [4]Wellcome EPSRC Centre for Interventional and Surgical Sciences (WEISS), UCL, London, United Kingdom, [5]Icometrix, Leuven, Belgium
		Thalamic changes have been reported in several neurological disorders, such as Alzheimer's disease and frontotemporal dementia (FTD). As pathologies affect different cortical and subcortical brain regions disproportionally, accurate segmentation of thalamic nuclei can provide relevant insights about brain function and neurological disorders mechanisms. Here, we used a previously developed thalamus parcellation strategy that relies on tractography and population-specific to infer any connectivity changes in presence of FTD. The obtained results were compared against to the ones derived with the commonly used probabilistic tractography pipeline available in FSL.

3083	Computer 9	Kurtosis and IVIM measurements applied to ischemic stroke diagnosis: an initial experience.
		Aude Pavilla[1,2,3], Alessandro Arrigo[4], Giulio Gambarota[1,2], Mehdi Mejdoubi[3], Régis Duvauferrier[3], and Hervé Saint-Jalmes[1,2,5]
		[1]INSERM, UMR 1099, Rennes, France, [2]Université de Rennes 1, LTSI, Rennes, France, [3]Department of Neuroradiology, Pierre-Zobda-Quitman Hospital, University Hospital of Martinique, Fort-de-France, Martinique, [4]Radiology, CH La Palmosa, Menton, France, [5]CRLCC, Centre Eugène Marquis, Rennes, France

		Diffusional kurtosis imaging (DKI) enables the characterization of non-Gaussian diffusion providing an additional diffusion parameter, the kurtosis (K), that may reflect microstructure heterogeneity. The DKI-IVIM model that incorporates DKI into the IVIM model has been investigated here to assess the feasibility and the potential utility of the DKI-IVIM model for both enhanced diffusion characterization and perfusion measurements in ischemic stroke. Five stroke patients were enrolled. DKI-IVIM imaging was performed using 8 b-values from 0 to 1500 s/mm^2 with a 4 minutes scan duration. IVIM pseudo-diffusion coefficient D*, perfusion fraction f, blood flow-related parameter fD* in addition to the diffusion parameters D (diffusion coefficient) and K were determined in the ischemic lesion and contralateral normal tissue for the stroke patients. Diffusion and perfusion parametric maps were reconstructed. A significant decrease for D (p<0.0001) and increase for K (p=0.0002) in the lesion was observed. The perfusion fraction exhibited a significant decrease in the ischemic regions (p=0.005). DKI-IVIM model enables for simultaneous cerebral perfusion and enhanced diffusion characterization in an acceptable clinically acquisition time that might improve ischemic stroke diagnosis.

3084	Computer 10	Interferon-alpha induced changes in NODDI predispose to the development of fatigue
		Nicholas G Dowell[1], Samira N Bouyagoub[1], Mara Cercignani[1], and Neil A Harrison[1]
		[1]Neuroscience and imaging, Brighton and Sussex Medical School, Brighton, United Kingdom
		Here we use NODDI modeling of multi-shell diffusion MRI to investigate whether changes in orientation-dispersion index (ODI) or intracellular volume fraction (Vic) can predict the later emergence of IFN-α-induced fatigue. Eighteen patients initiating IFN-α based treatment for hepatitis-C underwent diffusion MRI and blood sampling at baseline and 4 hours after their first IFN-α injection. They were then followed up with regular psychological assessments for 12 weeks of treatment. IFN-α injection stimulated an acute inflammatory cytokine response and evoked acute fatigue that peaked between 4 and 12 weeks of treatment. Within the brain, IFN-α induced an acute increase in intracellular volume fraction in patients that experienced a simultaneous increase in IFN-α induced fatigue but not patients that did not. Acute changes in striatal microstructure additionally predicted the continued development of fatigue but not mood symptoms 4 and 8 weeks later into treatment. Our findings highlight the value of NODDI as a potential in vivo biomarker of the central effects of peripheral inflammation. We highlight the exquisite sensitivity of the striatum to IFN-α and further implicate striatal perturbation in IFN-α-induced fatigue.

3085	Computer 11	Hippocampal Subfield-specific Tractography in Epilepsy Patients at 7 Tesla
		John W Rutland[1], Rebecca E Feldman[1], Lara V Marcuse[2], Madeline C Fields[2], Bradley N Delman[3], Prantik Kundu [1], Patrick R Hof[4], and Priti Balchandani[1]

[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Department of Neurology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [3]Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [4]Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY, United States

This is the first investigation to use diffusion tensor imaging at 7 Tesla to quantify changes in the structural connectivity of individual hippocampal subfields in epilepsy patients. Diffusion imaging and automated hippocampal subfield segmentation were performed on 19 epilepsy patients and 10 healthy controls. We found that hippocampal volumes are reduced bilaterally in epilepsy patients compared with controls. Connectivity in the left fimbria and right hippocampal-amygdaloid transition area is significantly reduced in epilepsy patients compared with controls. These findings suggest that connectivity of hippocampal subfields are independently affected in epilepsy patients.

3086 | Computer 12

Positive DTI Findings After Recovery Following Youth Sport-Related Concussion May Be of Little Clinical Relevance

Najratun Nayem Pinky[1], Carolyn Emery[2,3,4], Chantel Debert[5], and Bradley Goodyear[1,6,7]

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Mild traumatic brain injury (mTBI), including sport-related concussion, is a major health issue. Diffusion Tensor Imaging (DTI) can be useful for identifying alterations in white matter tracts following sport-related concussion. We found that fractional anisotropy (FA) significantly differed between recovered and control youth within the right anterior thalamic radiation and the right inferior longitudinal fasciculus; however, the effect size (< 0.02 change in FA) suggests that the difference may be of little or no clinical relevance, given the recovered group exhibited no symptoms. Large cohort studies are needed before statistically significant MRI findings should be used to inform return-to-play policy

3087 | Computer 13

Regional Brain Changes in Autonomic, Mood, and Cognitive Control Areas in Adolescents with Single Ventricle Heart Disease

Sadhana Singh[1], Bhaswati Roy[2], Nancy Halnon[3], Alan Lewis[4], Mary Woo[2], Nancy Pike[2], and Rajesh Kumar[1,5,6,7]

		[1]Department of Anesthesiology, University of California Los Angeles, Los Angeles, CA, United States, [2]UCLA School of Nursing, University of California Los Angeles, Los Angeles, CA, United States, [3]Division of Pediatric Cardiology, University of California Los Angeles, Los Angeles, CA, United States, [4]Division of Pediatric Cardiology, Children's Hospital Los Angeles, Los Angeles, CA, United States, [5]Department of Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States, [6]Department of Bioengineering, University of California Los Angeles, Los Angeles, CA, United States, [7]Brain Research Institute, University of California Los Angeles, Los Angeles, CA, United States
		Adolescents with single ventricle heart disease (SVHD) show both white and gray matter injury in multiple brain areas that control autonomic, mood, and cognitive functions that are deficient in the condition. However, the nature and extent of brain injury in SVHD are unclear. Using diffusion tensor imaging based MD procedures, we showed wide-spread chronic tissue changes in SVHD subjects in areas involved in autonomic, mood, and cognitive regulatory functions. These findings may have resulted from hypoxia/ischemia- or developmental-induced processes accompanying the condition.

3088	Computer 14	Brain White Matter Microstructure Changes in Alzheimer disease with Type 2 diabetes:a DKI study
		Junyi Dong[1], Liang Han[1], Xiaoxin Li[1], and Yanwei Miao[1]
		[1]Department of Radiology, The First Affiliated Hospital of Dalian Medical University, Dalian, China
		In this study, the groups were respectively used as the people with Alzheimer disease with type 2 diabetes, Alzheimer disease without type 2 diabetes and healthy person, the effect of high blood glucose on the microstructure in patients with type 2 diabetes mellitus, and the changes on microstructure in patients with AD patients were studied used DKI study, and it was concluded that the high blood glucose level may have certain damage to the microstructure of the white matter. In conclusion, DKI study can evaluate secondary brain microstructure changes from hyperglycemia in T2DM patients.

3089	Computer 15	Brain Microstructure Changes of gray matter detected by DKI in Alzheimer disease with Type 2 diabetes patients
		Junyi Dong[1], Xiaoxin Li[1], Liang Han[1], and Yanwei Miao[1]
		[1]Department of Radiology, The First Affiliated Hospital of Dalian Medical University, Dalian, China
		In this paper, the experimental group and the control group were respectively used as the people with Alzheimer disease with type 2 diabetes and Alzheimer disease without type 2 diabetes, the effect of high blood glucose on the microstructure in patients with type 2 diabetes mellitus was studied used DKI study, and it is concluded that the high blood glucose level may have certain damage to the microstructure of the gray matter. In conclusion, DKI study can evaluate secondary brain microstructure changes from hyperglycemia in T2DM patients.

3090	Computer 16	Looking at the structural connectivity of the frontal inferior cortex to better decipher the inhibitory control mechanisms in Obsessive Compulsive Disorder Ivy Uszynski[1,2], Cyril Poupon[2], Cédric Pichat[3,4], Pauline Favre[2], Benjamin Fredembach[3], Hervé Mathieu[1,5,6,7], Laurent Lamalle[6,7], Alexandre Krainik[1,6,7], Olivier David[1,5], Emmanuel L. Barbier[1,5], and Mircea Polosan[1,5,8] *[1]Grenoble Institut des Neurosciences, Université Grenoble Alpes, Grenoble, France, [2]NeuroSpin, CEA Saclay, Gif-sur-Yvette, France, [3]Department of Psychology, Université Grenoble Alpes, Grenoble, France, [4]LPNC UMR 5105, CNRS, Grenoble, France, [5]INSERM U1216, Grenoble, France, [6]Unité Mixte de Service IRMaGe, CHU Grenoble Alpes, Grenoble, France, [7]Unité Mixte de Service 3552, CNRS, Grenoble, France, [8]Department of Psychiatry, CHU Grenoble Alpes, Grenoble, France* Obsessive-compulsive disorder (OCD) is a neuropsychiatric disease affecting 2.5-3% of the population and characterized by repetitive compulsive behaviours with severe complications such as depression, suicide and addiction. Diffusion MRI is a powerful non-invasive technique that evaluates the integrity of the white matter pathways such as those implicated in the impulse control, likely to be impaired in OCD. Here, we investigate the connectivity of the right posterior inferior frontal cortex and in particular to the presupplementary motor area (also involved in inhibition), to the striatum (involved in proactive and/or selective control) and to the primary motor cortex in the contralateral hemisphere.

3091	Computer 17	Predicting treatment outcome of schizophrenia based on white matter tract integrity using a support vector classifier Wen-Bin Luo[1], Jing-Ying Huang[2,3], Yung-Chin Hsu[2], and Wen-Yih Isaac Tseng[2,4,5,6] *[1]School of Medicine, National Taiwan University College of Medicine, Taipei, Taiwan, [2]Institute of Medical Device and Imaging, National Taiwan University College of Medicine, Taipei, Taiwan, [3]Department of Radiology, Wei Gong Memorial Hospital, Miaoli, Taiwan, [4]Graduate Institute of Brain and Mind Sciences, National Taiwan University College of Medicine, Taipei, Taiwan, [5]Department of Medical Imaging, National Taiwan University Hospital, Taipei, Taiwan, [6]Molecular Imaging Center, National Taiwan University, Taipei, Taiwan* Although white matter tract microstructure has been implicated in treatment outcome of schizophrenia, its predictive capability on first-episode patients remains unknown. In the study, diffusion spectrum imaging (DSI) data were acquired from both chronic and first-episode patients, reconstructed by mean apparent propagator (MAP) MRI and analyzed with tract-based automatic analysis (TBAA). Stepwise statistical analysis was then performed to identify specific segments of white matter tracts that were significantly different between remitted and non-remitted chronic patients. We built a support vector classifier on the preprocessed data matrix. The resulting model yielded fair validation and test accuracy on chronic and first-episode patients, respectively.

3092	Computer 18	Diffusion MRI as an imaging marker of depression from a large and homogenous population study

		Julie Coloigner[1], Jean-Marie Batail[1,2,3], Isabelle Corouge[1], Jean-Christophe Ferré[1,4], Dominique Drapier[2,5], and Christian Barillot[1]
		[1]Univ Rennes, Inria, CNRS, Inserm, IRISA UMR 6074, VISAGES ERL U-1228, F-35000, Rennes, France, [2]Academic Psychiatry Department, Centre Hospitalier Guillaume Régnier, Rennes, France, [3]EA 4712 Behavior and Basal Ganglia, CHU Rennes, Rennes 1 University, Rennes, France, Metropolitan, [4]Department of Neuroradiology, University Hospital of Rennes, Rennes, France, [5]2 EA 4712 Behavior and Basal Ganglia, CHU Rennes, Rennes, France
		Despite the extensive therapy options available for depression, up to 80% of patients will suffer from a relapse. Consequently, understanding the neural correlates underlying the depression will optimize the diagnosis and treatment of individual depressed patients. The purpose of our study was to investigate alterations of white matter integrity in a large cohort of patients suffering from depression using diffusion tensor imaging. Our findings provide robust evidence that the reduction of white-matter integrity in the interhemispheric connections and fronto-limbic neuronal circuits may play an important role in depression pathogenesis.

3093	Computer 19	Wired for music? – a diffusion MRI based study of normative music perception skills
		Archith Rajan[1], Jacob Antony Alappatt[1], Apurva Shah[2], Megha Sharda[3], Jeffrey M Valla[1], Madhura Ingalhalikar[2], and Nandini C Singh[1,4]
		[1]Language,Literacy and Music lab, National Brain Research Centre, Gurgaon, India, [2]Department of Electronics and TeleCommunication, Symbiosis Institute of Technology, Symbiosis International University, Pune, India, [3]International Laboratory for Brain, Music and Sound (BRAMS), University of Montreal, Montreal, QC, Canada, [4]UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development (MGIEP), New Delhi, India
		White matter micro-structural correlates of music perception skills have only been studied in expert musicians, although skills can be independent of musical training. We assessed normative variation of music perception skills in adult population by the PROMS-S musicality test. A tract based spatial statistic on high angular diffusion data revealed negative associations between Mode of Anisotropy and d' measures of total scores, sub-scores of Accent, Embedded Rhythms and Tempo in the Corpus Callosum extending to Corona Radiata. Partial volumes of secondary fiber population also correlated positively to these scores, suggesting the recruitment of inter-hemispheric connections necessary for enhanced music perception.

3094	Computer 20	The neurosurgical implication of scanner, gradient performance and acquisition protocol on Meyer's loop reconstruction
		Maxime Chamberland[1], Chantal M.W. Tax[1], William Gray[1], and Derek K. Jones[1]
		[1]CUBRIC, Cardiff University, Cardiff, United Kingdom

		The optic radiation (OR) is a key brain fiber bundle of the visual system which must be spared as much as possible during resection of the temporal lobe in epilepsy surgery to prevent visual field defects. Therefore, it is of utmost importance to avoid underestimating its anterior location (Meyer's loop) with diffusion MRI tractography. For this reason, it is critical that this part of the OR is reconstructed as accurately as possible. In this abstract, we demonstrate that standard diffusion MRI acquisitions potentially underestimate the true location of Meyer's loop, when compared to state-of-the-art protocols.

3095	Computer 21	Retrospective Reduction of Systematic Differences Across Scanner Changes by Accounting for Noise Floor Effects in Diffusion Tensor Imaging
		Ken Sakaie[1], Xiaopeng Zhou[2], Jian Lin[1], Josef Debbins[3], Mark Lowe[1], and Robert Fox[4]
		[1]Imaging Institute, The Cleveland Clinic, Cleveland, OH, United States, [2]Life Science MRI Facility, Purdue University, West Lafayette, IN, United States, [3]Keller Center for Imaging Innovation, Barrow Neurological Institute, Phoenix, AZ, United States, [4]Neurological Institute, The Cleveland Clinic, Cleveland, OH, United States
		Scanner upgrades are a persistent but important problem when conducting MRI research studies. Systematic differences introduced by a scanner upgrade can have undesirable effects on the conclusions of a study. Quantitative tissue microstructure measurements by diffuson tensor imaging (DTI) can be affected by systematic differences in noise floor effects. Noise floor effects are due to rectification of signal by magnitude reconstruction than can, in turn, bias microstructure measurements. A retrospective correction that accounts for noise statistics is proposed to limit systematic differences in DTI measurements across scanner upgrades. A practical measure, signal to noise floor ratio (SNFR) is proposed to determine the conditions under which the retrospective correction works effectively.

3096	Computer 22	Age-effects on cortical tissue diffusivity
		Jordan A. Chad[1,2], David H. Salat[3], and J. Jean Chen[1,2]
		[1]Rotman Research Institute, Baycrest Health Sciences, Toronto, ON, Canada, [2]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]MGH/HST Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States
		Mean diffusivity (MD) is known to increase with age in the white matter (WM), serving as a measure of age-related WM degeneration. However, age-effects on MD with age have scarcely been studied in the gray matter. Here we examine age-effects on MD across the cerebral cortex. MD is shown to correlate more strongly with age than cortical thickness measurements derived from anatomical MRI. Cortical regions showing the largest MD age-effects include the insula and anterior cingulate, suggesting greatest neurodegeneration in these regions. This work suggests that MD may be used as a sensitive measure of aging in the cerebral cortex.

3097	Computer 23	Investigating the performance of Diffusional Kurtosis Imaging for group-wise analyses: A study from the Human Connectome Project
		Hamed Y. Mesri[1], Szabolcs David[1], Max A. Viergever[1], and Alexander A. Leemans[1]
		[1]Image Sciences Institute, University Medical Center Utrecht and Utrecht University, Utrecht, Netherlands
		Diffusional Kurtosis Imaging (DKI) is an extension to Diffusion Tensor Imaging (DTI), which allows the quantification of non-Gaussian water diffusion and the quantification of parameters related to microstructural changes. In this work, we used high-quality datasets from the Human Connectome Project and non-parametric statistical inference to evaluate the performance of the DKI measures for group-wise studies. To this end, we used the gender information to group the subjects and study the differences. Our results demonstrated that DKI metrics could reveal the differences more accurately compared to DTI metrics.

3098	Computer 24	IVIM values in healthy brain
		Steren Chabert[1], Jorge Verdu[1,2], Gamaliel Huerta[1], Cristian Montalba[3], Pablo Cox[4], Rodrigo Riveros[4,5], Sergio Uribe[3,6], Rodrigo Salas[1], and Alejandro Veloz[1,7]
		[1]Biomedical Engineering Department, Universidad de Valparaiso, Valparaiso, Chile, [2]Universidad Politécnica de Valencia, Valencia, Spain, [3]Center for Biomedical Imaging, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]Servicio de Imagenología, Hospital Carlos van Buren, Valparaiso, Chile, [5]Facultad de Medicina, Universidad de Valparaiso, Valparaiso, Chile, [6]Radiology Department, Pontificia Universidad Católica de Chile, Santiago, Chile, [7]Informatics Department, Universidad Técnica Federico Santa María, Valparaíso, Chile
		Even though there is much interest in brain IVIM imaging, it is difficult to get a clear view from literature on which values to expect. Our purpose is to obtain healthy brain D, D* and f, to add findings and get closer to reference values. Two distributions of 16 b-values were used to acquire data on 10 volunteers, at 1.5T: one commonly found in literature and the other considered as optimal. Values obtained from the "optimal distribution" were significantly different in all cases but D in white matter. This study emphasizes the dependence of IVIM results on the acquisition scheme applied.

Electronic Poster

Microstructure: Experiments & Applications

Exhibition Hall	Monday 8:15 - 9:15

3099	Computer 25	Biomimetic numerical phantoms for white matter tissues characterization using a reduced number of design parameters Kevin GINSBURGER[1], Fabrice POUPON[2], Felix MATUSCHKE[3], Jean-François MANGIN[2], Markus AXER[3], and Cyril POUPON[1] *[1]UNIRS, CEA/ISVFJ/Neurospin, Gif-sur-Yvette, France, [2]UNATI, CEA/ISVFJ/Neurospin, Gif-sur-Yvette, France, [3]INM-1 Forschungszentrum Jülich, Jülich, Germany* We propose to extend the functionalities of the Diffusion Microscopist Simulator to design more realistic white matter phantoms without any input mesh and with few parameters. The biomimetic phantoms can represent crossing configurations with an arbitrary number of fiber populations, include a myelin sheath and Ranvier nodes and account for beading, tortuosity and angular dispersion of fibers.

3100	Computer 26	Analysis of the T2-Relaxation-Diffusion Correlation MRI in Glioblastoma Yuan Li[1,2], Michelle Kim[3], Theodore Lawrence[2], Parmar Hemant[3], and Yue Cao[1,2,3] *[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Radiation Oncology, University of Michigan, Ann Arbor, MI, United States, [3]Radiology, University of Michigan, Ann Arbor, MI, United States* Analysis of the T2-relaxation-diffusion correlation is an emerging approach. It has the potential to reveal the biophysical behavior of tissue and tumor, which cannot be done by the analysis of T2-relaxation and diffusion MRI separately. This study applied this approach to glioblastoma (GBM) and revealed the different correlations between T2 and diffusion in tumor, normal tissue and edema.

3101	Computer 27	Bound Model for Extracting Small Airway Scales in Pediatric Asthma Annie Malkus[1], Robert V Cadman[1], and Sean B Fain[1,2,3] *[1]Medical Physics, University of Wisconsin, Madison, WI, United States, [2]Radiology, University of Wisconsin, Madison, WI, United States, [3]Biomedical Engineering, University of Wisconsin, Madison, WI, United States* We evaluate a morphometric approach for measuring acinar airway and alveolar scales with diffusion weighted MRI of hyperpolarized helium in pediatric asthma subjects.

3102	Computer 28	In Vivo 3D Axonal Diameter Estimation in the Human Brain with 300 mT/m Gradient MRI

		Alfred Anwander[1], Thomas R. Knösche[1], Thomas Witzel[2], Assaf Horowitz[3], and Yaniv Assaf[3]
		[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [3]Tel Aviv University, Tel Aviv, Israel
		The estimation of neural micro-structure in general and axon diameter in particular became feasible using advanced diffusion imaging frameworks such as CHARMED and AxCaliber. Recently, the AxCaliber model was extended to 3D enabling to capture the axonal properties of any fiber system in the brain. In this work we challenged the utility of using the CONNECTOM MRI, that provides a gradient strength of up to 300 mT/m, for axon diameter estimation. We found that the sensitivity of the model towards small diameter axons increases dramatically with the use of the strong gradient system increasing the validity and accuracy of AxCaliber3D.

3103	Computer 29	Estimation of Extracellular Matrix Diffusion Properties in Decellularized Porcine Myocardium from DTI
		Noel Naughton[1], Nicholas Gallo[2], Marcella Viacik[2], Aaron Anderson[1], Bradley Sutton[1], and John Georgiadis[1,2]
		[1]Univeristy of Illinois at Urbana Champaign, Urbana, IL, United States, [2]Illinois Institute of Technology, Chicago, IL, United States
		We present a method to estimate microstructural parameters of a decellularized pig myocardium using a two-compartment exchange model. We also show that the estimated parameters are in good agreement with other values found in the literature.

3104	Computer 30	MRI approaches to map focal cortical dysplasia in focal epilepsy using anomalous diffusion and magnetic susceptibility
		Qiang Yu[1], David Reutens[1], Javier Urriola[1], Surabhi Sood[1], and Viktor Vegh[1]
		[1]Centre for Advanced Imaging, University of Queensland, Brisbane, Australia
		Focal cortical dysplasias (FCD) are developmental malformations of the cerebral cortex that are often highly epileptogenic. When medications fail to control seizures, surgical removal of dysplastic epileptogenic tissue may be curative. But, in 20-40% of patients current MRI scans cannot identify FCD affected brain regions. Building on the anomalous nature of diffusion and magnetic susceptibility of tissue, we aimed to improve *in vivo* identification of FCD in the brain. We found the combination of anomalous diffusion model parameters and tissue magnetic susceptibility can be used to differentiate FCD from healthy tissue in the brain.

3105	Computer 31	A two-perfusion compartment model for human placenta.
		Michele Guerreri[1,2], Amanda Antonelli[3], Silvia Bernardo[3], Carlo Catalano[3], Lucia Manganaro[3], and Silvia Capuani[2]
		[1]SAIMLAL department, Sapienza University, Rome, Italy, [2]ISC, CNR, Rome, Italy, [3]Department of Radiological, Oncological and Pathological Sciences, Rome, Italy
		This work proposes the use of a two perfusion comparmtent model to fit diffusion MRI data of human placenta. The aim of the work is to characterize the parameters values and compare them with results obtained in animal models.

3106	Computer 32	Does the g-ratio influence resting-state functional connectivity? A group-level analysis
		Matteo Mancini[1], Charlotte Clarke[2], Nick Dowell[2], Neil Harrison[2], and Mara Cercignani[2,3]
		[1]Translational Imaging Group, University College London, London, United Kingdom, [2]Brighton and Sussex Medical School, Department of Neuroscience, University of Sussex, Brighton, United Kingdom, [3]Neuroimaging Laboratory, Santa Lucia Foundation, Rome, Italy
		Recent findings have shown specific relationships between the cortical myeloarchitecture of the brain and resting-state functional connectivity patterns, while little is known about the white matter myelin distribution. The aim of this work is to preliminary characterize how the g-ratio (i.e., the ratio of the inner and the outer diameters of myelinated axons) and functional connectivity are interrelated. We characterized at group level connectivity patterns using structural connectivity, functional connectivity and g-ratio. We then assessed potential differences between specific functional modules. We observed different distributions when comparing structure and function in terms of g-ratio, and reported significant differences.

3107	Computer 33	More certainty about your uncertainty in diffusion MRI microstructure estimates
		Robbert Leonard Harms[1] and Alard Roebroeck[1]
		[1]Department of Cognitive Neuroscience, Maastricht University, Maastricht, Netherlands

		Diffusion MRI microstructure approaches use point estimates ignoring the uncertainty in these estimates. In this work, we evaluate two general methods to quantify uncertainty and generate uncertainty maps for any microstructure model. We find that the Fisher Information Matrix method based in nonlinear optimization is fast and accurate for models with few parameters. The Markov Chain Monte Carlo (MCMC) based method takes more time, but provides robust uncertainty estimates even for sophisticated models with more parameters. Uncertainty estimates of microstructure measures can help power evaluations for group/population studies and assist in data quality control and analysis of microstructure model fit.

3108	Computer 34	Disentangling the Effects of Anisotropy and Orientation Dispersion Using Diffusion Spherical Mean Spectrum Imaging
		Tiantian Xu[1], Geng Chen[1], Haiyong Wu[1,2], Weili Lin[1], Dinggang Shen[1,3], and Pew-Thian Yap[1]
		[1]University of North Carolina, Chapel Hill, NC, United States, [2]Xiaozhuang University, Nanjing, China, [3]Korea University, Seoul, Korea, Democratic People's Republic of
		Diffusion fractional anisotropy (FA) measures voxel-level anisotropy, which mingles the effects of neurite microscopic-level anisotropy and orientation dispersion. We introduce a technique, called spherical mean spectrum imaging (SMSI), that can disentangle these two effects. We applied SMSI on baby brain diffusion MRI data collected during the first year of life and show that SMSI can extract microstructural information that is elusive to diffusion tensor imaging (DTI).

3109	Computer 35	Quantification of white matter pathologies during multiple sclerosis disease development
		Chunyu Song[1], Peng Sun[2], Anne H. Cross[3], and Sheng-Kwei Song[4]
		[1]Biomedical Engineering, Washington University in St. Louis, st louis, MO, United States, [2]Radiology, Washington University in St. Louis, st louis, MO, United States, [3]Neurology, Washington University in St. Louis, st louis, MO, United States, [4]The Hope Center for Neurological Disorders, Washington University in St. Louis, St Louis, MO, United States
		A new diffusion MRI histology (D-Histo) is proposed to model both intra and extra axonal diffusion, in addition to isotropic diffusion. It not only resolves crossing fibers but also quantitatively assess axonal injury, axon loss, demyelination, edema and inflammation. Through the multiple-tensor modelling of diffusion-weighted MRI signals, D-Histo has shown promise to monitor evolving pathologies in normal appearing corpus callosum in multiple sclerosis patient brain.

3110	Computer 36	Determining how varying the number of gradient strengths and frequencies affects fitted mean axon diameters in the corpus callosum using oscillating spin echo gradients

		Morgan Mercredi[1], Sheryl L Herrera[1], Richard Buist[2], Kant Matsuda[3], and Melanie Martin[1,4]
		[1]Physics and Astronomy, University of Manitoba, Winnipeg, MB, Canada, [2]Radiology, University of Manitoba, Winnipeg, MB, Canada, [3]Pathology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [4]Physics, University of Winnipeg, Winnipeg, MB, Canada
		There is an increasing drive to use diffusion spectroscopy to infer the sizes of structures in samples. We present here the first use of the sine OGSE to infer the effective mean axon diameters in the human corpus callosum and study the effect on accuracy of reducing the number of images used in the inference. Aiming to reduce imaging times, this study examines how the number of frequencies or number of gradients affects accuracy and precision. We found that collecting OGSE data with two gradients gives a difference in results of less than 5% compared to six gradients.

3111	Computer 37	Exchange arising from myelin water revealed from temperature-dependent multiexponential T2 mapping
		Noam Shemesh[1] and Mark D Does[2]
		[1]Champalimaud Research, Champalimaud Centre for the Unknown, Lisbon, Portugal, [2]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States
		The importance of myelin water exchange in relaxation and diffusion metrics extracted from tissues is still an open question. In particular, to what extent myelin water fraction (MWF) values derived from multiexponential T2 are due to exchange between myelin and intra/extra axonal spaces remains unclear. Here, fixed rat spinal cords were subject to temperature-dependent multiple spin echo experiments, aiming to probe how exchange modulates quantitative T2 maps in rat spinal cords. We find signatures for exchange from T2 shift patterns, which are tightly linked to the axon diameters in the spinal cord.

3112	Computer 38	Fast and robust estimation of NODDI parameters using non-Gaussian noise models and spatial regularization
		Erick Jorge Canales-Rodríguez[1,2,3], Jean-Philippe Thiran[1,2], and Alessandro Daducci[1,2,4]
		[1]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [2]Signal Processing Laboratory 5 (LTS5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [3]FIDMAG Germanes Hospitaláries, Barcelona, Spain, [4]Computer Science Department, University of Verona, Verona, Italy

		In this study we developed a robust inversion algorithm to estimate the Neurite Orientation Dispersion and Density Imaging (NODDI) model. It is based on the Accelerated Microstructure Imaging via Convex Optimization (AMICO) framework. However, in contrast to AMICO, the proposed method relies on realistic MRI noise models. Moreover, it allows to take into account the underlying spatial continuity of the brain image by including a total variation regularization term. In simulated data the new method was effective in reducing the outliers, producing results more close to the ground-truth and with lower variability. The method was also evaluated on real data.

3113	Computer 39	Diffusional changes of perivascular space in focused ultrasound induced Blood-Brain Barrier disruption in rat brain
		Heajung Choi[1], Huijin Song[2], Kyung Eun Jang[1], Hyunsil Cha[1], Eunji Kim[1], Mujin Yang[1], Jiung Yang[1], Hoesu Jung[3], Mun Han[4], Taekwan Lee[3], Juyoung Park[4], and Yongmin Chang[1,5]
		[1]Department of Medical & Biological Engineering, Kyungpook National University, Daegu, Republic of Korea, [2]Institute of Biomedical Engineering Research, Daegu, Republic of Korea, [3]Laboratory Animal Center, Daegu-Gyeongbuk Medical Innovation Foundation, Daegu, Republic of Korea, [4]Medical Device Development Center, Daegu-Gyeongbuk Medical Innovation Foundation, Daegu, Republic of Korea, [5]Department of Radiology, Kyungpook National University, Daegu, Republic of Korea
		Focused ultrasound (FUS) induces microbubble oscillation, which loosens the tight junction of the endothelial cells in the brain and opens Blood-Brain Barrier (BBB). In this study, we opened the BBB of rat brain using the MRI guided FUS to investigate the changes of diffusivity in perivascular space using diffusion-weighted imaging (DWI). Our results showed that ADC of the perivascular space increased after sonication suggesting the increased water diffusion in perivascular space after BBB opening. Therefore, our study suggests that ADC change can be a possible imaging marker for opening of BBB.

3114	Computer 40	Feasibility of VERDICT-MRI for non-invasive characterisation of rectal cancer microstructure
		Maira Tariq[1], Christopher Liao[2], Elisenda Bonet-Carne[1,3], Andrew A Plumb[2], Manuel Rodriguez-Justo[4], Daniel C Alexander[1], Manish Chand[2], David Atkinson[3], and Eleftheria Panagiotaki [1]
		[1]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom, [2]University College London Hospital, London, United Kingdom, [3]Centre for Medical Imaging, University College London, London, United Kingdom, [4]Department of Pathology, University College London Hospital, London, United Kingdom

		This work evaluates the feasibility of in-vivo microstructure imaging for rectal cancer using the VERDICT MRI framework. We perform a model comparison to find the form of VERDICT that can describe the rich DW-MRI data. Preliminary results from two subjects show promise for non-invasive clinical rectal cancer characterisation. We find that a multi-compartment VERDICT model that explicitly models restriction explains the signal in the rectal tissue better than the conventional cancer models and shows plausible estimates of microstructure in the rectal cancer tissue. Future work will compare these findings with corresponding histology.

3115	Computer 41	Towards the assessment of myelination using time-dependent diffusion MRI indices.
		Abib O. Y. Alimi[1], Alexandra Petiet[2], Mathieu Santin[2], Anne-Charlotte Philippe[2], Stephane Lehericy[2,3], Rachid Deriche[1], and Demian Wassermann[1,4]
		[1]Université Côte d'Azur, Inria, Valbonne, France, [2]Institut du Cerveau et de la Moelle épinière – ICM, Centre de NeuroImagerie de Recherche – CENIR, Paris, France, [3]Sorbonne Universités, UPMC Univ Paris 06, Inserm U1127, CNRS UMR 7225, Paris, France, [4]Inria, CEA, Université Paris-Saclay, Paris, France
		We study the sensitivity of time-dependent diffusion MRI indices or qτ-indices to demyelination in the mouse brain. For this, we acquire *in vivo* four-dimentional diffusion-weighted images -varying over gradient strength, direction and diffusion time- and estimate the qτ-indices from the corpus callosum. First order Taylor approximation of each index gives fitting coefficients α and β whose variance we investigate. Results indicate that, cuprizone intoxication affects mainly index coefficient β by introducing inequality of variances between the two mice groups, most significantly in the splenium and that MSD increases and RTOP decreases over diffusion time τ.

3116	Computer 42	Towards Non-Invasive Characterization of Intravoxel Tumor Heterogeneity: Correlation between Non-Gaussian Diffusion MRI and Histology Using Machine Learning
		Muge Karaman[1], Lingdao Sha[2], Tingqi Shi[1], Weiguo Li[3,4], Dan Schonfeld[2,5,6], Tibor Valyi-Nagy[7], and Xiaohong Joe Zhou[1,6,8]
		[1]Center for Magnetic Resonance Research, University of Illinois at Chicago, Chicago, IL, United States, [2]Department of Electrical and Computer Engineering, University of Illinois at Chicago, Chicago, IL, United States, [3]Research Resource Center, University of Illinois at Chicago, Chicago, IL, United States, [4]Department of Radiology, Northwestern University, Chicago, IL, United States, [5]Department of Computer Science, University of Illinois at Chicago, Chicago, IL, United States, [6]Department of Bioengineering, University of Illinois at Chicago, Chicago, IL, United States, [7]Department of Pathology, University of Illinois at Chicago, Chicago, IL, United States, [8]Departments of Radiology, and Neurosurgery, University of Illinois at Chicago, Chicago, IL, United States

		Tissue heterogeneity is an important consideration for diagnosing many diseases. Recently, a novel non-Gaussian diffusion model – continuous-time random-walk model (CTRW) – provided promising evidence indicating a possible link between voxel-level spatiotemporal diffusion heterogeneity and microscopic intravoxel tissue heterogeneity. Establishing a correlation between imaging-based and histology-based measurements, however, has been challenging because of the lack of efficient and subjective evaluation of tissue heterogeneity histologically. In this study, we applied a machine-learning algorithm to quantitatively determine microscopic tissue heterogeneity, enabling a correlation between intravoxel diffusion heterogeneity based on CTRW parameters and structural heterogeneity from histopathology.

3117	Computer 43	Stromal collagen content correlates with fast diffusivity signal fraction in breast lesions
		Liv Egnell[1,2], Igor Vidić[1], Dennis W. Adams, Jr.[3], Neil P. Jerome[2,4], Torill E. Sjøbakk[4], Agnes Østlie[2], Hans E. Fjøsne[5,6], Rebecca Rakow-Penner[7], Anders M. Dale[7,8], Anna M. Bofin[9], Tone F. Bathen[4], and Pål Erik Goa[1,2]
		[1]Department of Physics, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [2]Clinic of Radiology and Nuclear Medicine, St. Olavs University Hospital, Trondheim, Norway, [3]Department of Pathology, University of California San Diego School of Medicine, San Diego, CA, United States, [4]Department of Circulation and Medical Imaging, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [5]Department of Cancer Research and Molecular Medicine, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [6]Department of Surgery, St. Olavs University Hospital, Trondheim, Norway, [7]Department of Radiology, University of California, San Diego, La Jolla, CA, United States, [8]Department of Neurosciences, University of California, San Diego, La Jolla, CA, United States, [9]Department of Clinical and Molecular Medicine, NTNU – Norwegian University of Science and Technology, Trondheim, Norway
		The deviation from a monoexponential of the DW-signal decay towards higher *b*-values (>1000s/mm^2) reflects the complex tissue microstructure. The biexponential decay model assumes that the signal is composed of two components with different diffusivity, possibly originating from two physically separated tissue components. In this study, we estimate the collagenous and non-collagenous extracellular contents in sixteen breast lesions using hematoxylin-eosin-saffron stained histological specimens and compare with pre-surgical in vivo DW-MRI data. Our results show that the signal fraction of the faster diffusivity component correlated significantly with collagen content, suggesting that collagen contributes to the DWI signal decay

3118	Computer 44	Multimodal microstructure imaging: joint T2-relaxometry and diffusometry to estimate myelin, intracellular, extracellular, and cerebrospinal fluid properties
		Marco Pizzolato[1], Erick Jorge Canales-Rodríguez[1,2], Alessandro Daducci[1,2,3], and Jean-Philippe Thiran[1]
		[1]Signal Processing Lab (LTS5), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]Radiology Department, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland, [3]Computer Science Department, University of Verona, Verona, Italy

		We propose a multimodal joint estimation that aims at exploiting the complementary information of diffusion and multi-echo spin echo data to disentangle the contributions and properties of the main tissue microstructure compartments. We recovered T2, diffusion coefficient, and volume fractions values of myelin, intracellular, extracellular, and cerebrospinal fluid compartments within an *ex vivo* spinal cord sample by means of diffusometry and relaxometry. A g-ratio map was also calculated.

3119	Computer 45	Prostate Cancer Classification Using Stretched Exponential Model Parameters of Diffusion Signal Decay
		Meltem Uyanik[1], Michael Abern[2], Brandon Caldwell[2], Muge Karaman[3], Winnie Mar[4], Virgilia Macias[5], Xiaohong Joe Zhou[1,3,4,6], and Richard Magin[7]
		[1]Richard and Loan Hill Department of Bioengineering, University of Illinois at Chicago, Chicago, IL, United States, [2]Urology, University of Illinois at Chicago, Chicago, IL, United States, [3]Center for Magnetic Resonance Research, College of Medicine, University of Illinois at Chicago, Chicago, IL, United States, [4]Radiology, University of Illinois at Chicago, Chicago, IL, United States, [5]Pathology, University of Illinois at Chicago, Cahicago, IL, United States, [6]Neurosurgery, University of Illinois at Chicago, Chicago, IL, United States, [7]Richard and Loan Hill Department of Bioengineering, University of Illinois, Chicago, IL, United States
		Prostate cancer is a common malignancy among men. Using MRI to discriminating high-grade disease from benign and indolent cancer in the prostate is highly desirable for treatment planning. Single and multi- exponential models of diffusion signal decay in the prostate has proven useful for determining prostate cancer tissue structure. However, classification of cancer grade remains illusive. In this study, we investigate the stretched exponential signal decay model using histology and ROC analysis to determine if it will more accurately characterize aggressive prostate cancer.

3120	Computer 46	Pre-surgical high-resolution microstructural imaging in mesial temporal lobe epilepsy
		Farshid Sepehrband[1], Ryan P Cabeen[1], Meng Law[1,2], and Kristi A Clark[1]
		[1]Laboratory of Neuro Imaging, USC Stevens Neuroimaging and Informatics Institute, Keck school of medicine of USC, University of Southern California, Los Angeles, CA, United States, [2]Department of Radiology, University of Southern California, Los Angeles, CA, United States
		The gold standard for the treatment of medically refractory temporal lobe epilepsy continues to be surgical resection. This technique is not significantly different from when it was first popularized by Wilder Penfield in 1952. Significant advances in treatment are limited by our understanding of the structural abnormalities within the hippocampus prior to resection. In addition, pre-surgical planning for minimized resection demand accurate localization of hippocampal sclerosis (HS), which is limited by the achievable neuroimaging resolution. With advances in structural and diffusion MRI, microstructural imaging of brain tissue in high resolution is made possible, which can aid pre-surgical planning.

3121	Computer 47	Isotropic diffusion weighted 3D oscillating gradients at 7T Ivan I Maximov[1], Sebastian Vellmer[2], Rüdiger Stirnberg[3], and Tony Stöcker[3] *[1]Oslo University, Oslo, Norway, [2]Berstein Center for Computational Neuroscience, Berlin, Germany, [3]German Centre for Neurodegenerative Diseases (DZNE), Bonn, Germany* The diffusion MRI represents a signal obtained from the relatively large voxel size consisting of complex tissue microstructure. Modern diffusion MRI strategies typically work with one parametric dimension associated with either *b*-value or diffusion time. In turn, spatial anisotropy of biological tissue demands to take into account a high angular resolution. In order to simplify the interpretation of the diffusion signal, we introduce isotropic diffusion weightings. Essentially, we sample the diffusion signal by 3D oscillating gradient method. Novel biomarkers such as surface-to-volume ratio and mean neurite diameter are presented.

3122	Computer 48	Diffusion MRI in muscles at high b-values: towards a quantification of microscopic organelles Nicolas Moutal[1], Denis Grebenkov[1], Sylvie Clerjon[2], Guilhem Pages[2], and Jean-Marie Bonny[2] *[1]PMC, CNRS – Ecole Polytechnique, F-91128, Palaiseau, France, [2]AgroResonance - UR370 QuaPA, F-63122, Saint Genès Champanelle, France* We present an application of diffusion MRI at high b-values to a non-invasive quantification of micron-sized organelles such as mitochondria. The experiments were conducted *ex vivo* on pork muscle and analyzed with a bi-exponential tensorial model, which allows us to estimate the mitochondria content in the muscle. Even though a more systematic comparison between mesoscale diffusion and microscale histology is deserved, this work is a proof of concept and a prerequisite for developing *in vivo* methods for quantifying the content of various organelles in muscles, e.g. for studying mitochondrial dysfunction in aging.

Electronic Poster

Image Analysis for Neuroimaging

Exhibition Hall	Monday 8:15 - 9:15

3123	Computer 49	Atlas-based brain extraction for bias field-affected structural imaging demonstrated using MPRAGE in marmoset Isaac Huen[1], Krishna Kanth Chitta[1], Kuan Jin Lee[2], Philip Lee[3], Kheng Choon Lim[4], Lisa F. P. Ng[5], and Bhanu Prakash KN[1]

		[1]*Signal and Image Processing Group, Laboratory of Metabolic Imaging, Singapore Bioimaging Consortium, Singapore, Singapore,* [2]*MR Methods Development Group, Laboratory of Metabolic Imaging, Singapore Bioimaging Consortium, Singapore, Singapore,* [3]*Functional Metabolism Group, Laboratory of Metabolic Imaging, Singapore Bioimaging Consortium, Singapore, Singapore,* [4]*Department of Diagnostic Radiology, Singapore General Hospital, Singapore, Singapore,* [5]*Laboratory of Microbial Immunity, Singapore Immunology Network, Singapore, Singapore*
		Changes in volume and shape of structures under an intervention or disease state can be measured in many subjects by automatic segmentation of structural imaging. However, unwanted intensity variation (bias field artefact), such as observed using a surface coil, can compromise such segmentation. We investigated how this artefact could be resolved using post-processing, to yield accurate brain extraction from MPRAGE acquisition in a marmoset. This atlas-based method (ASM) significantly improved brain extraction, correcting multiple inaccuracies of the initial FSL-based method (FSM) such as exclusion of the olfactory bulb and inferior cerebellar structures, and is robust to bias field artefact.

3124	Computer 50	Fast and robust unsupervised identification of MS lesion change using statistical detection of changes (SDC) algorithm
		Thanh D Nguyen[1], Shun Zhang[1], Ajay Gupta[1], Susan A Gauthier[1], and Yi Wang[1]
		[1]*Weill Cornell Medical College, New York, NY, United States*
		The objective of this study was to develop a robust automated lesion change detection algorithm for MS. Our preliminary results in 30 patients show that our SDC algorithm achieves much higher sensitivity and specificity (99%/76%) compared to that obtained with off-the-shelf LPA algorithm (76%/27%).

3125	Computer 51	Clinical feasibility of Quantitative Susceptibility Mapping with Automatic Uniform Cerebrospinal Fluid Zero Reference
		Shun Zhang[1,2], Zhe Liu[2,3], Yihao Yao[1], Thanh D. Nguyen[2], Pascal Spincemaille[2], and Yi Wang[2,3]
		[1]*Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China,* [2]*Radiolgy, Weill Cornell Medical College, NewYork, NY, United States,* [3]*Biomedical Engineerring, Cornell University, Ithaca, NY, United States*
		Longitudinal and cross-center studies using conventional quantitative susceptibility mapping (QSM) methods require the choice of a reference tissue, its manual segmentation and subtraction of its average. In this work, we report our initial clinical experience with a fully automated zero-referenced Morphology Enabled Dipole Inversion (MEDI+0) method that uses the ventricular cerebrospinal fluid (CSF) as zero reference in 393 consecutive patients. In 92.62% of cases, excellent agreement of image quality between MEDI+0 and MEDI was observed with high correlation of lesion susceptibility in a combined glioma, ischemic stroke and multiple sclerosis subset of patients.

3126	Computer 52	Thalamus in schizophrenia revisited: a partial-volume estimation study Philipp S. Baumann[1,2], Elena Najdenovska[3,4], Mário João Fartaria[4,5], Alessandra Griffa[3], Timo Roine[2,3,4], Yasser Alemán-Gómez[2,3,4], Emeline Mullier[3], Philippe Golay[1], Zita Rovo[2], Patric Hagmann[3], Kim Q. Do[2], Philippe Conus[1], Pascal Steullet[2], and Meritxell Bach Cuadra[3,4,6] *[1]Service of General Psychiatry, Department of Psychiatry, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Center for Psychiatric Neuroscience, Department of Psychiatry, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [3]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Medical Image Analysis Laboratory (MIAL), Centre d'Imagerie BioMédicale (CIBM), Lausanne, Switzerland, [5]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [6]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland* The thalamus has a central role in the pathophysiology of schizophrenia. Formed by several nuclei, it is mainly constituted by a mixture of grey and white matter and, thus, its MR signal is heavily affected by the partial volume (PV) effect. We hypothesize that tissue segmentation based on a PV model will better depict subtle changes in schizophrenia patients than total thalamus volume or local tissue volume measurements that do not consider PV. Results show statistically significant changes in gray matter and white matter average concentration from PV model within the thalamus in schizophrenia patients (SCHZ) compared to healthy controls (HC).

3127	Computer 53	Comparison study of Visualization of Low Intensity Spots between Susceptibility Weighted Imaging and Quantitative Susceptibility Mapping Created from the Same Raw Phase Yasutaka Fushimi[1], Tomohisa Okada[2], Yuta Urushibata[3], Takuya Hinoda[1], Takayuki Yamamoto[1], Hikaru Fukutomi[1], Yusuke Yokota[1], Sonoko Oshima[1], Akira Yamamoto[1], Tsutomu Okada[1], and Kaori Togashi[1] *[1]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan, [3]Siemens Healthcare Japan K. K., Tokyo, Japan* This study was conducted to evaluate the contrast of microbleeds between SWI and QSM created from the identical raw phase of SWI. QSM was created by using STI Suite. The contrast between low intensity spot on SWI and the surrounding brain parenchyma was significantly higher in QSM than SWI.

3128	Computer 54	Regional Differences in Cortical Diffusion MRI Measurements Based on the HCP Dataset Zifei Liang[1], Di Wang[1], Tanzil Arefin[1], Yulin Ge[1], and Jiangyang Zhang[1]

		[1]Dept. of Radiology, New York University School of Medicine, NEW YORK, NY, United States
		Diffusion MRI (dMRI) is widely used for investigation of microstructural properties of white matter structures, but its application in cortical gray matter structures has only emerged recently due to limited spatial resolution. Little is known of the normal dMRI measurements among different cortical gray matter structures, their variations, and regional differences. In this work, we present the normative values of healthy volunteers for dMRI metrics across 74 parcellated cortical regions based on well-characterized high-resolution human connectome project (HCP) dataset. We found regional differences in several dMRI metrics among these cortical regions to be mainly in mean diffusivity and kurtosis.

3129	Computer 55	PROBABILISTIC MODEL-BASED FUNCTIONAL PARCELLATION OF THE PRIMARY OLFACTORY CORTEX
		Prasanna Karunanayaka[1], Jiaming Lu[2], Christopher Sica[1], Bing Zhang[2], Qing Yang[1], Paul Eslinger[3], and Ronald Janssen[4]
		[1]Radiology, Center for NMR Research, Penn State University College of Medicine, Hershey, PA, United States, [2]Radiology, Drum Tower Hospital, Medical School of Nanjing University, Nanjing, Nanjing, China, [3]Neurology, Penn State University College of Medicine, Hershey, PA, United States, [4]Radboud University Nijmegen, Donders Centre for Brain Cognition and Behaviour, Nijmegen, The Netherlands, Nijmegen, Netherlands
		The primary olfactory cortex (POC) is the largest recipient of olfactory bulb projections. It has a functionally versatile organization with extensive reciprocal connections to several higher-order cortical regions likely resulting in specific brain signals. Here, we propose a Bayesian model-based clustering approach, applied solely to resting state functional MRI time courses, to identify intrinsic POC functional parcellations. Results of this study suggest that multiple regions within the POC, with clear inter-hemispheric correspondence and functional relevance, can be identified using resting state fMRI data.

3130	Computer 56	A Deep Learning Approach to Synthesize FLAIR Image from T1WI and T2WI
		Takashi Abe[1] and Noriko Salamon[1]
		[1]Department of Radiological Sciences, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, United States
		We synthewized FLAIR images of the brain from T1WI and T2WI by using autoencoder, which is one of the state of the art deep-learning technology. Autoencoder compresses the input information and reproduces the information therefrom. We used T1WI and T2WI as an input and synthewized FLAIR image with high accuracy. This method could be applicable to other body part other than the brain and might synthewize of other MR imaging sequences. This technology seems to be useful to improve clinical diagnosis and computer-aided diagnosis.

3131	Computer 57	Automatic quality assessment of high-resolution T2-weighted images used in hippocampus volumetry and functional studies – a tool developed as part of DZNE-DELCODE study. Arturo Cardenas-Blanco[1,2], Yi Chen[3], Jose Pedro Valdes-Herrera[4], Laura Dobisch[1], Renat Yakupov[1], Klaus Fliessbach[5,6], Michael Wagner[5,6], Annika Spottke[6], Stefan Teipel[7,8], Katharina Buerger[9,10], Anja Schneider[5,6], Oliver Peters[11,12], Peter Nestor[1], Josef Priller[11,12], Jens Wiltfang[13,14], Christoph Laske[15,16], Frank Jessen[6,17], and Emrah Duezel[1,3,18] *[1]German Center for Neurodegenerative Diseases (DZNE), Magdeburg, Germany, [2]IKND, Magdeburg, Germany, [3]Institute of cognitive neurology and dementia research, Magdeburg, Germany, [4]Aging & Cognition Research Group, German Center for Neurodegenerative Diseases (DZNE), Magdeburg, Germany, [5]Department of Psychiatry, University Hospital Bonn, Bonn, Germany, [6]German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany, [7]German Center for Neurodegenerative Diseases (DZNE), Rostock, Germany, [8]Department of Psychosomatic Medicine, University Medicine Rostock, Rostock, Germany, [9]German Center for Neurodegenerative Diseases (DZNE), Munich, Germany, [10]Institute for Stroke and Dementia Research, Ludwig-Maximillian-Universitaets, Munich, Germany, [11]Department of Psychiatry, Charité-Universitätsmedizin Berlin, Berlin, Germany, [12]German Center for Neurodegenerative Diseases (DZNE), Berlin, Germany, [13]Department of Psychiatry and Psychotherapy, University Medical Center Göttingen, Goettingen, Germany, [14]German Center for Neurodegenerative Diseases (DZNE), Goettingen, Germany, [15]Department of Psychiatry and Psychotherapy, Eberhard Karls University, Tuebingen, Germany, [16]Aging & Cognition Research Group, German Center for Neurodegenerative Diseases (DZNE), Tuebingen, Germany, [17]Department of Psychiatry, University of Cologne, Cologne, Germany, [18]Institute of Cognitive Neuroscience, University College London, London, United Kingdom* This abstract presents a processing pipeline developed to automatically assess the quality of specific structural T_2-weighted images typically acquired in the study of the hippocampus. By combining existing neuroimaging tools, the presented pipeline generates descriptive information about the signal properties in different tissue classes of the T_2-weighted image. This information could subsequently be used to detect sub-optimal volumes due to noise or motion artifacts. Similarly as it measures the angulation of the T_2-weighted slices with respect to the HC, it could also be used to automatically determine whether the field of view angulation follows protocol.

3132	Computer 58	Large Vessel Filtering of In Vivo High-Resolution Mouse CBV Map Using Expectation-Maximization Gaussian Mixture Model Jia Guo[1] and Scott A. Small[2] *[1]Department of Biomedical Engineering, Columbia University, New York, NY, United States, [2]Departments of Neurology, Radiology or Psychiatry, Columbia University College of Physicians and Surgeons, New York, NY, United States*

		When examining relative cerebral blood volume (rCBV) between mice, values from the unwanted large vessels should be excluded, otherwise, they may result in findings that are not associated with the basal metabolism mapped by microvascular blood volume. Our proposed method provides an automated and robust approach to estimate the rCBV distribution in large vessels with the maximum likelihood estimation using expectation-maximization Gaussian mixture model and to help filter out this unwanted confounding. In research related to rCBV analysis, we suggest applying this as one preprocessing step, which may help improve both sensitivity and specificity when comparing rCBV between subjects.

3133	Computer 59	Regression of Quasi-Periodic patterns diminishes BOLD functional connectivity and reveals hidden dynamic correlations
		Michaël Belloy[1], Behnaz Yousefi[2], Anzar Abbas[2], Annemie van Der Linden[1], Georgios A. Keliris[1], Marleen Verhoye[1], and Shella Keilholz[2]
		[1]University of Antwerp, Antwerpen, Belgium, [2]Emory university, Atlanta, GA, United States
		Quasi-Periodic patterns (QPPs) represent large-scale recurring patterns in the brain, which appear as promising contributors to low frequency BOLD fluctuations. To assess the impact of QPPs on functional connectivity (FC), we used a general linear model approach to regress their contribution out of the functional images of a group of wild-type mice. We show that QPP regression diminished FC in co-active regions within the QPP, while anti-correlated regions became correlated. By calculating FC on QPP-scrubbed images, we highlight that these effects are not solely an artifact of regression. These results suggest that QPPs orchestrate dynamic correlations between resting state networks.

3134	Computer 60	Preliminary investigation of QSM stability across sites
		Renat Yakupov[1], Arturo Cardenas-Blanco[1,2], Klaus Fliessbach[3,4], Michael Wagner[3,4], Annika Spottke[4], Stefan Teipel[5,6], Katharina Bürger[7,8], Anja Schneider[3,4], Oliver Peters[9,10], Peter Nestor[1], Josef Priller[9,10], Jens Wiltfang[11,12], Christoph Laske[13,14], Frank Jessen[3,15], Emrah Duezel[1,2,16], and Julio Acosta-Cabronero[1,17]

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We compared quantitative susceptibility mapping (QSM) from two groups of subjects scanned at two different sites on different 3T Siemens MRI systems running different Syngo MR software versions. Qualitative whole-brain inspection of summary statistics and a statistical test comparing data from both sites revealed no major QSM offsets. The present results are only preliminary but they suggest QSM might be well suited for multi-site studies.

3135 Computer 61

Quantifying cortico-cerebellar structural covariance

Christopher J Steele[1,2], Sejal Patel[2], Jurgen Germann[2], Gabriel Devenyi[2], and Mallar Chakravarty[2]

[1]Neurology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Cerebral Imaging Center, Douglas Mental Health University Institute, McGill University, Montreal, QC, Canada

Invasive tract-tracing in primates has shown that cerebellar regions (lobules) are differentially connected to the cerebral cortex. As diffusion tractography to/from the cerebellum is problematic in living humans, we propose a simple non-invasive approach to identify the patterns of grey-matter structural covariance between cerebellar lobules and the cerebral cortex as a proxy for anatomical connectivity. We performed vertex-wise linear regressions between lobular volumes and cortical thickness/surface area. We then clustered lobule-wise correlations to identify similar spatial patterns of cortico-cerebellar covariance. We identified differential patterns that may reflect the underlying connectivity between the cerebellum and cortex.

3136 Computer 62

Carotid Artery Segmentation Based on Level Set Method in MR Images

Lian Luo[1], Fei Shang[1], Xinyu Tong[1], Shuai Liu[2], and Xihai Zhao[2]

		[1]Department of Biomedical Engineering, Beijing Institute of Technology, Beijing, China, [2]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University School of Medicine, Beijing, China
		Segmentation of blood vessels is the first step of visualization of vascular geometry and morphological analysis in cardiovascular diagnosis. However, the manual segmentation of blood vessels is time consuming. This study applied the level set method to automatic segmentation for carotid artery morphology on time-of-flight MR angiography images. The brightness weighting term is added to optimize the model, and the optimal setting of the parameters of the carotid artery images is discussed in detail. The results showed that the model with the brightness weighting term was more stable, accurate and efficient, which might be used to automatic segmentation of carotid arteries.

3137	Computer 63	Spatio-temporal features of brain's iron accumulation across the life span.
		Vyacheslav Karolis[1,2], Thomas Hope[3], Nikolaus Weiskopf[4], Martina Callaghan[3], Geraint Rees[5], and Marinella Cappelletti[5,6]
		[1]ICM - Institut du Cerveau et de la Moelle épinière, Hôpital de la Salpêtrière, Paris, France, [2]Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, [3]Wellcome Trust Centre for Neuroimaging, University College London, London, United Kingdom, [4]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [5]Institute of Cognitive Neuroscience, University College London, London, United Kingdom, [6]Psychology Department, Goldsmiths College, London, United Kingdom
		In this study we characterised the spatiotemporal features of age-related iron accumulation marked by R2* maps in 97 participants distributed over the whole range of ages between 20 and 75 years old. The analyses showed a broad spectrum of linear and non-linear patterns of age-related differences in R2*. These were predominantly confined to striatum, motor, pre-motor and parietal regions of grey matter as well as subgyral pre- and postcentral regions of white matter. The spatial distribution of R2* changes seems to be related to a higher prevalence of long-distance white matter connections originating from a region.

3138	Computer 64	Quantitative Assessment of the Intracranial Vasculature of an Elderly Population using the intraCranial Artery Feature Extraction (iCafe) Technique
		Li Chen[1], Quan Yuan[2], Niranjan Balu[3], Isabelle Yuan[4], Daniel S Hippe [3], Jie Sun[3], Xihai Zhao[5], Rui Li[5], Le He[5], Jenq-Neng Hwang[1], and Chun Yuan[3]
		[1]Electrical Engineering, University of Washington, Seattle, WA, United States, [2]Neurology, Xuanwu hospital, Capital Medical University, Beijing, China, [3]Radiology, University of Washington, Seattle, WA, United States, [4]Wellesley College, Wellesley, MA, United States, [5]Biomedical Engineering, Tsinghua University, Beijing, China

		iCafe is a novel technique which semi-automatically traces intracranial arteries from 3D magnetic resonance angiography (MRA) and computes corresponding quantitative morphometry and intensity features. MRA images of 100 healthy subjects (age 57-85) were processed and 8 representative features were extracted. We found significant decreases in total artery length (p=0.026), distal artery length (p=0.025), and number of branches (p=0.005) with increasing age using linear regression. These results suggest reduced vascularity with age, consistent with prior results showing cerebral blood flow with age. iCafe may be a useful tool to generalize systemic quantitative measurements of intracranial vascular structures.

3139	Computer 65	Prediction of Alzheimer’s disease by using deep learning 3D-Convolutional Neural Networks
		Na Sang[1], Francisco M. Garcia[2], Wanshun Wei[3], Huabing Li[4], Tao Ma[1], and Silun Wang[1]
		[1]YIWEI Medical Inc, Shenzhen, China, [2]University of Massachusetts - Amherst, Amherst, MA, United States, [3]YIWEI Meidcal Inc, Shenzhen, China, [4]ZhongNan University, ChangSha, China
		We analyzed the T1 structural MRI by using deep learning 3D-CNN method. The results indicate that deep learning models can accurately predict AD patients with diagnostic accuracy of 96%. This can be achieved using raw MRI data, with a minimum of processing necessary to generate an accurate AD prediction. Our model shows highly sensitivity and negative predictive value and thus appropriate for use for screening testing in population study. Currently model has the potential to be used as a screen biomarker to investigate the neurodegeneration, brain aging and associated brain diseases.

3140	Computer 66	Automated MR-based volumetry of basal ganglia and thalamus at the chronic phase of cortical stroke
		Cindy Baudat[1], Bénédicte Maréchal[1,2,3], Ricardo Corredor-Jerez[1,2,3], Patric Hagmann[1], Philippe Maeder[1], and Vincent Dunet[1]
		[1]Department of Diagnostic and Interventional Radiology, Lausanne University Hospital, Lausanne, Switzerland, [2]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [3]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
		We investigated the potential of automated T1-MPRAGE-based brain segmentation to assess individual basal ganglia and thalamus atrophy in nineteen patients with cortical stroke at the chronic phase. The basal ganglia and thalamus volumes z-scores were compared to the initial stroke ipsilateraly and contralateraly, and the relationship with the stroke volume was assessed. Except caudate nucleus, basal ganglia and thalamus, atrophy ipsilateraly to the stroke was observed and negatively correlated with the stroke volume in the territory of the middle cerebral artery. This suggests a potential role for automated MRI volumetry to assess brain plasticity after stroke at the individual level.

3141	Computer 67	Role of MRI Texture Analysis in Differentiating Post-treatment Changes from Tumour Recurrence in Patients with High Grade Glioma Fahad Essbaiheem[1], Rebecca Thornhill[1], Gregory Cron[1,2], John Woulfe[1], Mario Kontolemos[1], Beckie Manouchehri[3], Nader Zakhari[1], Andrew Boivin[4], and Thanh Binh Nguyen[1] *[1]The Ottawa Hospital, Ottawa, ON, Canada, [2]University of Ottawa, Ottawa, ON, Canada, [3]Carleton University, Ottawa, ON, Canada, [4]University of British Columbia, Kelowna, BC, Canada* In this prospective study, we have identified a combination of textural features from contrast-enhanced T1-weighted images which can help in differentiating tumour recurrence from post-treatment changes in patients with high grade gliomas. The diagnostic accuracy of textural analysis was similar or slightly higher than that of two neuroradiologists who performed visual assessment.

3142	Computer 68	Deep Learning approach for Automatic Segmentation and characterization of Traumatic Brain Injury using Multi-parametric MRI Krishna Kanth Chitta[1], Abdalla Z Mohamed[2], Fatima Nasrallah[2], and Bhanu Prakash KN[1] *[1]Laboratory of Molecular Imaging, Singapore Bioimaging Consortium, Singapore, Singapore, [2]Queensland Brain Institute, The University of Queensland, Brisbane, Australia* Automatic and accurate segmentation of Traumatic brain injury is vital to improve assessment of pathophysiology, plan treatment methods and enable large cohort studies. In this work we propose a framework based on 3D CNN and FCM to perform automatic segmentation of whole TBI volume and its sub-regions. The proposed framework utilizes multiple MRI contrasts and has shown high accuracy in delineating injury and sub-regions

3143	Computer 69	A Deep Learning Based Solution for Vertebrae Segmentation of Whole Spine MR Images: A Step Closer to Automated Whole Spine Labeling Kavitha Manickam[1], Jignesh Dholakia[1], and Vignesh Singh[1] *[1]GE Healthcare, Bangalore, India* Any reporting on an MR spine scans involves labeling of the vertebrae. Hence, providing labeled spine images for reading can save significant time for radiologists. First step of an automated labeling is reliable segmentation of vertebral bodies. Most of the studies provide methods only for the segmentation and labeling of only a part of the spine. Here, we have used a variant of U-Net based Deep Learning architecture for segmenting vertebrae of Whole Spine. The network was trained with 165 datasets of whole spine images and tested with 8 datasets. We achieved average DICE score of 0.921.

3144	Computer 70	Deciphering predictive models for differentiating vertebral lesions using multiparametric MRI Durgesh Kumar Dwivedi[1], Anit Parihar[1], Rashi Rathore[1], Neera Kohli[1], Alok Kumar Dwivedi[2], and Anil Chandra[3] *[1]Radiodiagnosis, King George's Medical University, Lucknow, India, [2]Division of Biostatistics & Epidemiology, Biomedical Sciences, Texas Tech University Health Sciences Center, El Paso, TX, United States, [3]Neurosurgery, King George's Medical University, Lucknow, India* Conventional MR imaging has high sensitivity but limited specificity in differentiating various vertebral lesions. We aimed to assess the ability of multiparametric MR imaging in differentiating spinal vertebral lesions and to develop statistical models for predicting the probability of malignant vertebral lesions. On the basis of the mean ADC and signal intensity ratio, we established automated statistical models that would be helpful in differentiating vertebral lesions. Our study shows that multiparametric MRI differentiates various vertebral lesions, and we established prediction models for the same.

3145	Computer 71	Evaluation of errors in image registration and diffusion measurement due to the cavum septum pellucidum Chen-Hsiang Weng[1], Yung-Chin Hsu[1], and Wen-Yih Isaac Tseng[1,2] *[1]Institute of Medical Device and Imaging, National Taiwan University College of Medicine, Taipei, Taiwan, [2]Molecular Imaging Center, National Taiwan University, Taipei, Taiwan, Taipei, Taiwan* To determine the registration errors caused by the cavum septum pellucidum (CSP), Dice coefficient and generalized fractional anisotropy (GFA) were assessed in brain using T1-weighted imaging and diffusion spectrum imaging (DSI), respectively. The subjects included 30 subjects with the CSP and 30 subjects without the CSP. Comparing with the subjects without the CSP, the subjects who had enlarged CSP showed significantly decreased Dice coefficient and significantly different GFA values in nine tracts. Our findings indicate that the existence of the CSP leads to errors in image registration and diffusion index calculation, and that the size of the CSP should be taken into consideration as a covariate in statistical analysis.

3146	Computer 72	Automated Segmentation and Volumetric Analysis of the Amygdala Nuclei in Epilepsy Patients at 7 Tesla John W Rutland[1], Rebecca E Feldman[1], Lara V Marcuse[2], Madeline C Fields[2], Bradley N Delman[3], Prantik Kundu [1], and Priti Balchandani[1] *[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Department of Neurology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [3]Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States*

		The present study employs ultra-high field MRI (7 Tesla) to perform structural imaging on a group of 19 epilepsy patients and 9 healthy controls. We use automated segmentation of the amygdala to derive volumes of constituent sub-nuclei. When comparing epilepsy patients and controls, we found that the volume of the right lateral nucleus was reduced compared with controls. We also found that the anterior-amygdaloid-area and the whole right amygdala approach significance for reduced volume. These are the first in vivo findings that indicate particular nuclei are affected in epilepsy patients.

Electronic Poster

Emerging Methods

Exhibition Hall	Monday 8:15 - 9:15

3147	Computer 73	Magnetic susceptibility in subcortical gray matter is associated with age-related neuropathologies: An ex-vivo QSM and pathology investigation in a community cohort of older adults
		Arnold Evia[1], Ashish Tamhane[2], Aikaterini Kotrotsou[1], Robert Dawe[1,2,3], Sue Leurgans[2,4], Julie Schneider[2,4,5], David Bennett[2,4], and Konstantinos Arfanakis[1,2,3]
		[1]Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, United States, [2]Rush Alzheimer's Disease Center, Rush University Medical Center, Chicago, IL, United States, [3]Department of Diagnostic Radiology, Rush University Medical Center, Chicago, IL, United States, [4]Department of Neurological Sciences, Rush University Medical Center, Chicago, IL, United States, [5]Department of Pathology, Rush University Medical Center, Chicago, IL, United States
		To understand the associations of quantitative susceptibility mapping with age-related neuropathologies, it is essential to combine QSM with direct assessments of age-related brain pathologies on the same individuals. Using ex-vivo QSM for this purpose may be more advantageous than in-vivo QSM, since ex-vivo QSM overcomes several of the obstacles that complicate MRI-pathology investigations and can provide magnetic susceptibility measurements that are linked to those collected in-vivo. Therefore, our goal was to investigate the associations of magnetic susceptibility with the pathology of multiple age-related diseases by combining ex-vivo QSM with histology.

3148	Computer 74	Imaging the effect of high-protein diet on the brain Glutaryl-CoA dehydrogenase deficient mice using GluCEST MRI
		Puneet Bagga[1], Damodara Reddy[1], Delia Talos[2], Kimberly Sansalone[2], Leah Jacobs[2], Gaurav Verma[1], Hari Hariharan[1], and Ravinder Reddy[1]
		[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States

		Autosomal recessive inheritance of Glutaryl-CoA dehydrogenase (GCDH) deficiency or Glutaric Acidemia-1 is one of the common inherited metabolic disorders affecting many children worldwide. We applied GluCEST MRI to image the metabolic changes in the brain of $GCDH^{-/-}$ mice following the exposure to high-protein diet. GluCEST contrast was found to be significantly reduced in the striatum and cortex of the $GCDH^{-/-}$ mice following high-protein diet exposure. ^1H MRS data corroborated with GluCEST results showing a significant reduction in the striatal glutamate level. GluCEST MRI may be used as an imaging biomarker for assessing the neurovascular damage caused by high-protein diet in $GCDH^{-/-}$ subjects.

3149	Computer 75	On Resonance Variable Delay Multiple Pulse (onVDMP) CEST MRI Detects Transient Lactate Depletion during Experimental Autoimmune Encephalomyelitis Progression
		Aline Thomas[1], Jiadi Xu[2], Peter Calabresi[3], Peter van Zijl[2], and Jeff Bulte[1]
		[1]Radiology, Johns Hopkins School of Medicine, Baltimore, MD, United States, [2]Radiology, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Neurology, Johns Hopkins School of Medicine, Baltimore, MD, United States
		On resonance variable delay multiple pulse CEST MRI detected a transient reduction in lactate levels in the cerebrospinal fluid during the disease course of a mouse model of multiple sclerosis, which was validated using magnetic resonance spectroscopy.

3150	Computer 76	On Resonance Variable Delay Multiple Pulse (onVDMP) CEST MRI for Monitoring Stem Cell Therapy in Experimental Autoimmune Encephalomyelitis
		Aline Thomas[1], Jiadi Xu[2], Shen Li[1], Piotr Walczak[1], Peter Calabresi[3], Peter van Zijl[2], and Jeff Bulte[1]
		[1]Radiology, Johns Hopkins School of Medicine, Baltimore, MD, United States, [2]Radiology, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Neurology, Johns Hopkins School of Medicine, Baltimore, MD, United States
		In mice with experimental autoimmune encephalomyelitis, spatiotemporal signal changes were detected with on resonance variable delay multiple pulse (onVDMP) CEST MRI for the brain and spinal cord. Transplantation of glial-restricted precursor cells resulted in normalization of those signal changes during the pre-onset stage of the disease.

3151	Computer 77	APT CEST in cerebrospinal fluid in patients with multiple sclerosis at 3T
		Richard Dylan Lawless[1,2], Quinn R Weinberg[2], Bailey Box[2], Samantha By[3], Francesca Bagnato[4], and Seth A Smith[1,2,5]

		[1]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Phillips Healthcare, Baltimore, MD, United States, [4]Department of Neurology, Vanderbilt University, Nashville, TN, United States, [5]Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States
		There is currently no clinically available MRI method capable of monitoring chronic, systemic inflammation in the central nervous system as a confirmatory biomarker. Chemical exchange saturation transfer (CEST) is a novel MR technique sensitive to low concentration, exchangeable mobile solutes. Amide proton transfer (APT) CEST provides information about concentration of proteins/peptides with amide backbones. Our results show that APT CEST of CSF in the spinal cord demonstrates significant changes when compared between the control and MS cohort.

3152	Computer 78	MT and QSM of the Locus Coeruleus and Substantia Nigra on human healthy subjects
		Catarina Rua[1], Luca Passamonti[2], Claire O'Callaghan[3], James Rowe[3,4,5], Adrian Carpenter[1], and Guy Williams[1]
		[1]Department of Clinical Neurosciences, University of Cambridge, Wolfson Brain Imaging Centre, Cambridge, United Kingdom, [2]Department of Clinical Neurosciences, University of Cambridge, Cambridge Centre for Frontotemporal Dementia and related disorders, Cambridge, United Kingdom, [3]University of Cambridge, Behavioural and Clinical Neuroscience Institute, Cambridge, United Kingdom, [4]University of Cambridge, Department of Clinical Neurosciences, Cambridge, United Kingdom, [5]Medical Research Council Cognition and Brain Sciences Unit, Cambridge, United Kingdom
		The Locus Coeruleus (LC) and the Substantia Nigra (SN) are located in the mid-brain are known to show severe cell loss in several neurodegenerative diseases (e.g., Alzheimer's disease). Developing new imaging techniques to quantify the signal changes in these regions is of high clinical relevance. In this pilot study of five healthy adults from different age groups, the LC and SN were evaluated for neuromelanin and iron content with an Magnetisation Transfer-weighted sequence and with Quantitative Susceptibility Mapping, respectively.

3153	Computer 79	Susceptibility weighted imaging with Compressed-SENSE: Quantitative and Clinical evaluation
		Jaladhar Neelavalli[1], Rakesh Kumar Gupta[2], Jakob Meineke[3], Rupsa Bhattacharjee[4], Suthambhara Nagaraj[1], Tejas Jatin Shah[1], Ulrich Katscher[3], and Indrajit Saha[4]
		[1]Philips Innovation Campus, Philips India Limited, Bengaluru, India, [2]Fortis Memorial Research Institute, Gurugram, India, [3]Philips Research Europe, Hamburg, Germany, [4]Philips India Limited, Gurugram, India

		The current work evaluates the influence of a combined SENSE and compressed sensing algorithm, Compressed-SENSE, on the quantitative and qualitative aspects of SWI data. Quantitative evaluation is done using quantitative susceptibility maps. Clinical qualitative assessment is done in patients with cerebral glioma using ITSS score as the metric for image diagnostic quality.

3154	Computer 80	Functional MRI reveals resting state network alterations upon DREADD-induced silencing of the right dorsomedial prefrontal cortex in mice.
		Lore Peeters[1], Rukun Hinz[1], Stephan Missault[1], Marleen Verhoye[1], Annemie Van der Linden[1], and Georgios A. Keliris[1]
		[1]Bio-Imaging Lab, University of Antwerp, Wilrijk, Belgium
		Combining chemogenetics with non-invasive functional MRI (fMRI) allows establishing a link between the activity of selected populations of neurons with large-scale network activity. Here, we show that Kappa Opioid Receptor (KOR) DREADD-induced decreases in neural activity result in network alterations that can be picked up by pharmacological and resting state fMRI. In particular, inhibition of the right dorsomedial prefrontal cortex (dmPFC), a core region of the attention network in rodents, induces functional connectivity changes between other regions of the attentional network and between regions of distinct sensory networks (e.g. the visual network).

3155	Computer 81	Cross-Platform Comparison of Regional Brain Stiffness
		Jun Chen[1], Matthew Murphy[1], Kevin Glaser[1], Curtis Johnson[2], Arvin Forghanian-Arani[1], Yuan Le[3], David Lake[1], Roger Grimm[1], John III Huston[1], and Richard Ehman[1]
		[1]200 1st St Sw, Mayo Clinic, Rochester, MN, United States, [2]University of Delaware, Newark, DE, United States, [3]200 1st St Sw, Mayo Clinic, Phoenix, AZ, United States
		Brain MR Elastography (MRE) has been shown to add value to neurological imaging. Brain biomechanical properties are correlated with age, gender, exercise and memory in normal volunteers. In patients with neurological diseases, such as multiple sclerosis, dementia and intracranial tumors, global and regional brain mechanical properties may be sensitive biomarkers. Characterization of the cross-platform performance of regional stiffness measurements using 3D brain MRE is important for future multiplatform, multicenter brain MRE studies. The purpose of our study was to compare regional 3D brain MRE in normal volunteers using two vendor platforms.

3156	Computer 82	Magnetization Transfer Ratio based Metric for APTw or CESTw MRI Suppressing Signal from Fluid Compartments - Initial Application to Glioblastoma Assessment
		Jochen Keupp[1] and Osamu Togao[2]

		[1]Philips Research, Hamburg, Germany, [2]Kyushu University Hospital, Fukuoka, Japan
		Amide proton transfer weighted (APTw) MRI has been shown to allow assessment of the tumor aggressiveness/tumor grade with high sensitivity and specificity. Compartments with significant fluid content, like cysts, haemorrhage or necrosis may complicate reading. A metric for APTw MRI is developed, applicable for chemical exchange saturation transfer (CEST) MRI in general, which suppresses fluids based on the spectral shape of the background magnetization transfer ratio (MTR). It is shown to essentially conserve numerical values of APTw MRI in solid tissues. Furthermore, no extra acquisition time is needed, because the metric can be computed from the minimum Z-spectral data also required for standard CEST MRI. The novel metric is explored in an intial study on N=12 gliobastoma cases.

3157	Computer 83	Longitudinal Change in the Developmental Rat Brain using in vivo Glutamate Chemical Exchange Saturation Transfer
		Wooyul Paik[1], Dong Cheol Woo[2], and Ho Sung Kim[3]
		[1]Graduate School, Ulsan University, Seoul, Republic of Korea, [2]Department of Convergence Medicine, Asan Medical Center, Seoul, Republic of Korea, [3]Department of Radiology, Asan Medical Center, Seoul, Republic of Korea
		Our study results and analyses show the trend in glutamate concentration and the decreases in T2 and ADC values influenced by myelination, neuronal change, and the water and macromolecule content of the developing rat brain, and also provide evidence indicating the time point where a neurochemical balance is achieved. Our results demonstrating changes in glutamate concentration up to the eighth postnatal week should provide valuable reference data for other studies of the developing healthy rat brain, and should be useful for comparisons with diseased rat brain in further developmental studies.

3158	Computer 84	Optimizing Brain MR Elastography with Multiple Motion Encoding Gradient Cycles
		Yuan Le[1], Kevin Glaser[2], Matthew Murphy[2], Yuxiang Zhou[3], Jun Chen[2], William Pavlicek[1], Joseph M. Hoxworth[3], Bradley D. Bolster Jr.[4], John Huston III.[2], Joel P. Felmlee[2], and Richard L. Ehman[2]
		[1]Radiology, Mayo Clinic Arizona, Scottsdale, AZ, United States, [2]Radiology, Mayo Clinic, Rochester, MN, United States, [3]Radiology, Mayo Clinic Arizona, Phoenix, AZ, United States, [4]Siemens Medical Solutions USA, Inc., Salt Lake City, UT, United States

		A spin-echo EPI MR Elastography sequence was optimized so that multiple motion encoding gradient (MEG) cycles can be added to increase the motion sensitivity. Volunteer tests showed that comparing with the original one MEG version, optimized two or three MEG cycles provided higher Octahedral Shear Strain Signal-to-Noise Ratio (OSS-SNR), which means higher stiffness measurement precision. Global brain Images acquired with 2 and 3 MEG cycles are in most cases comparable in stiffness and OSS-SNR while images with 1 MEG tend to have a slightly lower OSS-SNR.

3159	Computer 85	Regional Changes in Brain Stiffness with Age Assessed with MR Elastography
		Yu Sasaki[1], Utaroh Motosugi[1], Tomohiro Takamura[2], Kevin J. Glaser[3], Richard L. Ehman[3], Hiroshi Kumagai[1], Takashi Kakegawa[1], and Hiroshi Onishi[1]
		[1]Department of Radiology, University of Yamanashi, Yamanashi, Japan, [2]Department of Radiology, Juntendo University, Tokyo, Japan, [3]Department of Radiology, Mayo Clinic, Rochester, MN, United States
		Various MR-assessed quantities change with age in the brain, including T2, diffusion, and fractional anisotropy. MR elastography (MRE) is a new technique that can measure the stiffness of tissue and is now widely used in the clinic for assessing hepatic fibrosis. Recently, it has become feasible to perform brain MRE as well. In this study, we showed that the stiffness of the brain, measured using MRE, decreased with age, especially in the parietal lobes and the sensory-motor area.

3160	Computer 86	The impact of age and sex on mouse brain stiffness measured with Magnetic Resonance Elastography
		Katharina Schregel[1,2,3], Miklos Palotai[2,3], Navid Nazari[4], Julie Priya Merchant[5], Walter Monroe Taylor[5], Charles Guttmann[2,3], Ralph Sinkus[6], Tracy Young-Pearse[3,5], and Samuel Patz[2,3]
		[1]Institute of Neuroradiology, University Medical Center Goettingen, Goettingen, Germany, [2]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [3]Harvard Medical School, Boston, MA, United States, [4]Department of Biomedical Engineering, Boston University, Boston, MA, United States, [5]Ann Romney Center for Neurologic Diseases, Brigham and Women's Hospital, Boston, MA, United States, [6]Department of Radiological Imaging, Imaging Sciences & Biomedical Engineering Division, King's College London, London, United Kingdom
		Aging is accompanied by neurodegeneration, which affects the cerebral biomechanical properties. We investigated the impact of age and sex on mouse brain stiffness using magnetic resonance elastography (MRE). Repeated MRI and MRE exams were performed on 5 male and 5 female healthy C57BL/6 mice over 14 months. A significant decrease of the viscoelastic modulus |G*| was observed, while the phase angle Y remained unaltered. Grey and white matter exhibited significant differences in |G*| and Y. Sex differences were observed in the cortex at 11 months. This is relevant for future cerebral MRE studies on mice.

3161	Computer 87	Brain stiffness changes due to Alzheimer's disease in cortical-centric regions Matthew Christopher Murphy[1], David T Jones[1], Clifford C Jack[1], Kevin C Glaser[1], Matthew C Senjem[1], Armando C Manduca[1], Joel C Felmlee[1], Richard C Ehman[1], and John C Huston[1] *[1]Mayo Clinic, ROCHESTER, MN, United States* Brain stiffness is known to decrease in subjects with Alzheimer's disease (AD). However, previously reported stiffness estimates were heavily weighted toward white matter. Here we investigate the sensitivity of cortical-centric stiffness measurements for detecting AD pathophysiology, given that the cortex is the primary site of pathology. Using a neural network-based inversion algorithm, cortical-centric measurements are highly repeatable with test-retest errors of less than 2% on average. With respect to AD, the medial temporal lobe region of interest is found to best discriminate those with dementia from cognitively normal subjects, and performs better than previously reported methods.

3162	Computer 88	Acute changes in rat brain metabolism after intravenous administration of alcohol, cocaine, and nicotine: A simultaneous PET/MR study with dynamic 1H-MRS and continuous infusion 18FDG. Bart de Laat[1,2], Akila Weerasekera[1,3], Gwen Schroyen[1,3], Cesar Molinos[4], Uwe Himmelreich[1,3], Cindy Casteels[1,2], Koen Van Laere[1,2], and Willy Gsell[1,3] *[1]KU Leuven – University of Leuven, MoSAIC, Molecular Small Animal Imaging Center, Leuven, Belgium., Leuven, Belgium, [2]KU Leuven – University of Leuven/University Hospital Leuven, Division of Nuclear Medicine, Department of Imaging and Pathology, Leuven, Belgium., Leuven, Belgium, [3]KU Leuven – University of Leuven, Biomedical MRI unit, Department of Imaging and Pathology, Leuven, Belgium, Leuven, Belgium, [4]Bruker BioSpin, Preclinical Imaging NMI, Valencia, Spain* We have combined PET imaging with continuous ^{18}F-deoxy-glucose PET and dynamic ^{1}H-MRS focused on the prefrontal cortex in a rodent model of substance abuse. During imaging, animals received an intravenous injection of saline, alcohol, cocaine, or nicotine. Cocaine administration reduced the regional cerebral metabolic rate of glucose ($rCMR_{Glu}$) as measured by PET, but increased prefrontal glucose and creatine levels as measured with dynamic MRS. Furthermore, alcohol administration significantly influenced the prefrontal concentration of ethanol, glucose, creatine, and glutamate. Finally, our data show that alcohol induces a transient decrease in prefrontal glutamate coinciding with the peak in ethanol concentration.

3163	Computer 89	Assessment of cerebral infarction due to intracranial arterial stenosis in the human brain using hyperpolarized xenon-129 MRI Madhwesha Rao[1], Graham Norquay[1], Neil J Stewart[1], Nigel Hoggard[1], Paul D Griffiths[1], and Jim M Wild[1] *[1]University Of Sheffield, Sheffield, United Kingdom*

		In this pilot study we evaluate the feasibility of hyperpolarised ^{129}Xe brain perfusion MR imaging to evaluate brain tissue perfusion patho-physiology in a subject with established intracranial arterial stenosis with collateralized blood flow. The ^{129}Xe brain perfusion images from the patient exhibit regions of signal void which correspond to the infarcted region observed on T_2 weighted MRI. Imaging hyperpolarized ^{129}Xe dissolved in the brain tissue is a direct method of imaging perfusion of the tissue itself and we observe different patterns of cerebral perfusion than those measured with arterial spin labeling.

3164	Computer 90	Phase Laplacian Coil Combination
		Rüdiger Stirnberg[1], Lino Lemmer[1], and Tony Stöcker[1,2]
		[1]MR Physics, German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany, [2]Department of Physics and Astronomy, University of Bonn, Bonn, Germany
		We propose a novel, computationally efficient coil combination technique for multi-channel phase data based on the Laplacian of single-channel phase images. This renders explicit knowledge or estimation of the receive sensitivities unnecessary. The combined phase Laplacian can be either be transformed back to unwrapped phase domain (Laplacian-based unwrapping) or directly utilized for further analyses based on the phase Laplacian, e.g. harmonic background-field removal. At 3T we demonstrate similar-to-improved phase reconstruction compared to the vendor-provided state-of-the-art coil combination, which uses the body-coil as a uniform reference, and successfully apply the technique at 7T.

3165	Computer 91	Resting-state fMRI study of brain activation using low-intensity repetitive transcranial magnetic stimulation in rats.
		Bhedita J Seewoo[1,2,3], Kirk W Feindel[3], Sarah J Etherington[2], and Jennifer Rodger[1,4]
		[1]Experimental and Regenerative Neurosciences, School of Biological Sciences, The University of Western Australia, Crawley, Australia, [2]School of Veterinary and Life Sciences, Murdoch University, Murdoch, Australia, [3]Centre for Microscopy, Characterisation and Analysis, The University of Western Australia, Nedlands, Australia, [4]Perron Institute for Neurological and Translational Research, Perth, Australia
		Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive neuromodulation technique used to treat many neuropsychiatric conditions. However, the mechanisms underlying its mode of action are still unclear. This is the first rodent study using resting-state fMRI to examine low-intensity (LI) rTMS effects, in an effort to provide a direct means of comparison between rodent and human studies. Our study shows that similar to human rTMS, 10 Hz LI- rTMS alters the resting brain activity of rats directly at the site of stimulation (e.g. cortex) as well as in remote but inter-connected brain regions (e.g. hippocampus).

3166	Computer 92	Imaging toxin-induced inflammation in the mouse brain with hyperpolarized 13C MRS
		Lydia M Le Page[1,2], Caroline Guglielmetti[1,2], Brice Tiret[1,2], and Myriam M Chaumeil[1,2]
		[1]Department of Physical Therapy and Rehabilitation Science, University of California San Francisco, San Francisco, CA, United States, [2]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States
		^{13}C MRS of hyperpolarized (HP) [1-^{13}C] pyruvate has recently shown promise in assessing neuroinflammation in mouse models of MS and TBI. Here, we expanded on previous reports and evaluated whether HP ^{13}C MRS could detect the effect of the inflammation-inducing toxin lipopolysaccharide (LPS), using mice injected intracranially with either LPS or saline. LPS-injected mice showed significantly elevated HP [1-^{13}C] lactate:pyruvate ratios in the LPS-injected hemisphere compared to contralateral, in line with increased microglial number. In contrast, saline-injected mice showed no such changes. Our results further confirm the potential of hyperpolarized ^{13}C MRS for non-invasive assessment of neuroinflammation in the brain.

3167	Computer 93	A real-time metabolic investigation of the effect of hypothermia on hypoxic ischemia during mouse brain development using hyperpolarized 13C
		Yiran Chen[1], Alkisti Mikrogeorgiou[2], Robert Bok[1], Subramaniam Sukumar[1], R Ann Sheldon[2,3], A James Barkovich[1,3], Donna M Ferriero[2,3], and Duan Xu[1]
		[1]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Department of Neurology, University of California San Francisco, San Francisco, CA, United States, [3]Department of Pediatrics, University of California San Francisco, San Francisco, CA, United States
		In this study, we applied dynamic nuclear polarization (DNP) technique to investigate C1 labeled 13C pyruvate to lactate conversion to study the effect of hypothermia treatment on hypoxic ischemia (HI) injured neonatal mouse brains during development. Our results showed that lower pyruvate delivery to the injured hemisphere in comparison to the non-injured hemisphere at the day of injury (P10) for all subjects, and difference narrows as the brain matures. There were different individual responses to the lactate to pyruvate ratio between two hemispheres. With this technique, we are able to examine individual responses to treatment during brain development.

3168	Computer 94	19F Signal Distribution in Pre-Symptomatic Experimental Autoimmune Encephalomyelitis
		Paula Ramos Delgado[1], Jason M. Millward[1], Christian Prinz[1], Ludger Starke[1], Stefanie Münchberg[1], Andreas Pohlmann[1], Thoralf Niendorf[1,2], and Sonia Waiczies[1]

		[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrück Center for Molecular Medicine in the Helmholtz Association(MDC), Berlin, Germany, Berlin, Germany, [2]Experimental and Clinical Research Center, a joint cooperation between the Charité Medical Faculty and the Max Delbrück Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, Berlin, Germany
		Experimental autoimmune encephalomyelitis (EAE) is an animal model used to study the pathogenesis of autoimmune neuroinflammatory diseases, such as multiple sclerosis (MS). In MS, recruitment of immune cells into the central nervous system (CNS) occurs already at early stages of the disease. Magnetic resonance imaging (MRI) can be used as a non-invasive technique suited for tracking immune cell migration, following intravenous administration of fluorine (^{19}F)-loaded nanoparticles which can then be followed using ^{19}F MR techniques. The present study aims to investigate the distribution of immune cells during the pre-symptomatic disease phase in the EAE mouse model using ^{19}F MR methods.

3169	Computer 95	Multi-contrast Brain MRI Image Super-resolution with Gradient-guided Edge Enhancement
		Hong Zheng[1], Kun Zeng[1], Di Guo[2], Jiaxi Ying[1], Yu Yang[1], Xi Peng[3], Zhong Chen[1], and Xiaobo Qu[1]
		[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]Xiamen University of Technology, Xiamen, China, [3]Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China
		Since magnetic resonance imaging (MRI) can offer images of an object with different contrasts, e.g., T1-weighted or T2-weighted, the shared information between inter-contrast images can be used to benefit super-resolution. Multi-contrast images are assumed to possess the same gradient direction in a local pattern. We proposed to establish a relation model of gradient value between different contrast images, to restore a high-resolution image from its input low-resolution version. The similarity of image patches is employed to estimate intensity parameters, leading a more accurate reconstructed image. Then, iterative back-projection filter is applied to the reconstructed image to further increase image quality. The reconstructed edges are more consistent to the original high-resolution image, indicated with higher PSNR and SSIM than the compared methods.

3170	Computer 96	Novel Imaging Phantom for Accurate and Robust Measurement of Brain Atrophy Rates Using Clinical MRI
		Houshang Amiri[1], Iman Brouwer[1], Joost P.A. Kuijer[1], Jan C. de Munck[1], Frederik Barkhof[1,2], and Hugo Vrenken[1]
		[1]Radiology & Nuclear Medicine, VU University Medical Center, Amsterdam, Netherlands, [2]Institutes of Neurology and Healthcare Engineering, UCL, London, United Kingdom

		MR images are widely used to measure brain atrophy in neurodegenerative diseases. However, reliable evaluation of atrophy is hampered by scanner-induced systematic variability. Here, we developed an MR-compatible phantom and analysis software for robust and reliable evaluation of the brain volume loss. The phantom was made using 3D-printing and contains three inflatable brain structures equipped with a precise volume change system. The phantom was imaged at three different clinical 3T MR scanners and images were analyzed by our developed software. This phantom can accurately and robustly provide a selected volume change to mimic a certain disease.

Electronic Poster

Neuroimaging: Pulse Sequences & Reconstruction

Exhibition Hall	Monday 8:15 - 9:15

3171	Computer 97	Brain Vessel Extraction without MRA / V using Deep Convolutional Neural Network
		Hyungseob Shin[1], Yohan Jun[1,2], Taeseong Kim[1], Taejoon Eo[1], Sungsoo Ahn[3], and Dosik Hwang[1]
		[1]Electrical and Electronic Engineering, Yonsei University, Seoul, Republic of Korea, [2]Philips Korea, Seoul, Republic of Korea, [3]Radiology and Research Institute of Radiological Science, Yonsei University College of Medicine, Seoul, Republic of Korea
		In this paper, we introduce a deep residual learning approach to extract brain vessels from contrast-enhanced(CE) magnetic resonance images. Our experiment results show that we can successfully achieve and visualize brain vessel information from CE MRI without magnetic resonance angiography and magnetic resonance venography(MRA/V) that are currently used for brain vessel extraction.

3172	Computer 98	High resolution atlasing of the venous brain vasculature from 7T quantitative susceptibility
		Julia Huck[1], Yvonne Wanner[1,2], Audrey P. Fan[3], Anna-Thekla Schmidt[4], Sophia Grahl[4], Uta Schneider[4], Arno Villringer[4], Christopher J. Steele[4,5], Christine L. Tardif[6,7], Pierre-Louis Bazin[4,8,9], and Claudine J. Gauthier[1]
		[1]Concordia University / PERFORM centre, Montreal, QC, Canada, [2]Universität Stuttgart, Stuttgart, Germany, [3]Stanford University, Stanford, CA, United States, [4]Max Planck Institute for Human Cognitive and Brain Science, Leipzig, Germany, [5]Douglas Mental Health University Institute, Montreal, QC, Canada, [6]McGill University, Montreal, QC, Canada, [7]Montreal Neurological Institute, Montreal, QC, Canada, [8]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands, [9]Netherlands Institute for Neuroscience, Amsterdam, Netherlands

		We present the first atlas of the venous vasculature using quantitative susceptibility maps (QSM) acquired at 7T with a 0.6mm isotropic resolution. The atlas was created from 16 datasets in young and healthy volunteers by using a three step registration method on the inflated skeletons of the venous vasculature. This cerebral vein atlas shows the average vessel location and diameter.

3173	Computer 99	High Resolution Black-blood T1-weighted Turbo Spin Echo with Variable Flip Angles for Visualization of Small Perforating Arteries at 3 and 7 Tesla
		Samantha J Ma[1], Lirong Yan[1], Kay Jann[1], and Danny JJ Wang[1]
		[1]Stevens Neuroimaging and Informatics Institute, University of Southern California, Los Angeles, CA, United States
		Cerebral small vessel disease frequently affects the small perforating arteries, resulting in silent strokes, which contribute to progressive cognitive impairment in elderly persons. Previous studies have demonstrated the ability of time-of-flight (TOF) MRA to non-invasively image these small arteries at 7T; In this study, we introduce and optimize a T1-weighted turbo spin echo sequence with variable flip angles (T1w-VFA-TSE) sequence for high resolution black blood MRI to delineate the lenticulostriate arteries (LSA) at 3T and 7T. Our results show T1w-VFA-TSE provides high contrast for visualizing LSAs and delineates small arteries better than TOF MRA at 7T.

3174	Computer 100	Systematic comparison of DTI metrics as potential biomarkers in cerebral small vessel disease
		Ana Fouto[1], Rita G. Nunes[1], Joana Pinto[1], Luísa Alves[2], Sofia Calado[2], Carina Gonçalves[2], Pedro Vilela[3], Miguel Viana Baptista[2], and Patrícia Figueiredo[1]
		[1]Department of Bioengineering, ISR-Lisboa/LARSyS, Instituto Superior Técnico - Universidade de Lisboa, Lisboa, Portugal, [2]Department of Neurology, Hospital Egas Moniz, Lisbon, Portugal, [3]Imaging Department, Hospital da Luz, Lisbon, Portugal
		Cerebral small vessel disease (SVD) is the major cause of dementia among the elderly and sensitive biomarkers of disease progression are needed. Here, we investigated the potential of DWI to provide sensitive biomarkers of SVD, by evaluation multiple metrics extracted from DTI in terms of their predictive power of cognitive performance. We considered different white matter regions of interest to perform histogram analysis and extract multiple FA and MD metrics, and showed that specific DTI metrics were better than conventional structural MRI at explaining impairments in processing speed and execute function in a group of SVD patients.

3175	Computer 101	Feasibility and Evaluation of Multi-Delay Quantitative 3D GRASE pCASL MRI in Children at 3 Tesla

		Houchun Harry Hu[1], Ruiyue Peng[2], Xingfeng Shao[3], Mark Smith[1], Jerome Rusin[1], Ramkumar Krishnamurthy[1], Bhavani Selvaraj[1], and Danny JJ Wang[3]
		[1]Radiology, Nationwide Children's Hospital, Columbus, OH, United States, [2]Translational MRI, LLC, Los Angeles, CA, United States, [3]Stevens Neuroimaging and Informatics Institute, Laboratory of FMRI Technology, University of Southern California, Los Angeles, CA, United States
		Single post-labeling-delay (PLD) pCASL are commonly used to measure cerebral blood flow (CBF). A PLD of 1500-2000ms is commonly used in children and adults. Multi-delay pCASL has been developed as an alternative approach to better account for prolonged arterial transit times (ATT) and to improve the accuracy of CBF perfusion quantification. In this study, we evaluate the feasibility of multi-delay pCASL in children. We compare two algorithms (weighted-delay linear mapping vs. nonlinear iterative curve fitting) for estimating ATT and CBF. We further compare estimations of weighted-delay CBF derived from multi-delay pCASL data with those traditionally calculated from a single PLD measurement.

3176	Computer 102	Imaging Ultrashort-T2* structures in the Eye with UTE MRI
		Peder Eric Zufall Larson[1], Peng Cao[1], and Kevin C. Chan[2]
		[1]Radiology and Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States, [2]Ophthalmology and Radiology, New York University, New York, NY, United States
		Ultrashort echo time (UTE) MRI has the potential to image all structures in the eye, including the sclera, cornea and lens that have relatively short T2* relaxation times. UTE MRI was used for motion-robust imaging of the eye in vivo, and multiple TE measurements were combined for 3D T2* mapping. We report measurements of in vivo T2* relaxation times in the range of several ms that suggest that UTE MRI can be used effectively to study ocular structures with short T2* in vivo.

3177	Computer 103	Realistic dynamic speech numerical phantom for the evaluation of real-time MRI acquisition and reconstruction methods
		Joseph Martin[1,2], Redha Boubertakh[1,3], Matthieu Ruthven[1], and Marc E Miquel[1,3]
		[1]Clinical Physics, Barts Health NHS Trust, London, United Kingdom, [2]Medical Physics and Engineering, Kings College London, London, United Kingdom, [3]William Harvey Research Institute, Queen Mary University of London, London, United Kingdom

		Real time MRI (rtMRI) in human speech is an active field of research, with a particular clinical focus on the assessment of speech disorders. In this work, a numerical phantom is developed to allow acquisition and reconstructions schemes for rtMRI to be compared to a 'gold standard'. Previously acquired 2D rtMRI images of speech were used to create anatomical masks of various speech organs. An interpolation method was then used to create a continuous time model of the moving structures, which forms the dynamic phantom. The model is then tested using different k-space sampling schemes (Cartesian, radial and spiral).

3178	Computer 104	Improved susceptibility-weighted imaging of the thalamic nuclei at 7T with enhanced contrast and venous vessel exclusion
		João Jorge[1,2], Elena Najdenovska[2,3], Constantin Tuleasca[4,5,6], José P. Marques[7], Marc Levivier[4,6], Philippe Maeder[3], Rolf Gruetter[1,3,8], and Meritxell Bach Cuadra[2,3,5]
		[1]Laboratory for Functional and Metabolic Imaging (LIFMET), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]Medical Image Analysis Laboratory (MIAL), Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [3]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Department of Clinical Neurosciences, Neurosurgery Service and Gamma Knife Center, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [5]Signal Processing Laboratory, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [6]Faculty of Biology and Medicine, University of Lausanne (UNIL), Lausanne, Switzerland, [7]Donders Center for Cognitive Neuroimaging, Radboud University, Nijmegen, Netherlands, [8]Department of Radiology, University of Geneva, Geneva, Switzerland
		The thalamus plays a key role in neuronal signal transmission and modulation. While most of the current non-invasive imaging techniques fail to achieve substantial contrast between the thalamic nuclei, susceptibility-weighted imaging (SWI) has recently shown promising capabilities for their visualization at 7T, despite having been originally designed primarily for venous vessel imaging. The aim of the present work was to optimize the SWI technique specifically for improved thalamic nuclei visualization, by jointly modifying the SWI combination and suppressing venous vessels. These modifications yielded substantially improved contrast and delineation of various thalamic nuclei, in good agreement with histological atlas information.

3179	Computer 105	$$$T_1$$$ dependency of magnetization transfer effect in human brain
		Yuki Kanazawa[1], Toshiaki Sasaki[2], Hiroaki Hayashi[1], Kotaro Baba[3], Ikuho Kosaka[3], Yuki Matsumoto[4], Mitsuharu Miyoshi[5], and Masafumi Harada[1]
		[1]Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan, [2]Department of Radiology, Uji Tokushukai Hospital, Uji, Japan, [3]School of Health Sciences, Tokushima University, Tokushima, Japan, [4]Graduate school of Health Science, Tokushima University, Tokushima, Japan, [5]Global MR Applications and Workflow, GE Healthcare Japan, Hino, Japan

		The purpose of this study is to develop a T_1 mapping method derived from the variable flip angle with an MT pulse. T_1 mapping of the brain with an MT pulse was performed in five healthy subjects. The mean T_{1_MT} values were significantly decrease than the T_1 in all regions (P < 0.05). The difference of T_1 and T_{1_MT} in deep gray matter (included caudate nucleus and putamen) were more decreased than those in white matter. In conclusion, determination of T_1 with MT pulse makes it possible to obtain more detailed information of the macromolecular pool and the free water pool.

3180	Computer 106	Utility of real-time field control in subjects with mild cognitive impairment: T2* weighted imaging at 7T.
		Laetitia Vionnet[1], Jiri van Bergen[2], Yolanda Duerst[1], Rafael Meyer[2], Nicole Fichtner[1,3], Sonja Maria Kagerer[2], Michael Wyss[1], Paul Gerson Unschuld[2], and Klaas Paul Pruessmann[1]
		[1]ETH & University Zurich, Zurich, Switzerland, [2]University of Zurich, Zurich, Switzerland, [3]University of Bern, Bern, Switzerland
		Subjects with Alzheimer disease or mild cognitive impairment are known to produce strong field perturbation by particular breathing pattern and limb motion. In this work we explore the feasibility and success of real-time field control in subjects with mild cognitive impairment and age-matched controls in the scenario of high resolution T2*-weighted imaging at 7T. Real-time field control shows to be feasible and yield greatly enhanced data quality in both type of subjects: mild cognitive impairment and cognitively normal.

3181	Computer 107	Multi-echo OxFlow for quantification of the cerebral metabolic rate of oxygen at 1.5T, 3T, and 7T
		Erin K Englund[1], Ana E Rodriguez-Soto[1], and Felix W Wehrli[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States
		Fick's principle can be used to quantify the cerebral metabolic rate of oxygen ($CMRO_2$) as the product of oxygen extraction and blood flow. An interleaved dual-slice multi-echo GRE and phase contrast sequence, termed OxFlow, has previously been used for simultaneous measurement of SvO_2 and blood flow. Here, we developed and evaluated an extended multi-echo OxFlow sequence designed for operation at multiple field strengths. The rate of phase accumulation, rather than the inter-echo phase difference, is used to compute SvO_2. Results were obtained in 5 healthy subjects at 1.5T, 3T, and 7T, with agreement of the physiologic parameters between field strengths.

3182	Computer 108	Comparing MEGA editing techniques for in-vivo measurement of 2-hydroxyglutarate
		Ross Callaghan[1], Bhavana Solanky[2], Sotirios Bisdas[1], Hui Zhang[1], and Enrico De Vita[1]

		[1]University College London, London, United Kingdom, [2]Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom
		MEGA-semiLASER is compared to a previously proposed MRS sequence for 2HG detection, MEGA-PRESS. The sequences are assessed using simulations of SNR with TE and the chemical shift displacement error (CSDE). Both sequences are shown to maximise 2HG SNR at TE of approximately 100ms. MEGA-semiLASER displays marginally higher SNR whilst reducing the CSDE of MEGA-PRESS. MEGA-semiLASER should offer a comparable reduction in CSDE to another proposed sequence, MEGA-LASER, whilst requiring fewer refocusing pulses and thus a lower SAR.

3183	Computer 109	A novel minimally invasive, image-guided neurablation technique using MRI - MINIMA
		Christopher Payne[1], John J Connell[1], Matin J Mohseni[1], Stephen Patrick[1], Yichao Yu[1], Bernard Siow[1], Quentin A Pankhurst[2], and Mark F Lythgoe[1]
		[1]Centre for Advanced Biomedical Imaging, UCL, London, United Kingdom, [2]Department of Medical Physics and Biomedical Engineering, UCL, London, United Kingdom
		During tumour resection the goal is to remove a discrete region of cancerous tissue causing minimal damage to surrounding healthy tissue. Therefore, there is a demand for minimally invasive techniques, alongside MR imaging, for precise location of the tumour boundary. Presented here is the development of a minimally invasive, image-guided neurosurgery technique, whereby the position of an untethered surgical implant can be controlled and imaged in real time using an MRI scanner. We have demonstrated image-guided, precise movement of millimetre sized magnetic spheres inside ex vivo brain tissue by controlling the magnetic field gradients inside an MRI scanner.

3184	Computer 110	NODDI-DTI as proxy for Axonal Volume Fraction: Is g-ratio-weighted imaging feasible using single-shell DTI data?
		Gergely David[1], Maryam Seif[1], and Patrick Freund[1,2,3]
		[1]Spinal Cord Injury Center, Balgrist University Hospital, University of Zurich, Zurich, Switzerland, [2]Wellcome Trust Centre for Neuroimaging, UCL Institute of Neurology, London, United Kingdom, [3]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

		G-ratio-weighted imaging is an active field of research with the goal of better characterizing white matter in both health and disease. However, clinical adoption is significantly hampered by the fact that most g-ratio protocols rely on time-intensive multi-shell diffusion data which is typically not available in clinical settings. In this study, we adopted the recently introduced NODDI-DTI in combination with magnetization transfer saturation to calculate g-ratio maps based on a single diffusion shell in healthy subjects. The so-acquired g-ratio maps greatly resembled maps from the literature and had high scan-rescan repeatability, which has great implications for clinical g-ratio-weighted imaging.

3185	Computer 111	MR Myelo-Neurography: Improved Visualization of MR Neurography in the Brachial Plexus using a Combination of SHINKEI and Phase-Cycling balanced SSFP
		Hitoshi Tadenuma[1], Kayoko Abe[2], Masami Yoneyama[3], Yasuhiro Goto[1], Isao Shiina[1], Mamoru Takeyama[1], Isao Tanaka[1], and Shuji Sakai[2]
		[1]Department of Radiological services, Tokyo Women's Medical University Hospital, Tokyo, Japan, [2]Department of Diagnostic Imaging & Nuclear Medicine, Tokyo Women's Medical University Hospital, Tokyo, Japan, [3]Philips Electronics Japan, Tokyo, Japan
		The brachial plexus could be involved in various kinds of diseases, which may lead to serious functional disorders. MR neurography is a useful technique for evaluating the abnormal state of the peripheral nerves, however, it is still difficult to visualize the entire brachial plexus, including nerve roots, using conventional MR neurography due to its complicated anatomical structure. In this study, we evaluated a new MR neurography using a combination of SHINKEI and Phase-Cycling balanced SSFP sequence to visualize the entire brachial plexus.

3186	Computer 112	Nonlocal multispectral image filtering to improve determination of cerebral blood flow from pseudo-continuous arterial spin labeling imaging
		Mustapha Bouhrara[1], Diana Y. Lee[1], Abinand C. Rejimon[1], and Richard G. Spencer[1]
		[1]National Institute on Aging, National Institutes of Health, Baltimore, MD, United States
		Changes in the cerebral blood flow (CBF), measured using arterial spin labeling (ASL), are an emerging biomarker for normal aging, Alzheimer's disease, and other neurodegenerative conditions. However, ASL signal-to-noise ratio (SNR) is inherently low, diminishing the quality of CBF determination. While attempts have been made to improve SNR in ASL images using post-processing filters, performance is limited and several user-defined parameters are required adding further complexity in implementation. Here, we introduce a simple, novel filtering algorithm and demonstrate its potential to enhance the quality of CBF mapping.

3187	Computer 113	Rapid Myelin Measurement: Comparison Between SyMRI (Simultaneous Tissue Relaxometry), Magnetization Transfer Saturation Index, and T1w/T2w Ratio Methods Akifumi Hagiwara[1,2], Masaaki Hori[2], Koji Kamagata[2], Misaki Nakazawa[2], Christina Andica[2], Tomoko Maekawa[1,2], Saori Koshino[1,2], Ryusuke Irie[1,2], Lydia Chougar[2,3], Osamu Abe[1], and Shigeki Aoki[2] *[1]Department of Radiology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan, [2]Department of Radiology, Juntendo University School of Medicine, Tokyo, Japan, [3]Hôpital Cochin, Paris, France* In 20 healthy adults, we examined the correlation between three rapid MR myelin measurement methods, including simultaneous tissue relaxometry of R1 and R2 relaxation rates and proton density (SyMRI), magnetization transfer saturation (MTsat) index, and the ratio of T1-weighted to T2-weighted images (T1w/T2w ratio). Even though SyMRI and MTsat showed strong correlation in the white matter, only weak to moderate correlation was found between T1w/T2w and SyMRI or MTsat. In conclusion, SyMRI and MTsat seem to be suitable for evaluating myelin in the white matter, but T1w/T2w ratio may be less optimal.

3188	Computer 114	Interleaved Multi-Slice Averaged Magnetization Inversion Recovery Acquisitions (imsAMIRA) for Fast Spinal Cord Imaging Matthias Weigel[1,2], Zarko Celicanin[1,2], and Oliver Bieri[1,2] *[1]Division of Radiological Physics, Dept. of Radiology, University Hospital Basel, Basel, Switzerland, [2]Dept. of Biomedical Engineering, University of Basel, Basel, Switzerland* To increase the acquisition efficiency for the averaged magnetization inversion recovery acquisitions (AMIRA) approach for spinal cord imaging, an interleaved multi-slice AMIRA implementation was developed. Utilizing a slice-selective adiabatic inversion pulse with optimized slice thickness, the interleaved multi-slice AMIRA sequence provides spinal cord imaging with the same high gray matter and white matter contrast and very similar image quality like the conventional AMIRA approach, however, in considerably reduced scan times per slice.

3189	Computer 115	Sampling order optimization preserves contrast and improves clinical diagnostic utility of accelerated prospective 3D brain MRI: a radiological assessment study on healthy volunteers Arnold Julian Vinoj Benjamin[1,2], Wajiha Bano[1,2], Grant Mair[2], Michael Davies[1], and Ian Marshall[2] *[1]School of Engineering, Institute for Digital Communications, University of Edinburgh, Edinburgh, United Kingdom, [2]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom*

		This study shows the importance of sampling order optimization for the contrast preservation of accelerated prospective 3D MRI leading to the improvement in clinical diagnostic utility of accelerated scans using compressed sensing and parallel imaging reconstructions.

3190	Computer 116	Axial Gradient Echo Spiral MRI of the Pediatric Spine
		Ryan Keith Robison[1], Melvyn Ooi[2], Amber Pokorney[1], Zhiqiang Li[3], Dinghui Wang[3], James Grant Pipe[3], and Jeffrey Miller[1]
		[1]Phoenix Children's Hospital, Phoenix, AZ, United States, [2]Philips Healthcare, Phoenix, AZ, United States, [3]Barrow Neurological Institute, Phoenix, AZ, United States
		MRI spine examinations are an important tool in pediatric care. Long acquisition times and artifacts related to motion and flow are a regular challenge in these examinations. Spiral MRI offers substantial potential benefits with regards to both acquisition time and artifact reduction. This work studies spiral MRI for gradient echo imaging of the pediatric spine and demonstrates promising results in preliminary patient data. The results from a contrast and SNR optimization study in a volunteer are also presented.

3191	Computer 117	Improved brain MR imaging from a compact, lightweight 3T scanner with high performance gradients.
		Norbert Campeau[1], Yunhong Shu[1], Joshua D Trzasko[1], Erin M Gray[1], Thomas K.F. Foo[2], Matt A Bernstein[1], and John Huston[1]
		[1]Mayo Clinic, Rochester, MN, United States, [2]GE Global Research, Niskayuna, NY, United States
		A compact, low-cryogen 3T MRI scanner with high-performance gradients capable of simultaneously achieving 80 mT/m and 700 T/m/s was compared to a 60-cm, whole body 3T system (50 mT/m, 200T/m/s) for 5 routine brain MR imaging sequences in 9 clinical patients, graded by two neuroradiologists. The compact 3T system performed equally well to a standard whole-body scanner in terms of motion artifacts, and performed better in terms of signal-to-noise ratio, lesion conspicuity, gray/white contrast, susceptibility artifacts and overall exam quality.

3192	Computer 118	Dynamic imaging of hyperpolarized xenon-129 uptake in the human brain with spiral MRI
		Madhwesha Rao[1], Guilhem Collier[1], Rolf Schulte[2], Graham Norquay[1], and Jim Wild[1]
		[1]University Of Sheffield, Sheffield, United Kingdom, [2]GE Healthcare, Munich, Germany

		In this study we explore the use of continuous 2D spiral k-space sampling to dynamically image the uptake of inhaled hyperpolarized ^{129}Xe dissolved in human brain tissue. The sliding window reconstruction enables the monitoring of xenon uptake dynamics in the gray matter at high temporal resolution. Dynamic ^{129}Xe brain MRI may be useful in pathologies related to cerebral perfusion and may provide insight in to blood brain barrier permeability.

3193	Computer 119	Comparison between 2D and 3D MEDIC in human cervical spinal cord at 3T
		Abdullah Asiri[1,2], Franky Dimpudus[3], Aiman Alnajjar[1], Katie McMahon[1], and Nyoman kurniawan[1]
		[1]Centre for Advanced Imaging, University of Queensland, Brisbane, Australia, [2]Radiology department, College of applied medical sciences, Najran University, Najran, Saudi Arabia, [3]Radiology Department, Ramsay Sime Darby Healthcare, Surabaya, Indonesia
		High-resolution MRI of the cervical spinal cord is important to provide accurate diagnosis and pathological assessment of injuries. MEDIC (Multiple Echo Data Image Combination) sequence appears promising for use in clinical imaging, however the comparison in the performance of two-dimensional (2D) and three-dimensional (3D) MEDIC sequences for spinal cord imaging has not been reported. This study aims to compare axial 2D and 3D MEDIC sequence for the visualization of the grey matter (GM) and white matter (WM) of the human cervical spinal cord.

3194	Computer 120	Correcting a slice distortion artifact in the multiband diffusion images by postprocessing with the known diffusion gradients
		Jiancheng Zhuang[1]
		[1]University of Southern California, Los Angeles, CA, United States
		The diffusion weighted images acquired with the multiband sequence or the Lifespan protocols shows a type of slice distortion artifact. This artifact is caused by the eddy currents, which can be induced by the diffusion gradient associated with either the current DW image or the previous DW images. The artifact can be corrected by a correction algorithm which includes the diffusion gradients from both the current and previous DW images.

Electronic Poster

Diffusion: In Vivo & Ex Vivo Applications: Body

Exhibition Hall	Monday 9:15 - 10:15

3195	Computer 1	Atypical Imaging Features of Renal Pelvic Urothelial Carcinoma That Mimics Central Renal Cell Carcinoma：Utility of monoexponential, biexponential, and stretched exponential Diffusion-weighted imaging models Haojie Li[1] *[1]Department of Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wu Han, China* Multi-b values DWI are feasible and useful in the noninvasive tissue characterization of renal tumors. DDC and f may provide additional information and could lead to improved differentiation with better sensitivity and specificity between central renal cell carcinoma (RCC) from renal pelvic urothelial carcinoma compared with conventional diffusion parameters.

3196	Computer 2	A pilot study of the effect of high pressure renal pelvic perfusion on the renal microstructure and microcirculation using multiparametric magnetic resonance imaging (mpMRI) Qiong Ye[1], Zhixian Yu[1], Honghui Zhu[1], Zhao Zhang[1], and Jiance Li[1] *[1]The First Affiliated Hospital of Wenzhou Medical University, Wenzhou, China* Multiparametric MRI is widely used for tissue characterization. High pressure perfusion is commonly used in endoscopic surgery. In this study we compared the quantitative change of renal microstructure and microcirculation using DTI and simplified intravoxel incoherent motion imaging (sIVIM) in an operation simulating high pressure renal pelvic perfusion in the process of endoscopic surgery. Additionally, we compared the cortical and medullar difference. The results of this pilot study showed the feasibility of mpMRI to characterize renal physiology and investigate its quantitative change, with the potential value in early detection of renal function. But further study with larger sample size is required to draw a clear conclusion.

3197	Computer 3	IVIM DWI in the assessment of renal diffusion and perfusion alternations in ischemic acute kidney injury (AKI) animals Chengyan Wang[1,2], Hanjing Kong[2], Fei Gao[3], Li Jiang[4], Jue Zhang[2,3], and Xiaoying Wang[2,5] *[1]Institute for Medical Imaging Technology, Shanghai Jiao Tong university, Shanghai, China, [2]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [3]College of Engineering, Peking University, Beijing, China, [4]Philips Healthcare, Suzhou, China, [5]Department of Radiology, Peking University First Hospital, Beijing, China*

		Intravoxel incoherent motion (IVIM) DWI is able to simultaneously detect diffusion and perfusion characteristics of renal tissue, which provides more sensitive measurement of renal function than serum creatinine. This study investigates the feasibility of using IVIM DWI to evaluate renal diffusion and perfusion changes in ischemic AKI animals. IVIM DWI was performed on rabbits prior to (24 hours before surgery) and after the surgery (1 hour, 3 hours, 1 week and 2 weeks after surgery). After injection of 0.8 mg microspheres, a noticeable change of renal diffusion and perfusion can be seen in the cortex immediately after the surgery. Pathological results also confirmed the renal injury with findings of ischemic and wrinkled features with dilated change of Bowman's capsule.

3198	Computer 4	Diffusion kurtosis imaging in the characterization of rectal cancer: Evaluation of segmentation strategies and repeatability
		Yiqun Sun[1], Qin Xiao[2], Feixiang Hu[2], Chao Xin[2], Huixun Jia[2], Sanjun Cai[2], Robert Grimm[3], Caixia Fu[4], Xu Yan[5], Weijun Peng[2], Tong Tong[1], and Yajia Gu[1]
		[1]Department of Radiology;Department of Oncology, Fudan University Shanghai Cancer Center; Shanghai Medical College, Fudan University, Shanghai, China, [2]Fudan University Shanghai Cancer Center; Shanghai Medical College, Fudan University, Shanghai, China, [3]MR Application Predevelopment, Siemens Healthcare, Erlangen, Germany, [4]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China;, Shanghai, China, [5]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China;, Shanghai, China
		The aim of this study was to evaluate the influence of different segmentation strategies on diffusion parameters and the performance of diffusion kurtosis imaging in predicting rectal cancer histopathological characteristics before a treatment decision is made. The results show that the whole-tumor-volume segmentation strategy could achieve the best inter- and intra-observer repeatability among the six different strategies, and DKI with this segmentation strategy performed accurately for differentiating between well-differentiated and poorly to moderately differentiated patients.

3199	Computer 5	Evaluation of cervical cancer staging using readout segmentation of long variable echo-trains and single-shot diffusion weighted echo-planar imaging: a comparison study
		WeiLiang Qian[1], Qian Chen[1], Zhongshuai Zhang[2], Hong Wang[1], Jibin Zhang[1], and Jianming Xu[1]
		[1]Radiology, Suzhou Municipal Hospital, Nanjing Medical University, Suzhou, China, [2]Diagnosis Imaging, Siemens Healthcare Ltd, Shanghai, China
		Diffusion weighted imaging (DWI) sequence based on readout segmentation of long variable echo-trains (RESOLVE) is superior to that based on single-shot echo-planar imaging (SS-EPI) with respect to improved the image quality, which makes the images more valuable for clinical needs. In this study, we propose an idea to evaluate whether such differences in these images have an impact on staging of cervical cancer. The results show that RESOLVE can improve the accuracy of staging of cervical cancer because of the reductions of image artifacts and geometric deformation.

3200	Computer 6	Predictive and prognostic value of intravoxel incoherent motion (IVIM) MR imaging in patients with advanced cervical cancers undergoing concurrent chemo-radiotherapy Zhengyang Zhou[1] and Weibo Chen[2] *[1]Department of Radiology, Drum Tower Hospital, School of Medicine, Nanjing University, Nanjing, China, [2]Philips Healthcare, Shanghai, Shanghai, China* Pelvic IVIM MR imaging were performed on 30 women with advanced cervical cancers at three time points. The performance of tumour size and IVIM-derived parameters in predicting long-term prognosis was evaluated. After a median follow-up of 24 months, 83.33% patients were alive, 70.00% remained free of disease. A shrinkage rate of maximum diameter≥ 58.31% was useful in predicting a good long-term prognosis. The IVIM-derived ADCIVIM value at time point 2 and the ADCIVIM and f values at time point 3 also performed well in predicting a good prognosis. IVIM has great potential in predicting long-term prognosis in patients with advanced cervical.

3201	Computer 7	Whole-lesion apparent diffusion coefficient histogram analysis: significance in T and N staging of gastric cancers Zhengyang Zhou[1] and Weibo Chen[2] *[1]Department of Radiology, Drum Tower Hospital, School of Medicine, Nanjing University, Nanjing, China, [2]Philips Healthcare, Shanghai, Shanghai, China* Eighty patients with pathologically confirmed gastric carcinomas underwent DWI-MR imaging before surgery prospectively. Whole-lesion ADC histogram analysis was performed. The differences of ADC histogram parameters among different T and N stages were compared with independent-samples Kruskal-Wallis test. ROC analysis was performed to evaluate the performance of ADC histogram parameters in differentiating particular T or N stages of gastric cancers.There were significant differences of all the ADC histogram parameters at different T (except ADCmin and ADCmax) and N (except ADCmax) stages. Whole-volume ADC histogram parameters held great potential in differentiating different T and N stages of gastric cancers preoperatively.

3202	Computer 8	Diffusional kurtosis imaging of parotid glands in Sjögren's syndrome: Initial findings Zhengyang Zhou[1] and Weibo Chen[2] *[1]Department of Radiology, Drum Tower Hospital, School of Medicine, Nanjing University, Nanjing, China, [2]Philips Healthcare, Shanghai, Shanghai, China*

		A total of 40 patients with SS and 40 healthy volunteers underwent DKI-MR imaging, which generated ADC, D, and K values. The MR nodular grade was determined on the basis of MR morphological findings. The parotid ADC, D, and K values in patients with SS were significantly higher than those of healthy volunteers. The K values correlated positively with the MR nodular grade significantly in patients with SS.All parotid DKI parameters differed significantly among patients with SS at different MR nodular grades. Parotid DKI parameters hold great potential in diagnosing SS, especially in early-stage SS without MR morphological changes.

3203	Computer 9	Assessment of Liver Fibrosis: Comparison of Diffusion Kurtosis Imaging, Conventional DWI, Aspartate Aminotransferase-to-Platelet Ratio Index and Fibrosis-4
		Li Yang[1], Mengsu Zeng[1], Shengxiang Rao[1], Caizhong Chen[1], Robert Grimm[2], Caixia Fu[3], and Xu Yan[4]
		[1]Zhongshan Hospital, Fudan University, Shanghai, China, [2]MR Application Predevelopment, Siemens Healthcare, Erlangen, Germany, [3]Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China, [4]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China
		Diffusion kurtosis imaging (DKI) is a recently developed diffusion model that measures the non-Gaussian diffusion of water molecules in biological tissue. Few studies reported the potential of DKI on assessing hepatic fibrosis. Aspartate aminotransferase-to-platelet ratio index (APRI) and fibrosis-4 (FIB-4) are widely used non-invasive serum tests that estimate liver fibrosis. We compared the diagnostic performance of DKI, conventional DWI, APRI, and FIB-4 for evaluating the severity of liver fibrosis. Our results showed that diffusion-based measurements offer a similar diagnostic performance to the serum fibrosis biomarkers APRI and FIB-4 index for predicting liver fibrosis in patients with chronic liver disease.

3204	Computer 10	Postmortem MR diffusion-weighted imaging of the liver: Time behavior of the hepatic apparent diffusion coefficient in the early death interval
		Jin Yamamura[1], Tony Schmidt[1], Anne Catherine Kim[2], Roland Fischer[3,4], Gerhard Adam[1], and Sarah Keller[1]
		[1]Diagnostic and Interevntional Radiology, University Medical Center Hamburg Eppendorf, Hamburg, Germany, [2]Department Stroke and Neurovascular Imaging, The Permanente Medical Group, San Francisco, CA, United States, [3]Department of Pediatric Hematology/Oncology, University Medical Center Hamburg Eppendorf, Hamburg, Germany, [4]UCSF Benioff Children's Hospital Oakland, Oakland, CA, United States
		Postmortem liver ADC values shows a characteristic change over time in the first 16 hours postmortem, which seemed to be influenced by the core body temperature. The postmortem time behavior of liver DWI values could be of interest for postmortem MRI in virtual autopsy.

3205	Computer 11	Towards a definition of the biophysical bases of transient Anomalous Diffusion (tAD) parameters. Evaluation of tAD, DKI and DTI in normal and cancer prostate tissue with Magnetic Resonance micro-imaging at 9.4 Tesla Maria Giovanna Di Trani[1,2], Alessandra Caporale[2], Marco Nezzo[3], and Silvia Capuani[2] *[1]SAIMLAL Dept., Sapienza University of Rome, Rome, Italy, [2]CNR-ISC Physics Dept., Sapienza University of Rome, Rome, Italy, [3]Diagnostic and Interventional Radiology Dept., Tor Vergata University, Rome, Italy* Since DKI and transient anomalous diffusion imaging (tADI) are based on statistical models, they can be performed without the need of a-priori hypothesis on tissue micro-structures. However, the relation between tissue micro-structure DKI and tADI derived parameters have not been clearly established yet. In this work, we evaluated DKI, tAD and DTI diffusion parameters in normal and high-grade cancer prostate, by MR microimaging at 9.4T with a 70μmx70μm in plane resolution. As prostate tissue is a complex tissue, composed by several micro-compartments that exhibit different diffusion behaviors, it is an ideal tissue to investigate the biophysical features of diffusion parameters.

3206	Computer 12	Prostate Cancer: Influence of the Diffusion Time on Diffusion Kurtosis Imaging Tristan Anselm Kuder[1], Frederik Bernd Laun[2], David Bonekamp[3], and Matthias Carl Röthke[3,4] *[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany, [3]Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]Conradia, Hamburg, Germany* Diffusion MRI is routinely used in prostate cancer diagnosis. Diffusion kurtosis imaging allows measuring the kurtosis K_{app}, related to deviations from free diffusion, additionally to the diffusion coefficient D_{app}. Varying the diffusion time may yield additional information about the investigated tissue by probing the diffusion barriers at different length scales. Here, D_{app} and K_{app} were measured at three diffusion times in 27 patients with histologically confirmed prostate cancer. A reduction of K_{app} was observed in tumor and normal control regions with increasing diffusion time, while a D_{app} reduction was mostly seen in control regions.

3207	Computer 13	METastasis Reporting and Data System for Prostate Cancer (MET-RADS-P) for castration-resistant prostate cancer: prediction of clinical course, and identification of oligo-progressive lesions as targets for loco-regional ablative therapy. Soichiro Yoshida[1], Taro Takahara[2,3], Chikako Ishii[3], Thomas C Kwee[4], Keiko Nakagawa[5], Kazuma Toda[5], Yuki Arita[3], Toshiki Kijima[1], Minato Yokoyama[1], Junichiro Ishioka[1], Yoh Matsuoka[1], Kazutaka Saito[1], Ryoichi Yoshimura[5], Kazunori Kihara[1], and Yasuhisa Fujii[1]

		[1]Urology, Tokyo Medical and Dental University Graduate School, Tokyo, Japan, [2]Biomedical Engineering, Tokai University School of Engineering, Kanagawa, Japan, [3]Radiology, AIC Yaesu Clinic, Tokyo, Japan, [4]Radiology, UMC Groningen, Groningen, Netherlands, [5]Radiation Therapeutics and Oncology, Tokyo Medical and Dental University Graduate School, Tokyo, Japan
		Whole-body diffusion-weighted MRI is a new-generation imaging tool for detecting prostate cancer. The extent of bone metastasis and the presence of visceral metastasis on whole-body diffusion-weighted MRI according to METastasis Reporting and Data System for Prostate Cancer (MET-RADS-P) were associated with a lower cancer-specific survival in castration-resistant prostate cancer. Furthermore, whole-body diffusion-weighted MRI facilitates identification of oligo-progressive lesions, which can be targets for loco-regional radiotherapy. MET-RADS-P score of whole-body diffusion-weighted MRI can be an imaging biomarker for castration-resistant prostate cancer in predicting clinical course, and identifying oligo-progressive lesions as targets for loco-regional ablative therapy.

3208	Computer 14	Acute Ankle Sprain: Demonstration of Reliability and Reproducibility of DTI in Imaging Peripheral Nerves
		Natalia I Lopez[1], Nadia Barakat[1], Andrew M Youssef[1], Katie E Silva[1], Jürgen Finsterbusch[2], Laura Simons[1], and David Borsook[1]
		[1]Boston Children's Hospital, Boston, MA, United States, [2]University Medical Center Hamburg-Eppendorf, Hamburg, Germany
		We investigated potential structural changes in peripheral nerves following ankle sprain injuries. Specifically, we assessed the integrity of the sciatic nerve and its major divisions: the tibial and peroneal nerves. Reduced field-of-view DTI was used, and the reproducibility of the DTI measures was examined. Our results revealed excellent reliability of DTI measures in injured versus control nerves across each parameter (FA, AD, RD, MD). A comparison of injured versus control nerves in the associated nerve branch indicated significant difference in AD. Given these results, DTI may have potential as a powerful tool to determine disease profile.

3209	Computer 15	Evaluation of two collagen conduits and autograft in sciatic nerve regeneration in a rabbit nerve gap model with DTI, histology and electrophysiology
		Tina Jeon[1], Emil S Vutescu[2], Eliana B Saltzman[2], Jordan C Villa[2], Scott W Wolfe[2], Steve K Lee[2], Joseph H Feinberg[3], Sarah L Powder[1], Jonathan P Dyke[4], and Darryl B Sneag[1]
		[1]Radiology and Imaging, Hospital for Special Surgery, New York, NY, United States, [2]Department of Hand and Upper Extremity Service, Hospital for Special Surgery, New York, NY, United States, [3]Department of Rehabilitation Medicine, Hospital for Special Surgery, New York, NY, United States, [4]Citigroup Biomedical Imaging Center, Weill Cornell Medical College, New York, NY, United States

		DTI has been used primarily to evaluate white matter tracks in the brain. More recent studies have applied DTI techniques to peripheral nerves, due to their anisotropic architecture. In this investigation, we evaluated peripheral nerve regeneration in a rabbit sciatic nerve gap model comparing two collagen conduits with nerve autograft using DTI and comparison with functional/physiologic testing and histology. We hypothesized that this study would allow us to reliably compare outcomes of nerve regeneration between collagen-based conduits and autograft nerve reconstructions and provide validation for the use of DTI techniques to non-invasively monitor nerve regeneration in-vivo.

3210	Computer 16	Improvements in Whole Body Diffusion Weighted Imaging: Combination of Integrated Slice-Specific Dynamic Shimming and Readout-Segmented EPI
		Wei Liu[1], Alto Stemmer[2], Elisabeth Weiland[2], and Kun Zhou[1]
		[1]Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China, [2]Siemens Healthcare, Erlangen, Germany
		Single-shot echo planar imaging (ss-EPI) is most frequently used for whole body diffusion weighted imaging (WB-DWI) because of short acquisition time and motion insensitivity. However, ss-EPI is vulnerable to the effects of the static field inhomogeneity and poses a challenge to perform ss-EPI based WB-DWI at 3 Tesla. Integrated slice-specific dynamic shimming (iShim) combined with ss-EPI has shown a remarkable improvement on the susceptibility related artifacts in WB-DWI. In this study, we demonstrate the application of rs-EPI using iShim to WB-DWI, which can provide higher quality WB-DWI, specifically less spatial distortions.

3211	Computer 17	The clinical value of DWIBS in the diagnosis of bone marrow involvement in lymphoma and hyperplastic hematopoietic bone marrow
		Mengtian Sun[1], Jingliang Cheng[1], Yong Zhang[1], and Zhizheng Zhuo[2]
		[1]MRI, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China, [2]Philips Healthcare, Beijing, China
		This study aimed to investigate the clinical value of diffusion weighted imaging with background signal suppression(DWIBS) in differentiating bone marrow involvement(BMI) in lymphoma from hyperplastic hematopoietic bone marrow(HHBM). Eleven BMI patients, 19 HHBM patients and 20 normal controls underwent DWIBS before the bone marrow biopsy. The ADC value of the bone marrow within the biopsy regions in BMI group was lower than that of HHBM group and higher than that of normal controls. ADC values added relevant information in the potential clinical value of differentiating BMI and HHBM patients.

3212	Computer 18	Development of Diffusion Tensor Imaging to Assess Traumatic Peripheral Nerve Injury and Recovery

		Michael Pridmore[1], Wesley P. Thayer[2], Mark Does[3], and Richard Dortch[4]
		[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Plastic Surgery, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [4]Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States
		Current clinical management following traumatic peripheral nerve injuries (TPNI) and repair require physicians to rely on qualitative measures from patient history/physical exam that can cause delay in patient care. Such delays can a negative impact on outcomes because the healing of nerves must occur in a timely fashion to avoid permanent loss of sensory and/or motor function. The current study aims to test the feasibility of performing DTI measurements in TPNI patients to better improve clinical outcomes.

3213	Computer 19	A Local Coregistration for Quantitative Evaluation of Distortion of Parotid Gland Tumors in Echo-Planar DWI and PROPELLER DWI
		Kai-Min Chien[1], Yi-Jui Liu[2], Yi-Hsiung Lee [3,4], Hing-Chiu Chang [5], Hui-Chu Chiu [6], Ta-Wei Chiu [7], Kang Hsu [8], Hsian-He Hsu [4,9], Chun-Jung Juan[4,9], Yu-Shu Fu[10], and CHENG-YI JUAN[11]
		[1]Master 's Program of Biomedical Informatics and Biomedical Engineering, Feng Chia University, Taichung City 407, Taiwan, [2]Department of Automatic Control Engineering, Feng Chia University, Taichung City 407, Taiwan, [3]Ph. D. Program of Electrical and Communications Engineering, Feng Chia University, Taichung City 407, Taiwan, [4]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan, [5]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [6]Ph.D. program of Technology Management, Chung Hua University, Hsinchu, Taiwan, [7]Department of Medicine, Taipei Medical University, Taipei, Taiwan, [8]Department of Dentistry, National Defense Medical Center, Taipei, Taiwan, [9]Department of Radiology, National Defense Medical Center, Taipei, Taiwan, [10]Master 's Program of Biomedical Informatics and Biomedical Engineering, Feng Chia University, TAICHUNG, Taiwan, [11]Institute of Automatic Control Engineering, Feng Chia University, TAICHUNG, Taiwan
		The study is to quantitatively compare the morphology distortion in distinguishing parotid pleomorphic adenomas (PMA) between PROPELLER-DWI and EP-DWI. This retrospective study enrolled 14 PMAs. All participants underwent 1.5-T fat-saturated diffusion-weighted imaging with PROPELLER-DWI and EP-DWI. A local coregistration method to quantitatively evaluate the distortion of parotid gland tumors between single shot EP-DWI and PROPELLER DWI. Imaging distortion represented by Dice coefficient was quantitatively analyzed. Our results showed that PROPELLER-DWI allows distinguishing PMAs with less distortion than EP-DWI.

3214	Computer 20	Is ADC Affected by Distortion of EP-DWI for Distinguishing Parotid Gland Tumor- To Compare ADC of Parotid Gland in Echo-Planar DWI and PROPELLER DWI
		Kai-Min Chien[1], Yi-Jui Liu[2], Yi-Hsiung Lee [3,4], Hing-Chiu Chang [5], Hui-Chu Chiu [6], Ta-Wei Chiu [7], Kang Hsu [8], Hsian-He Hsu [4,9], Chun-Jung Juan[4,9], Yu-Shu Fu[10], and CHENG-YI JUAN[11]

		[1]Master 's Program of Biomedical Informatics and Biomedical Engineering, Feng Chia University, Taichung City 407, Taiwan, [2]Department of Automatic Control Engineering, Feng Chia University, Taichung City 407, Taiwan, [3]Ph. D. Program of Electrical and Communications Engineering, Feng Chia University, Taichung City 407, Taiwan, [4]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan, [5]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [6]Ph.D. program of Technology Management, Chung Hua University, Hsinchu, Taiwan, [7]Department of Medicine, Taipei Medical University, Taipei, Taiwan, [8]Department of Dentistry, National Defense Medical Center, Taipei, Taiwan, [9]Department of Radiology, National Defense Medical Center, Taipei, Taiwan, [10]Master 's Program of Biomedical Informatics and Biomedical Engineering, Feng Chia University, TAICHUNG, Taiwan, [11]Institute of Automatic Control Engineering, Feng Chia University, TAICHUNG, Taiwan
		The study is to investigate if the perceptible geometric distortions could bias for parotid pleomorphic adenomas (PMA) by ADC measurements by comparing PROPELLER-DWI with EP-DWI. This retrospective study enrolled 14 PMAs. All participants underwent 1.5-T fat-saturated diffusion-weighted imaging with PROPELLER-DWI and EP-DWI. ADCs were measured on normal parotid gland and PMA for PROPELLER-DWI and EP-DWI. Our results showed that PMAs had significantly higher ADC than normal parotid glands no matter on PROPELLER-DWI or EP-DWI. The ADC measured by PROPELLER-DWI was significantly higher than by EP-DWI, but they were proportional to each other. EP-DWI allows distinguishing PMAs even under image distortion.

3215	Computer 21	The value of DWI with Readout Segmentation of Long Variable Echo-trains in Differentiating Benign and Malignant Lesions of the Tongue
		Baohong Wen[1] and Jingliang Cheng[1]
		[1]the First Affiliated Hospital of Zhengzhou University, Zhengzhou, China
		The purpose of this study was to assess the role of readout segmentation of long variable echo-trains(RESOLVE) DWI in differentiating benign and malignant lesions of the tongue. 120 patients with lingual lesions underwent preoperative RESOLVE DWI. The results demonstrated that the mean ADC values of benign lesions of the tongue were significantly higher than malignant lesions. Using an ADC value of 1.25×10-3 mm2/s as the threshold value, the sensitivity and specificity were 94.64%, 93.75% respectively. RESOLVE can offer high quality DWI of tongue. The ADC value can be applied in differential diagnosis between benign and malignant lesions of the tongue

3216	Computer 22	Diffusion kurtosis imaging in evaluating non-Hodgkin’s lymphoma: associations with tumor aggressiveness and proliferation
		Jing Zhong[1], Yunbin Chen[1], Ying Chen[1], Cuifang Chen[1], and Weibo Chen[2]
		[1]Radiology, Fujian Cancer Hospital, Fuzhou, China, [2]Philips Healthcare, Shanghai, China

		This study tries to evaluate the usefulness of diffusion kurtosis imaging (DKI) parameters in segregating the pathological subtypes of NHL lymphoma, and to explore its associations with aggressiveness and proliferative index. Significant differences were found among the WHO classified subgroups. Meanwhile, the stronger tumor aggressiveness (higher Ki67 percentage) was accompanied with more restricted water diffusivity (lower ADC and D values) and more complex cell micro-structural environment (higher K value). The DKI technique may help estimation of tumor proliferation in NHL lymphoma and DKI parameters can be used as imaging biomarker of the biological aggressiveness of the tumor.

3217	Computer 23	Assessment of the Specificity and Sensitivity of DTI Metrics for Evaluation and Diagnosis in Degenerative Cervical Myelopathy
		Guangqi Li[1], Xiaodong Ma[1], JinChao Wang[2], Donghang Li[2], Xiao Han[2], Wen Jiang[3], Xiaoguang Cheng[3], and Hua Guo[1]
		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [2]Department of Spine Surgery, Beijing Jishuitan Hospital, Beijing, China, [3]Department of Radiology, Beijing Jishuitan Hospital, Beijing, China
		Diffusion Tensor Imaging (DTI) can detect diffusion information of water molecules, and is used to diagnose the severity of degenerative cervical myelopathy (DCM). However, the diagnostic capability of DTI metrics is not fully investigated. In this study, DTI metrics are employed to evaluate the spinal cord function in preoperative DCM patients and healthy volunteers. Nonparametric t-test results show that MD, FA and RD have significant differences between patients and healthy volunteers. In addition, ROC results indicate that FA has higher sensitivity, RD has higher specificity for evaluation and diagnosis in DCM.

3218	Computer 24	L-spine Bone Marrow on Female: A Intravoxel Incoherent Motion MR Imaging Study
		Teng Zhao[1], Yunsong Zheng[1], Hui Xu[2], Yuanyuan Chen[1], Yanbing Guo[1], Dong Han[1], and Nan Yu[1]
		[1]Department of Medical Imaging, Affiliated Hospital of Shaanxi University of Traditional Chinese Medicine, Xianyang, China, [2]Department of Medical Imaging, The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China
		To our knowledge, no studies have employed IVIM diffusion-weighted MRI to explore the variation trend of bone marrow in female. Whether gender difference exists in marrow structure is not well investigated. Therefore, we explored the diagnostic utility of IVIM diffusion-weighted MRI parameters in this context. We found that D, D* and f value showed a decreased trend with age, and the D, D* value of bone marrow in female was significantly higher than that in male except the f value. IVIM diffusion-weighted MRI was useful in the evaluation of bone marrow.

Electronic Poster

Diffusion MRI: Validation

Exhibition Hall	Monday 9:15 - 10:15

3219	Computer 25	How do current diffusion-based MR methods reflect hypomyelination – comparison of diffusion tensor, neurite orientation dispersion and density, and diffusion kurtosis imaging
		Rakshit Dadarwal[1], Amir Moussavi[1], Wiebke Möbius[2], and Susann Boretius[1]
		[1]Functional Imaging Laboratory, German Primate Center, Göttingen, Germany, [2]Department of Neurogenetics, Max Planck Institute for Experimental Medicine, Göttingen, Germany
		Diffusion-based MRI comprises an exciting toolset to analyze tissue microstructures under normal and pathological conditions. Among numerous diffusion-based methods compared, all reflected the differences in myelination in a mouse model expressing only reduced levels of the myelin basic protein. However, diffusion tensor was more robust than diffusion kurtosis imaging. Intra-neurite volumes, as revealed by neurite orientation dispersion and density imaging or by the spherical mean technique, were not specific for the numbers of axons but were also affected by difference in myelination.

3220	Computer 26	Realistic 3D Fiber Crossing Phantom Models for Monte Carlo Diffusion Simulations
		Jonathan Rafael-Patino[1], Gabriel Girard[1], David Romascano[1], Muhamed Barakovic[1], Gaëtan Rensonnet[2,3], Jean-Philippe Thiran[1,4], and Alessandro Daducci[1,4,5]
		[1]Signal Processing Lab (LTS5), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]ICTEAM Institute, Université catholique de Louvain., Louvain-la-Neuve, Belgium, [3]Signal Processing Lab (LTS5), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, Lausanne, Switzerland, [4]Radiology Department, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland, [5]Computer Science Department, University of Verona, Verona, Italy
		Monte-Carlo Diffusion Simulations has proved to be a powerful approach to study Diffusion-Weighted MRI; from generating ground-truth data, to study the diffusion process in complex media. However, a major problem with the current approaches is that they oversimplify the geometrical properties of the diffusion media. In this work we present a framework to create 3D meshes for realistic configurations that can be used for MCDS. The synthesized signals from this models can be used to study microstructure and tractography methods, which is of vital importance since novel methods require better ground-truth that mimics real tissue properties to avoid oversimplifications.

3221	Computer 27	Critical Choices in ROI Analysis of Diffusion MRI Data
		Mohammad Alipoor[1] and Stephan E Maier[1,2]

		[1]Radiology, University of Gothenburg, Gothenburg, Sweden, [2]Radiology, Brigham and Women's Hospital, Boston, MA, United States
		Diffusion parameters such as diffusivity, compartment fractions and diffusion signal itself are informative bio-markers in understanding and analyzing pathological changes in biological tissue. One frequently needs to compute a representative value of a diffusion parameter in a homogeneous ROI. Here we compare and contrast 3 common choices that researcher would make in the course ROI analysis. Though ROI analysis is deemed to be a common practice, the critical choices of computational methods (depending on noise distribution and underlying model) can considerably affect its findings and conclusions.

3222	Computer 28	Transient anomalous diffusion micro-MRI parameters reflect white matter morphology: comparison with histology of the mouse spinal cord.
		Alessandra Caporale[1], Giovanni Battista Bonomo[2], Giulio Tani[2], AdaMaria Tata[3], Bice Avallone[4], Felix Werner Wehrli[5], and Silvia Capuani[1]
		[1]Physics, CNR ISC, UOS Roma Sapienza, Sapienza University of Rome, Rome, Italy, [2]Physics, Biophysics division, Sapienza University of Rome, Rome, Italy, [3]Biology and Biotechnologies C. Darwin, Research Center of Neurobiology Daniel Bovet, Sapienza University of Rome, Rome, Italy, [4]Biology, University of Naples Federico II, Naples, Italy, [5]Radiology, Laboratory for Structural, Physiologic and Functional Imaging, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States
		Transient-anomalous diffusion (tAD) has previously been used for tumor delineation and human brain tissue characterization, however, comparison with histology is largely missing. This work aims to compare α and γ tAD parameters, DTI and q-space-imaging parameters obtained at 9.4T with micro-MRI, with the morphologic characteristics provided by optical microscopy of mouse spinal cord white matter (MSC-wm). We found that γ- and q-space-imaging are sensitive to axon diameter and effective local axon density, while α-imaging is sensitive to the heterogeneity or degree of disorder of the wm tracts. These techniques outperform DTI as a means to probe MSC-wm morphology.

3223	Computer 29	Developing 3D perfusion bioreactor for MRI and optical imaging
		Slavka Carnicka[1], Jeanne E. Barthold[2], Kathryn E. Keenan[1], Karl F. Stupic[1], Corey P. Neu[3], and Stephen E. Russek[1]
		[1]NIST, Boulder, CO, United States, [2]Department of Mechanical Engineering, University of Colorado Boulder, Boulder, CO, United States, [3]University of Colorado Boulder, Boulder, CO, United States

		Whole-body medical imaging (such as MRI) can map many physical tissue parameters; however, there are currently many questions in the field regarding how changes in MRI are representative of changes in the underlying cells. To better understand these processes, we need to correlate MRI measurements with changes in microstructure. We created a living phantom for evaluation of techniques such as diffusion tensor imaging (DTI) that can be monitored and validated by optical techniques. Our future plan is to use MRI to study cell growth and monitor response to chemical and mechanical stimuli.

3224	Computer 30	Test-retest reliability of graph theoretic metrics in adolescent brains
		Justin P. Yuan[1], Eva Henje Blom[2], Trevor Flynn[1], Yiran Chen[1], Tiffany C. Ho[3], Colm G. Connolly[4], Rebecca A. Dumont Walter[1], Tony T. Yang[5], Duan Xu[1], and Olga Tymofiyeva[1]
		[1]Department of Radiology & Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Department of Clinical Science Child and Adolescent Psychiatry, Umeå University, Umeå, Sweden, [3]Department of Psychology, Stanford University, Stanford, CA, United States, [4]Department of Biomedical Sciences, Florida State University, Tallahassee, FL, United States, [5]Department of Psychiatry, University of California San Francisco, San Francisco, CA, United States
		Graph theory analysis of structural brain networks derived from diffusion tensor imaging (DTI) has been utilized to study neurological and psychiatric disorders but its reliability remains understudied, especially in the still-developing brain. Repeated DTI scans of adolescents were acquired to assess the test-retest reliability of different weighting schemes of brain networks: fractional anisotropy (FA), streamline count (SC), and binary (B). The test-retest scans were performed at two time intervals: 12 weeks apart and within the same scan session, approximately 30 minutes apart. Results suggest that FA-weighting outperforms the other schemes.

3225	Computer 31	Design of multi-purpose and 3D-printed fibre phantoms for investigating complex tissue microstructures
		Husan-Han Chiang[1], Kuan-Hung Cho[1], Ezequiel Farrher[2], Johannes Lindemeyer[2], Richard Buschbeck[2], Ming-Jye Chen[1], Farida Grinberg[2,3], Nadim Jon Shah[2,3], Chang-Hoon Choi[2], and Li-Wei Kuo[1]
		[1]Institute of Biomedical Engineering and Nanomedicine, National Health Research Institutes, Miaoli, Taiwan, [2]Institute of Neuroscience and Medicine – 4, Forschungszentrum Juelich, Juelich, Germany, [3]Department of Neurology, Faculty of Medicine, RWTH Aachen University, Aachen, Germany
		Investigating complex tissue microstructures has become of great interest during the past decade. One of the most promising MRI methods to map tissue microstructures is diffusion MRI. However, the validation of its accuracy in mapping fibre orientation and microstructural characteristics is still challenging. In this work, we have successfully designed and prototyped a fibre phantom using 3D printing and micro-scale fused silica capillaries. Our results show that susceptibility of the capillaries and/or the coating material is different from that of distilled water and suggest that our phantom design could provide detectable microstructures for further studies.

3226	Computer 32	Multisite Reproducibility of Radiomics and ADC Measurements for temperature-controlled phantom: Preliminary Results. Michael A. Jacobs[1], Dariya I. Malyarenko[2], David C. Newitt[3], Vishwa S. Parekh[4], Nola M. Hylton[3], and Thomas L. Chenevert[2] *[1]The Russell H. Morgan Dept of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Radiology, University of Michigan, Ann Arbor, MI, United States, [3]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [4]Computer Science, The Johns Hopkins University, Baltimore, MD, United States* Radiomics is an emerging field which deals with high throughput extraction of quantitative features from radiological images. Radiomic features correspond to textural information that is otherwise not visually perceivable. To establish confidence intervals for extracted features the longitudinal reproducibility of the radiomic metrics should be assessed with the standard. This work has demonstrated radiomic reproducibility for ADC mapping acquired for the ice-water phantom over several years on three independent systems at two different field strengths (1.5 and 3T).

3227	Computer 33	MR Characterization and Temperature Dependence of Aqueous Polyvinylpyrolidone (PVP) Solutions for use as MR Phantoms Joelle E Sarlls[1], Michal Komlosh[2], Ferenc Horkay[2], Uri Nevo[3], Peter J Basser[2], and Carlo Pierpaoli[4] *[1]NINDS/NMRF, National Institutes of Health, Bethesda, MD, United States, [2]NICHD, National Institutes of Health, Bethesda, MD, United States, [3]Biomedical Engineering, Tel Aviv University, Tel Aviv, Israel, [4]NIBIB, National Institutes of Health, Bethesda, MD, United States* Diffusion-weighted MRI methods often contain variability and bias in diffusion parameters that are measured between sites, scanners, and vendors. There is a clear need for a calibrated diffusion phantom to help identify and mitigate these differences. Here we utilize a 7T spectrometer to characterize MR parameters of T_1, T_2, and the water self-diffusion coefficient in aqueous Polyvinylpyrolidone (PVP) solutions and their dependence on temperature and PVP concentration, without imaging confounds. An empirical formula is presented for use wtih PVP aqueous solutions as a calibrated diffusion phantom. Data show that aqueous PVP solutions are well suited as a MR phantom material.

3228	Computer 34	Does neurite density as measured by diffusion-weighted MR imaging relate to neuronal density as measured by MR spectroscopy? Hamied A Haroon[1], Ben R Dickie[1], Faezeh Sanaei Nezhad[1,2], Martyn McFarquhar[1], Stephen R Williams[1], Geoff JM Parker[1,2], and Laura M Parkes[1]

		[1]The University of Manchester, Manchester, United Kingdom, [2]Bioxydyn Limited, Manchester, United Kingdom
		Capturing the earliest signs of dementia with MR imaging relies on techniques that are sensitive to the subtle loss or disconnection of neurons before atrophy occurs. Models of multi-shell HARDI such as NODDI claim to quantify neurite density *in vivo* and non-invasively, but the specificity of these HARDI-based metrics remain unvalidated. This study aims to determine the sensitivity of NODDI's neurite density and orientation dispersion index to regional variation of MRS markers of neuronal and glial cell density. We find that caution must be exercised when interpreting NODDI's neurite density as related to neuronal density. Orientation dispersion instead appears to be a closer marker of neuronal density and may be a more sensitive marker of disease-related change.

3229	Computer 35	Free watER iNvariant Estimation of Tensor (FERNET): Addressing the Issue of Edema in Clinically Feasible Acquisitions
		Abdol Aziz Ould Ismail[1], Drew Parker[1], Simon Alexander[2], Emmanuel Caruyer[3], Ofer Pasternak[4], and Ragini Verma[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Synaptive Medical Inc., Toronto, ON, Canada, [3]IRISA, CNRS, Rennes, France, [4]Psychiatry and Radiology, Harvard Medical School, Boston, MA, United States
		Despite the growing research in free water elimination (FWE) methods with advanced diffusion acquisition protocols, the need for robust single-shell based FWE remains, as this is the standard acquisition protocol in the clinic. This is especially important in the characterization of peritumoral regions with infiltration. However, single-shell FWE is an ill-posed problem, dependent on parameter initialization, solutions to which often fail to obtain a balanced correction between healthy and abnormal tissue. We introduce FERNET, a robust FWE protocol for single-shell data with a comprehensive investigation of initialization parameters based on a software simulated phantom where the ground truth is known.

3230	Computer 36	Multi-shell multi-tissue fODF tractography improves V1-V2 macaque connectivity mapping
		Guillaume Theaud[1], Maxime Descoteaux[1], Rémi Cossette-Roberge[1], Jean-Christophe Houde[1], Chuyang Ye[2], Nathalie Richard[3], Yujie Hou[4], Loïc Magrou[4], Kenneth Knoblauch[4], Henry Kennedy[4], and Bassem Hiba[3]
		[1]Sherbrooke Connectivity Imaging Lab (SCIL), University of Sherbrooke, Sherbrooke, QC, Canada, [2]Brainnetome Center, Institute of Automation, Chinese Academy of Sciences, Beijing, China, [3]Institut des Sciences Cognitives Marc Jeannerod, CNRS/université Lyon1 (UMR 5229), Bron, France, [4]Inserm, Stem Cell and Brain Research Institute U1208, Université Claude Bernard Lyon 1, Bron, France

		We show that multi-shell (multi b-value), multi-directional, and high spatial resolution (300 microns isotropic) diffusion MRI combined with multi-tissue fiber orientation distribution function (fODF) tractography increases by 6% the number of true positive connections and uniformly increases the cortical coverage by 3%, while preserving the same percentage of false positive connections, with respect to a more standard single-tissue single-shell tractography. As a result, it is possible to find all 5 ground truth V1-V2 bundles (true positives), while reconstructing only 4 invalid bundles (false positives) corresponding to 4 pairs of spatially neighboring regions.

3231	Computer 37	Apparent exchange rate mapping: relation to membrane permeability
		Dominik Ludwig[1], Frederik Bernd Laun[2], Peter Bachert[1], and Tristan Anselm Kuder[1]
		[1]Department of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany
		Apparent exchange rate (AXR) mapping might provide an insight into the exchange of water between intra- and extracellular space by using a double-diffusion encoded sequence with varying mixing time between the two gradient pairs. To investigate the connection between AXR and membrane permeability and to test the assumptions of the underlying theory, Monte Carlo simulations using simplified tissue models were performed. Simulations covered a broad range of membrane permeabilities to determine limits of the applicability of this technique. For the considered simplified tissue model, AXR-values could be reliably related to membrane permeabilities typically occurring in vivo.

3232	Computer 38	Characterization of Diffusion Metric Map Similarity in MRI Data from a Clinical PACS using the Histogram Distance
		Graham C Warner[1] and Karl G Helmer[1,2]
		[1]Radiology, Massachusetts General Hospital, Boston, MA, United States, [2]Radiology, Harvard Medical School, Boston, MA, United States
		As data reuse becomes more popular, it is critical to develop methods that characterize the similarity of data. Methods have been developed that characterize raw image files, but users often only have access to calculated parameter maps. Here we describe a histogram-distance-based method applied to diffusion metric maps generated from MRI data extracted from a clinical data repository. We find that metric maps from GE scanners are less similar than that from Siemens scanners. We also find within vendor differences at any selection of the acquisition parameters considered here (field strength, number of gradient directions, b-value and vendor).

3233	Computer 39	Pre-treatment intra- and inter- voxel magnetic resonance diffusion heterogeneity correlates with chemoradiotherapy treatment outcome of patients with head and neck squamous cell carcinoma Marianthi-Vasiliki Papoutsaki[1], Harbir Singh Sidhu[1], Nikolaos Dikaios[2], David Atkinson[1], Timothy Beale[3], Simon Morley[3], Martin Forster[4], Dawn Carnell[5], Ruheena Mendes[5], and Shonit Punwani[1] *[1]Centre of Medical Imaging, Division of Medicine, University College of London, London, United Kingdom, [2]Centre for Vision, Speech and Signal Processing, University of Surrey, London, United Kingdom, [3]Department of Radiology, University College Hospital, London, United Kingdom, [4]Research Department of Oncology, University College Hospital, London, United Kingdom, [5]Radiotherapy Department, University College Hospital, London, United Kingdom* Heterogeneity assessment and diffusion weighted magnetic resonance imaging (DW-MRI) have been considered powerful diagnostic tools in predicting chemoradiotherapy treatment outcome in patients with cancer. In this study, pre-treatment microstructural heterogeneity derived by intra- and inter-voxel MR diffusion rates was assessed in patients with neck squamous cell carcinoma (HNSCC). A correlation was presented between the pre-treatment MR diffusion heterogeneity and the chemoradiotherapy treatment outcome of patients with HNSCC. Future work, to ascertain the mechanisms of these correlations would open the opportunity to tailor therapies to individuals in clinical practice.

3234	Computer 40	Histological breast cancer stroma patterns correlate with diffusion MR signal Sara Reis[1], Colleen Bailey[1], Thomy Mertzanidou[1], Bernard Siow[2], Eleftheria Panagiotaki[1], John H. Hipwell[1], Julie Owen[3], Patrycja Gazinska[3], Sarah E. Pinder[3], Daniel C. Alexander[1], and David J. Hawkes[1] *[1]Centre for Medical Image and Computing, University College London, London, United Kingdom, [2]Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom, [3]King's College London, London, United Kingdom* We report on the histological analysis of the stroma compartment of two formalin-fixed breast cancer ex-vivo samples that were scanned under a wide range of PGSE acquisitions. Our histological analysis of stroma approach shows that mature regions present higher ADC values compared to immature regions. Mature regions are mainly composed by highly organised fibres, normally following the same direction, which may facilitate directional movement of molecules. This increases the effective tortuosity in the tumour and its interstitial fluid pressure and osmotic pressure, which inhibits water diffusion and subsequently results in a lower ADC value.

3235	Computer 41	Investigating Diffusion-MRI based neurite density estimation model dependency: an in-vivo study on the HCP dataset Mauro Zucchelli[1], Maxime Descoteaux[2], and Gloria Menegaz[1]

		[1]University Of Verona, Verona, Italy, [2]Université De Sherbrooke, Sherbrooke, QC, Canada
		Diffusion MRI can be used to estimate the brain tissue neurite density from Multi-Compartment models. This index corresponds to the “stick” compartment volume fraction estimated in every voxel. In this work, we provide evidence that the distribution of stick volume fraction is characteristic of the brain tissue and is highly reproducible between subjects but strongly depends on the underlying multi-compartment model definition. In particular, in-vivo results on 10 subjects of the Human Connectome Project show that the neurite density distribution depends on both the stick parallel diffusivity and the extra-axonal compartment model.

3236	Computer 42	Time-dependent diffusion modeling using a hollow textile-based Phantom
		Sudhir Kumar Pathak[1], Vinod Jangir Kumar[2], Catherine Fissell [3], Anthony Zuccolotto[4], and Walter Schneider[5]
		[1]Learning Research and Development Center, University Of Pittsburgh, Pittsburgh, PA, United States, [2]Biological Cybernetics, Max Planck Institute, Tuebingen, Germany, [3]Learning Research and Development center, University of Pittsburgh, Pittsburgh, PA, United States, [4]Phantom Metrics division, Psychology Software Tools, Inc, Pittsburgh, PA, United States, [5]1Learning Research and Development center, University of Pittsburgh, Pittsburgh, PA, United States
		A Textile Anisotropic Brain Imaging Phantom incorporating textile water filled hollow fibers (taxons with inner/outer diameter 12/34 micron) is used to examine time-dependent diffusion. In this study, impermeable hollow tubes (taxons) with 12-micron diameter are used to test the relationship between axial and radial diffusivities with diffusion time (Δ) for a given taxon packing density. An inverse relationship of radial diffusivity with diffusion time (Δ) is established. A constant relationship of axial diffusivity with diffusion time is established. The dependence of these relationships on packing density is then tested and the radial diffusivity relationship is shown to vary with packing density.

3237	Computer 43	Investigation of Myocardial Fiber Crossings in the Human Heart Using Realistic HARDI Simulation Based on PLI
		Lihui WANG[1], Feng YANG[2], Gabrielle Michalowicz[3], Yves Usson[3], Pierre-Simon Jouk[3], Rongpin Wang[4], and Yuemin Zhu[5]
		[1]Key Laboratory of Intelligent Medical Image Analysis and Precise Diagnosis of Guizhou Province, School of Compute Science and Technology, Guizhou University, Guiyang, China, [2]School of Computer and Information Technology, Beijing Jiaotong University, Beijing, China, [3]Laboratoire TIMC-IMAG, UMR5525 CNRS, Université Grenoble Alpes, Grenoble, France, [4]Department of Radiology, Guizhou Provincial People’s Hospital, Guiyang, China, [5]Univ.Lyon, INSA-Lyon, Université Claude Bernard Lyon 1, UJM-Saint Etienne, CNRS, Inserm, CREATIS UMR 5220, U1206, F-69621, Lyon, France

		We investigate fiber crossings in the myocardium of the human heart using realistic HARDI simulation based on polarized light imaging (PLI). The whole human heart was first imaged using PLI. Based on the fiber orientations measured by PLI, cardiac fiber structures were then modeled, and finally diffusion-weighted images were simulated at different scales using Monte Carlo method and the corresponding ODFs were calculated. The results show that fiber crossings clearly appeared in the myocardium with the increase of scale and that the accuracy of estimating the number of fiber crossings degraded with variable false positive and/or false negative errors.

3238	Computer 44	Reliability of Neurite Orientation Dispersion and Density Imaging (NODDI) at 9.4 Tesla
		Patrick McCunn[1,2], Alex Li[1], Peter Zeman[1], Kyle Gilbert[1], Ali Khan[1,2], and Robert Bartha[1,2]
		[1]CFMM, Robarts Research Institute, London, ON, Canada, [2]Medical Biophysics, Western University, London, ON, Canada
		Neurite Orientation Dispersion and Density Imaging (NODDI) is a rapidly emerging diffusion MRI (dMRI) technique used to characterize microstructural complexity through the compartmental modelling of neural water fractions into Intra-neurite, Extra-neurite and CSF volume fractions. This project aimed to further the ability of preclinical diffusion imaging through the application of NODDI to a rodent model with the objective to determine its utility, precision and reliability at 9.4 Tesla.

3239	Computer 45	Test-Retest and Between-Site Reliability in a Multisite Diffusion Tensor Imaging Study
		Ikbeom Jang[1], Sumra Bari[1], Yukai Zou[2,3], Nicole L. Vike[3,4], Pratik Kashyap[1], and Thomas M. Talavage[1,2]
		[1]Electrical and Computer Engineering, Purdue University, West Lafayette, IN, United States, [2]Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, United States, [3]College of Veterinary Medicine, Purdue University, West Lafayette, IN, United States, [4]Department of Basic Medical Sciences, Purdue University, West Lafayette, IN, United States
		Diffusion tensor imaging (DTI) has been frequently employed in the identification of brain biomarkers for neurodevelopmental and neurodegenerative disorders due to its ability to measure spatial organization of brain tissue. Due to the need for larger sample size to address substantive questions of interest, many studies try to merge data from several scanners, and ideally, a reliability study should come first. In this study, we assess reliability of DTI measures across two systems using the intraclass correlation coefficient, such that we may pool data in future multi-site DTI studies.

3240	Computer 46	Optimal tissue preparation for ex vivo preclinical imaging

Rachel L. C. Barrett[1,2], Diana Cash[1], Camilla Simmons[1], Tobias Wood[1], Anthony C. Vernon[3,4], Marco Catani[1,2], and Flavio Dell'Acqua[2]

[1]Department of Neuroimaging, IOPPN, King's College London, London, United Kingdom, [2]Natbrainlab, Department of Forensic and Neurodevelopmental Sciences, IOPPN, King's College London, London, United Kingdom, [3]Department of Basic and Clinical Neuroscience, IOPPN, King's College London, London, United Kingdom, [4]MRC Centre for Neurodevelopmental Disorders, King's College London, London, United Kingdom

Ex vivo imaging is beneficial for studying rodent brain microstructure in healthy and pathological tissue at high resolution. There are challenges however associated with changes in tissue properties resulting from fixation. We present a tissue preparation protocol optimised for diffusion MRI in the rat brain by varying fixative concentration, gadolinium concentration and rehydration time. By altering T1 and T2 relaxivity, we show how these factors can be combined to maximise SNR efficiency. Improving SNR efficiency in ex vivo diffusion MRI will allow higher spatial and angular resolution for studying tissue microstructure in the rodent brain.

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Oscillating gradient spin echo (OGSE) diffusion weighted imaging of the epidermoid cysts: simulation application

Saori Koshino[1,2], Akiyuki Sakakibara[3], Antoine Choppin[3], Christina Andica[1], Akifumi Hagiwara[1,2], Tomoko Maekawa[1,2], Mihiro Takemori[1,4], Atsushi Arakawa[5], Lydia Chougar[1,6], Masaaki Hori[1], and Shigeki Aoki[1]

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Diffusion weighted imaging with shorter diffusion time using oscillating gradient spin echo (OGSE) may reveal microstructural features among brain disorders. Here we observed apparent diffusion coefficient (ADC) values in three patients with intracranial epidermoid cysts. ADC values measured by OGSE were higher than those measured by pulsed gradient spin echo (PGSE; used in conventional MRI), indicating restricted diffusion due to spatial restriction. The results of our diffusion simulation based on the pathological feature of epidermoid cysts suggest that spatial restriction of “Rugby Ball” regions formed by keratin layers should mainly affect the extent of restricted diffusion.

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Correlation of baseline DSI based metrics with clinical motor outcomes at 6 weeks after acute ischemic stroke

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The difference between the baseline ipsilesional and contralesional mean values in the internal capsule from Orientation Dispersion Index and Generalized Fractional Anisotropy correlate strongly with upper extremity clinical outcomes at 6 weeks. These models account for regions of crossing fibers and demonstrate improvements over DTI in using brain microstructure to make clinical judgments.

Electronic Poster

Brain Morphometry

Exhibition Hall	Monday 9:15 - 10:15

3243 Computer 49

Brain morphometry using diffusion MRI data (DTBM) reveals abnormalities in Down Syndrome that are not detected by conventional DTI analysis.

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We performed Tensor Brain Morphometry (TBM) as well as conventional FA analysis to compare the brains of subjects with Down Syndrome (DS) to typically developing Healthy Controls (HC). TBM deformation fields were computed from T1 weighted images (T1-TBM), as well as from diffusion data (D-TBM). D-TBM identifies differences between DS and HC brains that would have gone completely undetected by conventional TBSS analysis of FA results.

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An Automatic Classification of Alzheimer’s Disease Based on Structural MRI Data Compared with Voxel-Based Morphometry Method

Xiangzhu Zeng[1], Huishu Yuan[1], Yan Liu[2], Ling Wang[3], Ying Liu[1], Zheng Wang[1], and Lizhi Xie[4]

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		In this study, a compartmental sparse feature selection method was used with feature parameter identified, and compared with classical voxel-based morphometry method (VBM) for classification of Alzheimer 's disease (AD) from the healthy subjects. Our method had high classification accuracy for AD diagnosis and a strong linear correlation between the extracted feature parameter and volume of hippocampus obtained by VBM. The feature parameter of hippocampus had a higher linear correlation with mini-mental state examination (MMSE) score than volume of hippocampus with MMSE. Hence, compartmental sparse feature selection is an effective computer-aided diagnosis method to help clinician identify AD.

3245	Computer 51	Accuracy of Morphometry Measures from MPRAGE data with Prospective Motion Correction Based on an Optical Tracking System
		Joelle E Sarlls[1], Francois Lalonde[2], J Andrew Derbyshire[3], Sean Marrett[3], Patrick Hucker[4], Maxim Zaitsev[4], and S Lalith Talagala[1]
		[1]NINDS/NMRF, National Institutes of Health, Bethesda, MD, United States, [2]NIMH/DNU, National Institutes of Health, Bethesda, MD, United States, [3]NIMH/fMRIF, National Institutes of Health, Bethesda, MD, United States, [4]MR Development and Application Center, University Medical Center Freiburg, Freiburg, Germany
		Subject motion during MRI results in poor image quality and may cause bias in the morphormetric measures extracted from segmentation algorithms. Prospective motion correction (PMC) techniques can mitigate these effects by tracking brain motion and updating the scan parameters in realtime. Here, we compared the accuracy of cortical thickness and volume extracted from MPRAGE data of non-moving and intentionally moving subjects when using a PMC method based on a Moire phase tracking marker and an optical system. Data show that the PMC method used here can greatly reduce image artifacts and provide more accurate segmentation results during intentional motion.

3246	Computer 52	Brain volumetric and fractional anisotropy differences in mice selected for high and low empathy-like traits
		Diana Cash[1], Tobias Wood[1], Francesca Zoratto[2], Simone Macri[2], Camilla Simmons[1], Eugene Kim[1], Steve Williams[1], Jeffrey Glennon[3], and Giovanni Laviola[2]
		[1]Neuroimaging, King's College London, London, United Kingdom, [2]Centre for Behavioural Sciences and Mental Health, Istituto Superiore di Sanità, Rome, Italy, [3]Cognitive Neuroscience, Radboud University Medical Centre, Nijmegen, Netherlands

		High resolution ex vivo imaging of mice with high and low empathy-like behavior revealed widespread volumetric and fractional anisotropy (FA) changes. Low empathy mice had decreased volumes of the dorsal and ventral hippocampi, periaqueductal grey and the cerebellar cortex, and increased volumes of the olfactory bulb and the hypothalamus compared to high empathy mice. FA was decreased in the low empathy group, specifically in the hippocampus and in the periaqueductal grey. Functional significance can be inferred as these affected brain circuits mediate olfactory cues-based communication of pain, predatory odor fear responses and autonomic stress responses.

3247	Computer 53	Multicentric test-retest reproducibility of human hippocampal volumes: FreeSurfer 6.0 longitudinal stream applied to 3D T1, 3D FLAIR and high-resolution 2D T2 structural neuroimaging
		Andrea Chiappiniello[1], Roberto Tarducci[2], Cristina Muscio[3], Giovanni B. Frisoni[4,5], Maria Grazia Bruzzone[6], Marco Bozzali[7], Daniela Perani[8,9], Pietro Tiraboschi[3], Anna Nigri[6], Claudia Ambrosi[10], Massimo Caulo[11,12], Elena Chipi[13], Stefano Chiti[14], Enrico Fainardi[15], Stefania Ferraro[6], Cristina Festari[4,16], Roberto Gasparotti[17], Andrea Ginestroni[15], Giovanni Giulietti[7], Lorella Mascaro[18], Riccardo Navarra[11,12], Valentina Nicolosi[4], Lucilla Parnetti[13], Cristina Rosazza[6], Laura Serra[7], Fabrizio Tagliavini[3,19], and Jorge Jovicich[20]
		[1]Physics and Geology Department, University of Perugia, Perugia, Italy, [2]Medical Physics Department, Santa Maria della Misericordia Hospital, Perugia, Italy, [3]Division of Neurology V/Neuropathology, Fondazione IRCCS Istituto Neurologico "Carlo Besta", Milan, Italy, [4]Laboratory of Alzheimer's Neuroimaging and Epidemiology, IRCCS Fatebenefratelli, Brescia, Italy, [5]Memory Clinic and LANVIE-Laboratory of Neuroimaging of Aging, University Hospitals and University of Geneva, Geneva, Switzerland, [6]Fondazione IRCCS Istituto Neurologico "Carlo Besta", Milan, Italy, [7]Neuroimaging laboratory, IRCCS Santa Lucia Foundation, Rome, Italy, [8]Vita-Salute San Raffaele University, Milan, Italy, [9]Division of Neuroscience, San Raffaele Scientific Institute, Milan, Italy, [10]University of Brescia, Brescia, Italy, [11]Department of Neuroscience, Imaging and Clinical Sciences, University "G. d'Annunzio" of Chieti, Chieti, Italy, [12]Institute for Advanced Biomedical Technologies (ITAB), University "G. d'Annunzio" of Chieti, Chieti, Italy, [13]Centre for Memory Disturbances, Lab of Clinical Neurochemistry, University of Perugia, Perugia, Italy, [14]Department of Health Professions - U.O.c Research and Development, Careggi University Hospital, Florence, Italy, [15]Department of Neuroradiology, Careggi University Hospital, Florence, Italy, [16]Department of Molecular and Translational Medicine, University of Brescia, Brescia, Italy, [17]Neuroradiology Unit, University of Brescia, Brescia, Italy, [18]Medical Physics Unit, Spedali Civili di Brescia, Brescia, Italy, [19]Scientific Direction, Fondazione IRCCS Istituto Neurologico "Carlo Besta", Milan, Italy, [20]CIMEC - Center for Mind/Brain Sciences, University of Trento, Trento, Italy
		This study evaluates across-session test-retest reproducibility of automatic hippocampus subfields segmentation. A customized acquisition protocol was designed to enhance segmentation reliability in FreeSurfer 6.0 longitudinal analysis stream. Images were processed performing a within-session T1 averaging, using FLAIR images for PIAL surface reconstruction and a high-resolution T2 for the hippocampal subfield segmentation. Results on 12 healthy subjects suggest high reproducibility for different hippocampal subfields and whole hippocampus, generally better than those achievable without T1 averaging and without using FLAIR and high-resolution T2 images.

3248	Computer 54	Regularized k-means clustering for segmentation of brain tissues using hemodynamic features in DSC-MRI Jonathan Arvidsson[1,2], Oscar Jalnefjord[1,2], Fredrik Kahl[3], Magnus Båth[1,2], and Göran Starck[1,2] *[1]Department of Radiation Physics, University of Gothenburg, Gothenburg, Sweden, [2]Department of Medical Physics and Biomedical Engineering, Sahlgrenska University Hospital, Gothenburg, Sweden, [3]Department of Electical Engineering, Chalmers University of Technology, Gothenburg, Sweden* Inclusion of voxels containing CSF and/or blood vessels can bias ROI statistics used in DSC-MRI analysis. In order to address this problem we propose an automatic method for tissue segmentation based on hemodynamic features obtained from DSC-MRI data. Application of the method in test subjects shows promising results.

3249	Computer 55	Brain extraction and segmentation framework for bias field rich cranial MRI scans of rats Jacob Daniel Kirstejn Hansen[1], François Lauze[1], Sune Darkner[1], Kristian Nygaard Mortensen[2], Simon Sanggaard[2], Helene Benveniste[3], and Maiken Nedergaard[2,4] *[1]Department of Computer Science, University of Copenhagen, Copenhagen, Denmark, [2]Center for Translational Neuromedicine, University of Copenhagen, Copenhagen, Denmark, [3]Anesthesiology, Yale School of Medicine, Yale University, New Haven, CT, United States, [4]Center for Translational Neuromedicine, University of Rochester, Rochester, NY, United States* This abstract presents a framework to extract brain tissue and internal Cerebrospinal fluid in cranial magnetic resonance imaging of rats with strong bias fields. Desired segments are obtained through bias field correction and several passes of segmentation. A refinement procedure is proposed to remove brain surface CSF. Promising planar and 3D visualizations of results are presented and demonstrate the capabilities of the framework.

3250	Computer 56	A 3D-printed anatomical multimodal phantom for brain segmentation validation Anna Altermatt[1,2], Francesco Santini[1,3], Xeni Deligianni[1,3], Stefano Magon[2,4], Till Sprenger[5], Ludwig Kappos[1,4], Philippe Cattin[1], Jens Wuerfel[1,2], and Laura Gaetano[2,4] *[1]Department of Biomedical Engineering, University of Basel, Allschwil, Switzerland, [2]Medical Image Analysis Center (MIAC) AG, Basel, Switzerland, [3]Department of Radiology, University Hospital of Basel, Basel, Switzerland, [4]Department of Neurology, University Hospital of Basel, Basel, Switzerland, [5]DKD HELIOS Klinik, Wiesbaden, Germany*

		Brain tissue segmentation algorithms applied on magnetic resonance imaging (MRI) data lack a ground truth for evaluating their performance. For this purpose, an anatomical brain phantom prototype mimicking T1 relaxation times and the complex 3D geometry of the human brain was created for use with MRI and computed tomography (CT). A scan-rescan experiment showed a low within-session variability of white matter (WM) and grey matter (GM) volumes when MRI images of the phantom were segmented with a commonly used software. Compared to the ground truth volumes derived from CT, the software overestimated the WM, while the GM was slightly underestimated.

3251	Computer 57	Multiparametric MRI characterization of microstructural substrate of literacy: Observations from a community cohort of literate and illiterate elderly in India
		Kenchaiah Raghavendra[1], Alladi Suvarna [1], Jala Sireesha[2], Mekala Shailaja [3], and Bapi S Raju[4]
		[1]Neurology, National Institute of Mental Health and Neurosciences, Bangalore, BANGALORE, India, [2]Nizam's Institute of Medical Sciences Hyderabad, Hyderabad, India, [3]Nizam's Institute of Medical Sciences, Hyderabad, Hyderabad, India, [4]University of Hyderabad, Hyderabad, India
		Few studies have evaluated neuroanatomical differences between illiterates and literates and majority have been unimodal investigations. We explore multiparametric, neuroanatomical substrates of literacy by studying grey and white matter microstructural neuroimaging biomarker differences between 61 literate and 15 illiterate elderly subjects with normal cognition. Univariate and multivariate methods for grey matter density, diffusion tensor parameters and cortical/subcortical morphometric measures were employed. Literacy provided an advantage through increase in grey matter density, white matter integrity, cortical thickness, area and volumes in brain areas related to reading, writing, language, Visuospatial and sensorimotor processes. Enhanced white matter integrity was the most discriminating factor on the machine learning.

3252	Computer 58	Alterations in Cortical Thickness with Hydroxyurea Therapy in Children Treated for Sickle Cell Anemia
		John O Glass[1], Kathleen J Helton[1], and Wilburn E Reddick[1]
		[1]Diagnostic Imaging, St. Jude Children’s Research Hospital, Memphis, TN, United States
		Sickle cell anemia is a devastating hematological disease leading to brain injury and neurocognitive deficits. Twenty-five patients (16 Hydroxyurea treated; 9 not) were imaged twice one year apart. Cortical thickness was assessed using FreeSurfer and compared between groups. Treated patients had thicker cortex in frontal and bilateral parietal lobes and in superior temporal and bankssts regions. Preservation of cortex in these regions may have implications for neurocognitive functions supported by associated networks such as central executive, attention and memory networks. These findings should be further evaluated for their impact on neurocognitive performance and Diffusion Tensor Imaging.

3253	Computer 59	Alterations in cortical thickness and axonal density due to Experimental Autoimmune Encephalomyelitis in the Lewis Rat
		J. Keiko McCreary[1], Brietta Gerrard[1], L. Sorina Truica[1], and Gerlinde A.S. Metz[1]
		[1]Neuroscience, Canadian Centre for Behavioural Neuroscience, Lethbridge, AB, Canada
		The animal model of experimental autoimmune encephalomyelitis (EAE) is characterized by inflammatory lesions and demyelination which leads to axonal damage and subsequent neuronal death within the central nervous system. The effect is debilitating, resulting in loss of motor and sensory functions. Here, we investigated changes in cortical thickness using MRI, and axonal density in the corpus callosum using a neuronal tract tracer, biotinylated dextran amine, in Lewis rats induced with EAE. Our study found that EAE leads to a decrease in cortical thickness, particularly in the primary somatosensory trunk region, and axonal density in the corpus callosum.

3254	Computer 60	In-vivo probabilistic structural atlas of the inferior colliculus, superior colliculus, medial geniculate nucleus, and lateral geniculate nucleus based on 7 Tesla MRI
		Christian Strong[1], Nicola Toschi[2,3], Bruce Rosen[2], Lawrence L Wald[2], and Marta Bianciardi[2]
		[1]Department of Neurosurgery, Brigham and Women's Hospital and Harvard Medical School, Boston, MA, United States, [2]Department of Radiology, A.A. Martinos Center for Biomedical Imaging, MGH and Harvard Medical School, Boston, MA, United States, [3]Medical Physics Section, Department of Biomedicine and Prevention, Faculty of Medicine, University of Rome "Tor Vergata", Rome, Italy
		Brainstem and thalamic nuclei such as the inferior-colliculus, superior-colliculus, lateral-geniculate-nucleus, and medial-geniculate-nucleus modulate visual/oculo-motor and auditory/auditory-motor functions. Dysfunction of these nuclei is implicated in disease states such as auditory-agnosia, pure-word deafness, eye-movement and visual-field deficits, Parkinson's hallucinations, and glaucoma. However, a stereotaxic probabilistic atlas of these nuclei in humans does not exist. We used segmentation of 1.1mm-isotropic 7Tesla T_2-weighted- and diffusion-fractional-anisotropy-images to generate and validate an *in-vivo* probabilistic neuroimaging-based structural atlas of these nuclei in stereotaxic-MNI space. We constructed this atlas to aid the localization of these nuclei in conventional images for future research and clinical investigations of visual/auditory functions.

3255	Computer 61	Dual Fully Convolutional Networks for Multiscale Context based Robust MRI Skull Stripping
		Pascal Ceccaldi[1], Benjamin Odry[1], Boris Mailhe[1], and Mariappan Nadar[1]
		[1]Medical Imaging Technologies, Siemens Healthineers, Princeton, NJ, United States

		Brain Segmentation is a standard preprocessing step for neuroimaging applications, but can however be subject to differences in MR acquisition that can lead to added noise, bias field and / or partial volume effect. To address those protocol differences, we therefore present a generic supervised framework, using consecutively two deep learning networks, to produce a fast and accurate brain extraction aimed at being robust across MR protocol variations. While we only trained our network on Human Connectome Project 3T dataset, we can still achieve state-of-the-art results on1.5T cases from LPBA dataset.

3256	Computer 62	Precision of Manual vs. Automated Corpus Callosum Atrophy Measurements in Multiple Sclerosis
		Michael Platten[1,2], Katarina Fink[1,3], Juha Martola[1], and Tobias Granberg[1,2]
		[1]Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden, [2]Department of Radiology, Division of Neuroradiology, Karolinska University Hospital, Stockholm, Sweden, [3]Department of Neurology, Karolinska University Hospital, Stockholm, Sweden
		Corpus callosum atrophy is a favorable imaging biomarker in MS. Manual measurements of the corpus callosum are considered the best current standard, but their repeatability and reproducibility are uncertain. FreeSurfer is an automatic software that can volumetrically measure the corpus callosum. Using a representative cohort of 9 MS patients, scanned twice with repositioning on 3 different MRI scanners, we compared the manual and automatic measurements of corpus callosum. We found the longitudinal FreeSurfer method to be the most precise method. Thus, we recommend that this method be used in future studies of measuring corpus callosum atrophy in patients with MS.

3257	Computer 63	Morphological Correlates of Objective and Subjective Cognitive Control in Healthy Adults
		Adam Clemente[1], Emma Lawrence[1], Phoebe Imms[1], Derek K Jones[1,2], and Karen Caeyenberghs[1]
		[1]School of Psychology, Australian Catholic University, Melbourne, Australia, [2]School of Psychology, Cardiff University Brain Research Imaging Centre, Cardiff, United Kingdom
		There is evidence showing the neural basis of cognitive control utilizing morphological measures of the brain in healthy adults. In the present study, we complement and extend on previous voxel-based morphometry based research by utilizing the more specific brain macrostructure metric of cortical thickness to investigate the differential morphological correlates of objective and subjective cognitive control. Here, we used a rigorous cognitive control test battery implemented on 25 healthy adults. Further research on morphological correlates of objective and subjective cognitive control in healthy populations is necessary to provide baseline data for future clinical populations.

3258	Computer 64	Hippocampal subfield analysis at 7 tesla in young adults with Down syndrome

		Katherine A Koenig[1], Sehong Oh[1,2], Melissa R Stasko[3], Emma Lissmore[3], Elizabeth Roth[3], Anne Birnbaum[3], Thomas Scheidemantel[4], Hudson Taylor[4], Nancy Roizen[4], Stephen Ruedrich[4], Mark J Lowe[1], and Alberto Costa[3]
		[1]Imaging Sciences, The Cleveland Clinic, Cleveland, OH, United States, [2]Biomedical Engineering, Hankuk University of Foreign Studies, Yongin, Republic of Korea, [3]Case Western Reserve University, Cleveland, OH, United States, [4]University Hospitals, Cleveland, OH, United States
		This work uses ultra-high resolution at 7 tesla to assess hippocampal subfield volume in young adults with Down syndrome (DS). As compared to matched controls, individuals with DS show decreases in total hippocampal volume and in select regions, particularly on the left.

3259	Computer 65	Gray matter alterations in childhood obesity
		Gergely Orsi[1], Gabor Perlaki[1], Gergely Darnai[2], Denes Molnar[3], Peter Bogner[4], and Jozsef Janszky[2]
		[1]MTA-PTE Clinical Neuroscience MR Research Group, Pecs, Hungary, [2]Department of Neurology, University of Pécs, Pecs, Hungary, [3]Department of Paediatrics, University of Pécs, Pecs, Hungary, [4]Department of Radiology, University of Pécs, Pecs, Hungary
		Childhood obesity a is major public health problem. 89 children were selected from a subsample of the I. Family study and investigated the volumes of predefined reward system structures -which are presumed to play crucial roles in body weight regulation- using MR volumetry and voxel-based morphometry. Statistical associations between obesity-related measures and MR based volumetric and morphometric parameters were assessed. Volumes of accumbens and amygdala showed significant positive correlations with obesity, while their gray matter density inversely related to obesity. Our results indicate that obesity is associated with enlarged brain volumes, but decreased gray matter density in the reward system.

3260	Computer 66	A 3D Convolutional Neural Network for Hippocampal Volume Estimation
		Luca Jan Schmidtke[1,2,3], Ricardo Corredor-Jerez[1,2,3], Jonas Richiardi[1,2,3], Bènèdicte Marèchal[1,2,3], Alexis Roche[1,2,3,4], and Tobias Kober[1,2,3]
		[1]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [2]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [3]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [4]CoVii Ltd, Porto, Portugal

		Accurate estimation of hippocampal volume is essential for exploiting its sensitivity to pathological changes caused by Alzheimer's disease (AD) and other forms of dementia. We built and trained a 3D convolutional neural network for fast and accurate segmentation of the hippocampus in T1-weighted structural MR images of the brain. Compared to two software packages (MorphoBox prototype and FreeSurfer), we achieved good disease classification results based on estimated hippocampal volume in a significantly shorter amount of time.

3261	Computer 67	Bayesian Convolutional Neural Network Based Nonhuman Primate Brain Extraction in Fully Three-dimensional Context
		Gengyan Zhao[1], Fang Liu[2], Jonathan A. Oler[3], Mary E. Meyerand[1,4], Ned H. Kalin[3], and Rasmus M. Birn[1,3]
		[1]Department of Medical Physics, University of Wisconsin - Madison, Madison, WI, United States, [2]Department of Radiology, University of Wisconsin - Madison, Madison, WI, United States, [3]Department of Psychiatry, University of Wisconsin - Madison, Madison, WI, United States, [4]Department of Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States
		Brain extraction of MR images is an essential step in neuroimaging, but current brain extraction methods are often far from satisfactory on nonhuman primates. To overcome this challenge, we propose a fully-automated brain extraction framework combining deep Bayesian convolutional neural network and fully connected three-dimensional conditional random field. It is not only able to perform accurate brain extraction in a fully three-dimensional context, but also capable of generating uncertainty on each prediction. The proposed method outperforms six popular methods on a 100-subject dataset, and a better performance was verified by different metrics and statistical tests (Bonferroni corrected p-values$<10^{-4}$).

3262	Computer 68	Cerebrovascular Brain Aging Examined with Arterial Spin Labelling and Applied to Age Prediction
		M. Ethan MacDonald[1], Nils D. Forkert[1], Yuhan Ma[2], Rebecca J. Williams[1], Alexandru Hanganu[1], Hongfu Sun[1], Randall Stafford[1], Cheryl R. McCreary[1], Richard Frayne[1], and G. Bruce Pike[1]
		[1]University of Calgary, Calgary, AB, Canada, [2]McGill University, Montreal, QC, Canada
		Changes in both cortical thickness and cerebral blood flow are observed with age. In this work, we look at how these parameters are modulated across the lifespan. T1-weighted and arterial spin labelling data from 146 subjects were analyzed, with 68 cortical regions selected in each subject to obtain mean cortical thickness and cerebral blood flow. We calculated rates of change, correlation, and laterality for both parameters. Finally, we explored predictive modeling using cortical thickness, CBF and a model combining the two. Predictive modelling was slightly improved when both measures were included.

3263	Computer 69	Evaluation of tumor shape features for overall survival prognosis in glioblastoma multiforme patients Parita Sanghani[1], Ang Beng Ti[2], Nicolas Kon Kam King[2], and Hongliang Ren[1] *[1]Department of Biomedical Engineering, National University of Singapore, Singapore, Singapore, [2]Department of Neurosurgery, National Neuroscience Institute, Singapore, Singapore* We evaluated 13 shape features of glioblastoma multiforme (GBM) tumor for overall survival (OS) prognosis in 75 patients using univariate and multivariate Cox regression analysis. Age and Karnofsky performance scale were used as covariates for the multivariate analysis. Three shape features were found to be significant for OS prognosis in GBM patients. Kaplan-Merier survival curves were obtained for the significant features to illustrate their effectiveness. In future works, these shape features can be used along with volumetric and texture features derived from the tumor for OS prediction of GBM patients.

3264	Computer 70	Investigation of Cerebral Structural Alterations of Patients with Mild Cognitive Impairment based on VBM and DBM Analysis Zhe Ma[1], Zhizheng Zhuo[1], Lijiang Wei[1], Bin Jing[1], Haiyun Li[1], and Yingjie Mei[2] *[1]Capital Medical University, Beijing, China, [2]Clincial Science, Philips Healthcare, Guangzhou, China* Voxel-based morphometry (VBM) and deformation-based morphometry (DBM) are wildly-used automated analysis pipelines for neuro-structural images. This study aims to investigate gray matter abnormalities in mild cognitive impairment (MCI) patients. Some altered brain regions could be detected with VBM and DBM method for MCI patients compared to healthy controls. Besides, the features extracted from VBM and DBM could effectively identify the MCI from healthy controls.

3265	Computer 71	Rostro-caudal architecture of the frontal lobes in humans Michel Thiebaut de Schotten[1], Marika Urbanski[1], Leonardo Cerliani[1], and Emmanuelle Volle[1] *[1]BCBlab, Institut du Cerveau et de la Moelle, Paris, France* Functional models of the frontal lobes suggest a rostro-caudal organization that is essential for goal-directed behaviour and cognitive control, in which higher processing-level anterior regions send control signals to lower processing-level posterior regions. Here we show that tractography can divide the frontal lobes into 12 regions organized in a rostro-caudal axis showing a gradient of cortical thickness, myelination and cell body density.

3266	Computer 72	Volume and surface-based structural analyses in active Crohn's Disease Patients Gita Thapaliya[1], Sally Eldeghaidy[2], Shellie Radford[1], Gordon Moran[1], and Susan Francis[2] *[1]National Institute for Health Research (NIHR) Biomedical Research Centre in Gastrointestinal and Liver disease at Nottingham University Hospitals NHS Trust, Queens Medical Centre Campus, University of Nottingham, Nottingham, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom* Structural brain changes in Crohn's Disease (CD) have been studied in remission, however the data is inconsistent and not assessed in the active disease state. Grey matter volume (GMV) and cortical thickness (CT) were measured using VBM and CAT12/FreeSurfer in 25 active CD patients and age-matched healthy controls (HC). CD patients showed reduced CT and GMV in frontal and motor areas. Both CT and GMV were negatively correlated with proinflammatory markers, indicating these changes could be due to chronic inflammatory response. CAT and Freesurfer measures were highly comparable.

Electronic Poster

Functional & Structural Connectivity in the Brain

Exhibition Hall	Monday 9:15 - 10:15

3267	Computer 73	Investigation of the default mode network in awake marmosets Cirong Liu[1], Cecil Chern-Chyi Yen[1], Frank Ye[2], David Leopold[2], and Afonso C. Silva[1] *[1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States, [2]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States* We investigated the default mode network (DMN) in awake marmosets, by combining both resting-state and task-based fMRI, and by performing diffusion tractography and neuronal tract tracing. We found that dorsolateral (dlPFC) but NOT medial prefrontal cortex (mPFC) is a major region of the marmoset DMN. The dlPFC has direct anatomical connections and strong functional connectivity with the posterior DMN and also exists in macaques and humans, suggesting that it is more evolutionary conservative than the mPFC. However, its functions as a default mode are poorly understood and worth investigation.

3268	Computer 74	Resting state fMRI “Epilepsy networks”.

Rose Dawn Bharath[1], Rajanikant Panda[2], Jeetu Raj[3], Sanjib Sinha[4], Kenchaiah Raghavendra[4], Ravindranadh Chowdary Mundlamuri[4], Ganne Chaitanya[5], Anita Mahadevan[6], Arivazhagan Arimappamagan[7], Malla Bhaskara Rao[7], Kandavel Thennarasu[8], Kaushik Majumdar[9], Parthasarathy Satishchandra[4], and Tapan Gandhi[3]

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Resting state functional MRI (rsfMRI) research typically focuses on few well identified networks though many more networks (15-80) are often visualized, in the course of investigating functional networks. It is customary to discard these networks as they are presumed to have no functional relevance. We used machine learning methods to identify “epilepsy networks” in 45 individuals with TLE using FSL derived 88 independent components. In line with evidence from experimental models, the current results indicates that TLE is associated with disease specific “rsfMRI epilepsy networks” which can be visualised in-vivo at individual subject level.

3269 | Computer 75

Effects of intraocular pressure elevation and oral citicoline treatment on resting state functional connectivity in the visual system

Yolandi van der Merwe[1], Matthew C Murphy[2], Leon C Ho[3], Xiaoling Yang[4], Yu Yu[5], Ying Chau[5], Christopher K Leung[6], and Kevin C Chan[7]

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Glaucoma is a neurodegenerative disease that causes irreversible damage to the visual system. While elevated intraocular pressure (IOP) is a major risk factor, its neurobehavioral effects on the visual system remain unclear. Here we showed that increasing magnitude and duration of IOP elevation resulted in differential effects on the visuomotor behavior and resting-state functional connectivity between visual brain nuclei. In addition, under similar levels of chronic IOP elevation, oral citicoline treatment appeared to ameliorate visual behavioral deficits and functional connectivity decrease in some brain regions. These results suggest new potential mechanistic targets for treatment of glaucoma beyond IOP lowering.

3270	Computer 76	Construction of an MRI-Based Connectome for the Marmoset Brain: Methods and Initial Results Cecil Chern-Chyi Yen[1], Cirong Liu[1], and Afonso C. Silva[1] *[1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States* The common marmoset, a small New World primate, is an excellent translational animal model due to the similarity between its brain network and humans. However, marmoset's brain networks are not fully explored because of lacking a large group of resting-state functional MRI (rfMRI) data, like human connectome project. To facilitate collecting rfMRI in awake marmosets across multiple marmoset MRI sites, an MRI protocol was developed and optimized for ultra-high filed small animal MRI. Preliminary results show high data quality and robust detection of brain networks such as default mode network. More data are being acquired and collaboration is desired for the success of marmoset connectome database.

3271	Computer 77	Disrupted Nodal Organization of brain functional Network in Children with Type I Gaucher Disease Miao Zhang[1], Di Hu[1], Shengpei Wang[2], Huiying Kang[1], and Yun Peng[1] *[1]Beijing Children's Hospital, Capital Medical University,National Center for Children's Health, China, Beijing, China, [2]State Key Laboratory of Management and Control for ComplexSystems, Institute of Automation, Chinese Academy of Sciences, Beijing, China, Beijing, China* In our study, we utilize graph-based network analysis to investigate the topological properties of resting-state brain functional connectivity in children with type I GD. Sixteen children diagnosed as type I GD and sixteen age- and sex- matched healthy controls were recruited. No alterations were found at global level. Three nodes within the executive control network showed decreased nodal degree or efficiency. Our provide new insight to further understand the neurophysiological change of these patients.

3272	Computer 78	Altered Topological Properties of Brain Functional Networks in Type I GD Patients During a Near Five-year Follow-up Di Hu[1], Miao Zhang[1], Shengpei Wang[2], Huiying Kang[1], and Yun Peng[1] *[1]Beijing Children's Hospital, Capital Medical University,National Center for Children's Health, China, Beijing, China, [2]State Key Laboratory of Management and Control for ComplexSystems, Institute of Automation, Chinese Academy of Sciences, Beijing, China, Beijing, China*

		Our previous had shown altered nodal properties within the executive control network in children with type I GD. This time we further investigate the variation trend of brain topological properties in type I GD patients during a near five-year folloe-up under regular enzyme replacement. Results showed that the efficiency of functional segregation in brain network were increased and more nodes were involved and reorganized. The result may explain the improved mood and global functioning that have previous reported.

3273	Computer 79	Multimodal study of hyperbaric oxygenation effects on normal human brain metabolism and functional connectivity at 3 Tesla.
		Andrei Valerievich Manzhurtsev[1,2], Olga Vasiukova[3], Dmitry Kupriyanov[4], Victoria Sergeeva[5], Tolib Akhadov[2], Petr Menshchikov[2,6], and Natalia Semenova[1,2,6]
		[1]0501, Emanuel Institute of Biochemical Physics of the Russian Academy of Sciences, Moscow, Russian Federation, [2]Radiology, Clinical and Research Institute of Emergent Pediatric Surgery and Trauma, Moscow, Russian Federation, [3]National Research Nuclear University MEPhI, Moscow, Russian Federation, [4]Dmitry Rogachev National Research Center of Pediatric Hematology, Oncology and Immunology, Moscow, Russian Federation, [5]Hyperbaric Oxygen Dept., Clinical and Research Institute of Emergent Pediatric Surgery and Trauma, Moscow, Russian Federation, [6]Semenov Institute of Chemical Physics of the Russian Academy of Sciences, Moscow, Russian Federation
		This study is aimed to reveal the effects of hyperbaric oxygenation (HBO) on human brain metabolites using ^{1}H and ^{31}P MRS, and functional connectivity using resting-state fMRI. The MRS and rs-fMRI studies were performed twice: before and after one HBO session (p=1.2 atmosphere, 100% O_2). The results demonstrate the positive effect of hyperbaric oxygenation on human brain metabolism and functioning.

3274	Computer 80	Brain structural plasticity associated with emotional processing in postpartum women: A longitudinal voxel-based morphometry study
		Kaihua Zhang[1,2], Mengxing Wang[2], Xueyun Su[3], Jilei Zhang[2], Junyao Xie[1], Haifeng Lu[2], Zhong Chen*[1], and Xiaoxia Du*[2]
		[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]Shanghai Key Laboratory of Magnetic Resonance and Department of Physics, School of Physics and Materials Science, East China Normal University, Shanghai, China, [3]Department of Special Education, Faculty of Education, East China Normal University, Shanghai, China

		Pregnancy constitutes a significant period in women's lives, after which they often experience numerous physiological and psychological changes. However, structural changes in the brains of postpartum women remain unclear. To investigate these phenomena, we recruited forty-seven postpartum women to participate in a longitudinal magnetic resonance imaging study. Our results first suggest that brain structures in postpartum women show adaptive plasticity, especially regarding alterations in empathy-related regions, including grey matter volume, white matter volume, and cortical thickness, that can facilitate effective adaption and behavioural and emotional adjustments towards nurturing infants.

3275	Computer 81	Age related changes in topological properties of brain functional network and structural connectivity
		Chandan Shah[1], Jia Liu[2], Peilin Lv[2], Huaiqiang Sun[2], Yuan Xiao[2], Jieke Liu[2], Youjin Zhao[2], Wenjing Zhang[2], Li Yao[2], Qiyong Gong[2], and Su Lui[2]
		[1]Radiology, Sichuan University, Chengdu, China, [2]Sichuan University, Chengdu, China
		Title of the abstract was written. The body of the abstract was within word limits. Acknowledgements were mentioned. one figure was uploaded with figure caption.

3276	Computer 82	Resting state functional networks longitudinally correlate with working memory in a transgenic rat model of Alzheimer's disease
		Raúl Tudela[1], Emma Muñoz-Moreno[2], Xavier López-Gil[2], and Guadalupe Soria[1,2]
		[1]Group of Biomedical Imaging of the University of Barcelona, CIBER de Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN), Barcelona, Spain, [2]Experimental MRI 7T Unit, IDIBAPS, Barcelona, Spain
		The TgF344-AD rats represent the most suitable and promising animal model for Alzheimer's disease (AD) research. Resting-state functional MRI was longitudinally acquired every 3 months in a cohort of transgenic Tg344-AD and control Fisher rats between 5 and 15 months of age, together with cognitive task evaluation. Independent component analysis was applied to rs-fMRI volumes and 10 networks were anatomically identified. Spearman correlation coefficients between functional and cognitive parameters were computed. Our results show that while no differences were observed in the cognitive task between both groups, significant differences were found in the functional networks.

3277	Computer 83	A meta-analysis of studies using graph theory in traumatic brain injury suggests inconclusive evidence for structural disconnectivity
		Phoebe Elizabeth Imms[1], Adam Clemente[1], Derek K Jones[1,2], and Karen Caeyenberghs[1]

[1]*School of Psychology, Australian Catholic University, Melbourne, Australia,* [2]*School of Psychology, Cardiff University Brain Research Imaging Centre, Cardiff, United Kingdom*

The purpose of this meta-analysis is to investigate which graph metrics reliably represent changes to structural connectivity following Traumatic Brain Injury (TBI). Effect sizes were pooled for sixteen different graph metrics, from ten diffusion MRI articles that compared the structural connectome of TBI patients and healthy controls. Interestingly, no metric showed consistent differences across the studies. This analysis indicates that heterogeneity in samples are hindering progress towards clinically relevant disconnectivity biomarkers following brain trauma.

3278 Computer 84

Structural and functional connectivity of the ipsilateral or nondecussating dentato-rubro-thalamic tract

Kalen Petersen[1], Jacqueline Reid[2], Srijata Chakravorti[3], Meher Juttukonda[4], Giulia Franco[1], Paula Trujillo-Diaz[1], Adam Stark[1], Benoit Dawant[3], Manus J. Donahue[4], and Daniel O. Claassen[1]

[1]*Neurology, Vanderbilt University, Nashville, TN, United States,* [2]*Meharry Medical College, Nashville, TN, United States,* [3]*Biomedical Engineering, Vanderbilt University, Nashville, TN, United States,* [4]*Radiology, Vanderbilt University, Nashville, TN, United States*

The dentato-rubro-thalamic tract (DRTT) is a cerebellar efferent pathway important to normal motor function and neurological disease. While the DRTT is described as a decussating (crossing) pathway, the existence of a nondecussating DRTT was recently demonstrated. We compared thalamic connectivity of decussating and nondecussating DRTT using both structural and functional MRI. Probabilistic tractography indicated that the two pathways contact distinct but partially overlapping sets of thalamic nuclei. These results were reinforced by significant correlations with functional connectivity. We conclude that the decussating and nondecussating DRTT exhibit different connectivity patterns, which suggests participation in divergent neural networks.

3279 Computer 85

A Preliminary MR g-Ratio–Based Connectome Analysis in Multiple Sclerosis

Koji Kamagata[1], Andrew Zalesky[2], Kazumasa Yokoyama[3], Akifumi Hagiwara[4], Kouhei Kamiya[4], Maria Angelique Di Biase[2], Yuki Takenaka[1,5], Christina Andica[1], Asami Saito[1], Masaaki Hori[1], Keigo Shimoji[6], Ryusuke Irie[1], Akihiko Wada[1], Nobutaka Hattori[3], and Shigeki Aoki[1]

[1]*Department of Radiology, Juntendo University Graduate School of Medicine, Tokyo, Japan,* [2]*Melbourne Neuropsychiatry Centre, Department of Psychiatry, The University of Melbourne & Melbourne Health, Parkville, Australia,* [3]*Department of Neurology, Juntendo University Graduate School of Medicine, Tokyo, Japan,* [4]*Department of Radiology, The University of Tokyo Graduate School of Medicine, Tokyo, Japan,* [5]*Department of Radiological Sciences, Graduate School of Human Health Sciences, Tokyo, Japan,* [6]*Department of Diagnostic Radiology, Tokyo Metropolitan Geriatric Hospital, Tokyo, Japan*

		Multiple sclerosis (MS) is an inflammatory demyelinating disease of the central nervous system. We propose the use of g-ratio–based connectome for evaluating the network topology of MS since it is reported to be useful in the evaluation of demyelinating lesions in MS. Here, we evaluated the structural connectome of patients with MS, as mapped by MR g-ratio based connectome. The network-based statistic identified a subnetwork of reduced connectivity in patients with MS involving the limbic area. In conclusion, MR g-ratio–based connectome analysis can potentially detect changes in brain topology in MS with high sensitivity.

3280	Computer 86	Temporal evolution of functional connectivity of the intrinsic networks in mild traumatic brain injury
		Zhuonan Wang[1], Lijun Bai[2], Qiuli Zhang[1], Guanghui Bai[3], Bo Yin[4], Xuan Niu[1], Yingxiang Sun[1], and Ming Zhang[1]
		[1]Department of Medical Imaging, First Affiliated Hospital of Xi'an Jiaotong University, XI AN, China, [2]The Key Laboratory of Biomedical Information Engineering, Ministry of Education, Department of Biomedical Engineering, School of Life Science and Technology, Xi' an Jiaotong University, XIAN, China, [3]Department of Radiology, The Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University, Wenzhou, China, [4]Neurosurgery, The Second Affiliated Hospital and Yuying Children's Hospital of Wenzhou Medical University, Wenzhou, China
		Mild traumatic brain injury (mTBI) often leads to disconnection of the brain intrinsic networks. Our study was to investigate how SN interacts with CEN/DMN can be viewed from the observation of how network connectivity damage affects other networks as a function of time, as well as its impact on cognition and emotion. The results suggests that intrinsic brain networks in mTBI patients showed continued damage from acute to sub-acute phase after injury. Function connectivity of SN interacts with CEN/DMN are especially susceptible in mTBI patients and the damage for inter-network functional disconnection will lead to high level cognitive dysfunction.

3281	Computer 87	A preliminary report: Confirmation of the relationship of episodic memory performance and frontoparietal functional connectivity in Multiple Sclerosis
		Katherine A Koenig[1], Jian Lin[1], Daniel Ontaneda[2], Kedar Mahajan[2], Stephen M Rao[3], Sanghoon Kim[1], Stephen Jones[1], and Mark J Lowe[1]
		[1]Imaging Sciences, The Cleveland Clinic, Cleveland, OH, United States, [2]Neurological Institute, The Cleveland Clinic, Cleveland, OH, United States, [3]Schey Center for Cognitive Neuroimaging, The Cleveland Clinic, Cleveland, OH, United States
		This work assesses the relationship of resting state fMRI (rs-fMRI) of the dorsal lateral prefrontal cortex to episodic memory in patients with multiple sclerosis (MS). We find that rs-fMRI in the frontoparietal network is related to performance on a verbal episodic memory measure. This finding confirms previous reports and suggests this measure is appropriate to investigate as a potential predictive marker of cognitive decline.

3282	Computer 88	Diffusion MR Imaging of Structural Connectivity and Therapeutic Potential of Deep Brain Stimulation in Alzheimer's Disease Model Ching-Wen Chang[1], Yi-Chao Lee[2], Ssu-Ju Li[1], Ting-Chun Lin[1], Yin-Chieh Liu[1], You-Yin Chen[1], and Yu-Chun Lo[2] *[1]Biomedical Engineering, National Yang Ming University, Taipei, Taiwan, [2]The Ph.D. Program for Neural Regenerative Medicine, Taipei Medical Univeristy, Taipei, Taiwan* Alzheimer's disease (AD) is one of the major causes of death that currently cannot be reversed or slowed. Fornix, a major output tract of the hippocampus, has been shown to be a promising target for DBS therapy in AD patients. In this study, triple-transgenic Alzheimer's mice were used to investigate the changes of white matter integrity and the cognitive functions after the DBS-fornix therapy. We found improvement of the cognition and increased white matter integrity after that DBS-fornix therapy in AD mice. It suggested that the DBS-fornix therapy may be a potential therapeutic intervention of AD.

3283	Computer 89	Modulation of cortico-subcortical functional connectivity occurs after symptomatic treatment of fatigue in patients with multiple sclerosis Paola Valsasina[1], Bruno Colombo[2], Paolo Preziosa[1,2], Vittorio Martinelli[2], Andrea Falini[3], Giancarlo Comi[2], Massimo Filippi[1,2], and Maria A. Rocca[1,2] *[1]Neuroimaging Research Unit, INSPE, Division of Neuroscience, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy, [2]Department of Neurology, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy, [3]Department of Neuroradiology, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy* In this study, 45 fatigued patients with multiple sclerosis (MS) were randomly assigned to undergo treatment with fampridine, amantadine or placebo and underwent clinical, neuropsychological and 3T resting state (RS) functional MRI at baseline and after four weeks of treatment. We found that treatment with fampridine (and, to a lesser extent, with amantadine) ameliorates fatigue in MS. Concomitant increase of RS functional connectivity (FC) in inferior frontal and parietal cortical regions, and decrease of abnormally high intra-thalamic FC were detected, suggesting an improved regulation of cortico-subcortical functional circuits.

3284	Computer 90	Relevance of functional connectivity abnormalities to cognitive impairment in neuromyelitis optica spectrum disoders Paola Valsasina[1], Maria A. Rocca[1,2], Filippo Savoldi[1], Gianna Carla Riccitelli[1], Marta Radaelli[2], Paolo Preziosa[1,2], Giancarlo Comi[2], Andrea Falini[3], and Massimo Filippi[1,2]

		[1]*Neuroimaging Research Unit, INSPE, Division of Neuroscience, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy,* [2]*Department of Neurology, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy,* [3]*Department of Neuroradiology, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy*
		In this study, we explored resting state (RS) functional connectivity (FC) abnormalities of the main cognitive networks of patients with neuromyelitis optica spectrum disorders (NMOSD) and their correlation with cognitive impairment (CI). We found increased RS FC in the default mode, salience and working memory networks in cognitively preserved NMOSD, and decreased RS FC in the default mode and working memory networks in CI NMOSD. Increased RS FC seems to contribute to a better cognitive performance, probably reflecting an adaptive mechanism. Conversely, reduced RS FC is likely to be a maladaptive mechanism associated with impaired cognitive functions.

3285	Computer 91	Longitudinal Evaluation of Post-Surgical Connectivity Changes of the Default Mode Network in Operated Glioma Patients
		Domenico Zacà[1], Silvio Sarubbo[2], Monica Dalla Bona[2], Umberto Rozzanigo[3], Francesco Corsini[2], Giovanna Faraca[2], Franco Chioffi[2], and Jorge Jovicich[1]
		[1]*Center for Mind/Brain Sciences-University of Trento, Trento, Italy,* [2]*Department of Neurosciences, Division of Neurosurgery, “S. Chiara” Hospital, Trento APSS, Trento, Italy,* [3]*Department of Radiology, “S. Chiara” Hospital, Trento APSS, Trento, Italy*
		In this study we evaluated the post-surgical changes in functional connectivity of the default mode network (DMN) in 6 operated glioma patients and assessed their relationship with pre-operative brain tumor size, a factor that pre-operatively has been negatively associated to cognitive performance. We found in all but one patient an increase in connectivity (average Z-score) of the DMN following brain tumor surgery. These changes were not associated with brain tumor volume, thus indicating that mechanisms other than reduction of mass effect may drive the post-surgical reorganization of the DMN.

3286	Computer 92	Short-term Visual Experience Increases Intrinsic Brain Connectivity Within Ventral Visual Pathway
		Bingqiang Xu[1], Hongmei Wang[1], Jiayin Tong[1], Xiaoyan Gao[1], Chenwang Jin[1], and Ming Zhang[1]
		[1]*Department of Medical Imaging, First Affiliated Hospital of Medical College, Xi’an Jiaotong University, Xi'an, China*

		Medical imaging interpretation fundamentally lies in radiologists' exceptional visual recognition skill, which enables the identification of pathological regions to render diagnosis1. Such expertise is obtained through training across review hundreds of cases2, facilitated by the plastic changes in the central visual system3. Specifically, ventral visual pathway (VTP) is responsible for visual object recognition, i.e. the fine-grained visual information processing. Visual information processing in the adult human brain is highly malleable with neural processing adapting to incoming information4. The plastic changes in the VTP in response to visual recognition tasks are well studied5. While we propose that the information embedded in the intrinsic brain activity, as revealed in the resting data, is also important6. Therefore, in the current study, we investigate how visual experience, i.e. short-term radiological training, modulates brain activity in the VTP under task-free state in the resting brain using ICA.

3287	Computer 93	Individual patient-specific quantification of the network effects of lesions and diffuse disconnections with diffusion MRI
		Christopher J Steele[1,2], Yasser Iturria-Medina[3], Pierre-Louis Bazin[1,4], Bernhard Sehm[1], and Arno Villringer[1]
		[1]Neurology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Cerebral Imaging Center, Douglas Mental Health University Institute, McGill University, Montreal, QC, Canada, [3]Montreal Neurological Institute, McGill University, Montreal, QC, Canada, [4]Spinoza Centre for Neuroimaging. Netherlands Institute for Neuroscience, Amsterdam, Netherlands
		Even with its crucial role as the backbone of communication within the brain and susceptibility to damage from diseases such as stroke and multiple sclerosis, the white-matter connectional architecture of the human brain has been largely ignored. To address this, we have developed a whole-brain model for the quantification of white-matter connectional anatomy – the Tractography-based Lesion Assessment Standard (TractLAS) – which provides a complete connectional network description of the human brain. It can be used to quantify the impact of lesions on the connectivity of the brain within individuals, providing clinically useful information for individualised care.

3288	Computer 94	Normal aging differences in static and dynamic functional connectivity between men and women studied by quantitative data-driven analysis of R-fMRI data
		Ninni Persson[1] and Tie-Qiang Li[2]
		[1]2Aging Research Center, Karolinska Institute, Stockholm, Sweden, [2]Department of Medical Radiation and Nuclear Medicine, Karolinsak University Hospital, Stockholm, Sweden

		A growing number of resting-state fMRI (R-fMRI) studies have reported a significant effect of normal aging in resting-state functional connectivity (RFC) of the default mode network (DMN). One of the more intriguing findings is that gender can interact with normal aging effect to influence the RFC changes over lifespan. This adds to our understanding of gender-related cognitive differences and gender-specific nature of aging-related brain disorders. However, the precise interaction effects between sex and age on RFC remain inconclusive. The aim of the study is to quantify the normal aging induced RFC reduction difference between man and women.

3289	Computer 95	Brain metabolic and connectivity changes associated to the progression of Alzheimer's disease in a transgenic rat model
		Emma Muñoz-Moreno[1], Rui Vasco Simoes[2], Raúl Tudela[1,3], and Guadalupe Soria[1]
		[1]Experimental 7T MRI Unit, Institut d'Investigacions Biòmediques August Pi i Sunyer (IDIBAPS), Barcelona, Spain, [2]Champalimaud Foundation, Lisbon, Portugal, [3]CIBER de Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN) Group of Biomedical Imaging of the University of Barcelona, Barcelona, Spain
		TgF344-AD is a transgenic rat model of Alzheimer's disease (AD) that shows all its pathological hallmarks in a progressive way. A cohort of transgenic rats and their control littermates were scanned at different time-points from early adulthood to aged animals, including spectroscopy and diffusion-weighted MRI. Acquisitions were processed to obtain regional structural connectivity parameters and metabolite concentrations in hippocampus and striatum. Decrease in network metrics in both regions at different ages, and increases in glutamine and decreases in glutamate, NAA, NAAt and taurine were observed in the transgenic group. Thus, multimodal MRI can improve characterization of different AD stages.

3290	Computer 96	A novel method to detect fractional anisotropy differences in short association fibers discriminated by their functional connectivity between Multiple Sclerosis patients and healthy subjects
		Cristian Montalba[1], Mariana Zurita[1,2], Tomas Labbe[1,3], Pamela Guevara[4], Claudia Carcamo[3,5], Juan Pablo Cruz[6], Carlos Sing-Long[1,7], Marcelo Andia[1,6], and Sergio Uribe[1,6]
		[1]Biomedical Imaging Center, Pontificia Universidad Católica de Chile, Santiago, Chile, [2]Electrical Engieneering, Pontificia Universidad Católica de Chile, Santiago, Chile, [3]Interdisciplinary Center of Neurosciences, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]Faculty of Engineering, Universidad de Concepción, Chile, Concepción, Chile, [5]Neurology Department, Pontificia Universidad Católica de Chile, Santiago, Chile, [6]Radiology Department, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile, [7]Institute for Biological and Medical Engineering, Schools of Engineering, Medicine and Biological Sciences, Pontificia Universidad Católica de Chile, Santiago, Chile

		We propose a novel method to evaluate fractional anisotropy (FA) differences in short association fibers (U-fibers) between patients with relapsing-remittent multiple sclerosis (RRMS) and healthy subjects by classifying each U-fiber in different groups according to their functional connectivity.

Electronic Poster

Neuroimaging at Ultra-High Fields

Exhibition Hall	Monday 9:15 - 10:15

3291	Computer 97	Age-related changes in cortical thickness and R1 values measured at 7T
		Koji Fujimoto[1], Yuta Urushibata[2], Hideto Kuribayashi[2], Tobias Kober[3,4,5], Tadashi Isa[1], and Tomohisa Okada[1]
		[1]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Siemens Healthcare K.K., Tokyo, Japan, [3]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [4]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [5]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
		Healthy volunteers at the age between 20-30 (N=22) and over 60 (N=8) were scanned using a 7T MRI and a 1ch-Tx/32ch-Rx coil with a MP2RAGE prototype sequence at 0.7mm isotropic resolution. Cerebral cortex was segmented based on the human connectome project pipelines with some modifications to obtain cortical thickness and R1 on the gray-ordinate space. Results showed that the average cortical thickness decreased from 2.58 to 2.34 (9%) between the age groups; average R1 increased from 0.542 to 0.552 (1.9%). R1 change seems to have spatial predominance, with the preference in the frontal area.

3292	Computer 98	Test-retest reproducibility of cortical thickness, B1+, and R1 in healthy young adults measured at 7T
		Koji Fujimoto[1], Yuta Urushibata[2], Hideto Kuribayashi[2], Tobias Kober[3,4,5], Tadashi Isa[1], and Tomohisa Okada[1]
		[1]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Siemens Healthcare K.K., Tokyo, Japan, [3]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [4]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [5]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

		Twenty-two healthy volunteers were scanned at 7T using MP2RAGE (R1 mapping) and Sa2RAGE (B1 mapping) sequences. Applying a modified HCP pipeline, within-subject (test-retest) reproducibility and across-subject variability of cortical thickness, B1+, and R1 were analyzed. The mean absolute difference of cortical thickness was larger at the bilateral lower temporal lobes and insula. Intra-subject variation of B1+ was larger in the lower temporal lobe, whereas across-subject variation of B1+ seems to come from reference transmitter amplitude settings. Except for the lower temporal lobes, variation in the cerebral cortex R1 was very small for both intra-subject measurement (1.5%) and across-subject measurement (3%).

3293	Computer 99	In-Vivo Evaluation of MR Fingerprinting at 7T
		Thai Akasaka[1,2], Koji Fujimoto[3], Martijn A. Cloos[4], and Tomohisa Okada[3]
		[1]Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Osaka Red Cross Hospital, Osaka, Japan, [3]Human Brain Research Center, Kyoto Univerisity Graduate School of Medicine, Kyoto, Japan, [4]Department of Radiology, New York School of Medicine, Center for Advanced Imaging Innovation and Research (CAI2R) and Bernard and Irene Schwartz Center for Biomedical Imaging, New York, NY, United States
		At 7T RF wavelength effects create a highly heterogeneous B1+ field, which can lead to contrast artifacts and signal dropouts. Instead of attempting to mitigate the B1+ inhomogeneity, the Plug-and-Play MRF (PnP-MRF) method simultaneously encodes the B1+ produced by multiple transmit channels alongside desired tissue properties (PD,T1,T2) to extract B1+ bias free multi-parametric maps. Although this method was designed for use with multiple transmit-channels, a single transmit channel may suffice if B1+ voids can be avoided. In this work, we evaluate the performance of PnP-MRF for brain imaging at 7T in a single transmit configuration.

3294	Computer 100	Echo time dependence in temporal frequency shift curves at 3T and 7T
		Surabhi Sood[1], David C Reutens[1], Shrinath Kadmangudi[1], Markus Barth[1], and Viktor Vegh[1]
		[1]Centre for Advanced Imaging, Brisbane, Australia
		Quantitative susceptibility mapping is an MRI tool for mapping anatomical variations. The region specific echo time dependence of frequency shift curves computed from gradient recalled echo MRI data are likely due to variations in tissue microstructure, arrangement and packing. However, the effect of field strength on frequency shift curves has not been established to date. We investigated how frequency shift curves vary with field strength (3T versus 7T) and assessed how changes in the quantitative susceptibility mapping pipeline change the result. 7T data leads to less variability in frequency shift curves and, non-linear trends are present irrespective of methodological differences.

3295	Computer 101	Quantification of venous structures in the hippocampus using segment co-registered 7T susceptibility and structural images: First application to focal temporal lobe epilepsy Rebecca Emily Feldman[1], Alexandru L Rus[2], Lara V Marcuse[3], John W Rutland[1], Madeline C Fields[4], Bradley N Delman[5], and Priti Balchandani[5] *[1]Radiology, Translational and Molecular Imaging Institute, New York, NY, United States, [2]Icahn School of Medicine at Mount Sinai, New York, NY, United States, [3]Neurology, Mount Sinai Hospital, New York, NY, United States, [4]Mount Sinai Hospital, New York, NY, United States, [5]Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States* Susceptibility-weighted imaging offers superior contrast between veins and surrounding tissue. Our technique to isolate and quantify vein-like objects on SWI, combined with hippocampal segmentation of T1-weighted images, permits characterization of vascular density in focal temporal lobe epilepsy. We found difference in vascular density of both epilepsy patients (16%) and controls (30%), with diminished density on the left in both groups.

3296	Computer 102	Imaging the perivascular spaces and lenticulostriate arteries at 3T and 7T to provide insight into the pathophysiology of neurodegenerative and neurovascular diseases Giuseppe Barisano[1], Samantha J. Ma[2], Danny JJ. Wang[2], Yonggang Shi[2], Arthur Toga[2], and Meng Law[1,2] *[1]Radiology, University of Southern California, Los Angeles, CA, United States, [2]Stevens Institute of Neuroimaging and Informatics, University of Southern California, Los Angeles, CA, United States* The CSF microcirculation in the brain is not well understood and the role of the perivascular spaces in the clearance of metabolic waste products (including amyloid beta and tau) is still debated. We hypothesize that the increased permeability of the BBB and the resulting passage of blood products into the perivascular spaces may be responsible for the obstruction of CSF-ISF flow. Using a novel T1-weighted 3D Turbo spin-echo with variable flip angles at 3T and 7T, we are able to demonstrate leakage of fibrin from the small lenticulostriate arteries into the perivascular spaces.

3297	Computer 103	Dissecting white-matter fiber pathways of the marmoset brain using ultra-high-resolution diffusion MRI at 7T and 14T Cirong Liu[1], John Newman[2], Cecil Chern-Chyi Yen[1], Frank Ye[3], David Leopold[3], and Afonso C. Silva[1] *[1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States, [2]The Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, United States, [3]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States*

		The common marmoset has received growing interests in neuroscience. The lissencephalic brain of the marmoset grants it experimental advantages for brain mapping and stimulation, but also brings challenges for dissecting white matter tracts, which is poorly depicted in existing marmoset brain atlases. Here, we collected ultra-high-resolution diffusion MRI datasets at 7T and 14T and performed probabilistic tractography and manual segmentation. The marmoset brain demonstrates a complex multi-layer white matter structure with many regions consist of multiple different fiber pathways. With the ultra-high-resolution data, we will provide the first comprehensive map (atlas) for the white matter of the marmoset brain.

3298	Computer 104	Age-related neurochemical changes in normal human brain: a proton MR spectroscopy study at 7T
		Toru Ishii[1], Koji Fujimoto[1], Hideto Kuribayashi[2], Yuta Urushibata[2], Nouha Salibi[3], Ravi Teja Seethamraju[3], Sinyeob Ahn[3], Tadashi Isa[1], and Tomohisa Okada[1]
		[1]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Siemens Healthcare K.K., Japan, Tokyo, Japan, [3]Siemens Healthcare, Charlestown, MA, United States
		The purpose of this study was to quantify changes of neurochemical concentrations in human brain associated with normal aging with greater sensitivity and accuracy using ultra-high field 7T-MRI. 1H magnetic resonance spectra in the posterior cingulate cortex of 54 healthy adults were measured using a stimulated echo acquisition mode (STEAM) sequence with short echo time, and analysed with LCModel. In addition to the expected result of NAA decrease with aging, both Glutamate and GABA showed significant negative correlations with age. The results may provide significant insights in understanding alterations of human brain accompanying the normal aging.

3299	Computer 105	Validation of a Radiological Definition for Central Vessel Sign using 7T FLAIR and SWI
		Zahra Hosseini[1,2], Jacob Matusinec[3], David Rudko[4], Junmin Liu[1], Benjamin YinMing Kwan[5], Fateme Salehi[5], Manas Sharma[5], Marcelo Kremenchutzky[6], Ravi Menon[1], and Maria Drangova[1,2]
		[1]Robarts Research Institute, Western University, London, ON, Canada, [2]Graduate Program in Biomedical Engineering, Western University, London, ON, Canada, [3]Medicine, Western University, London, ON, Canada, [4]Department of Neurology/Neurosurgery, McGill University, Montreal, QC, Canada, [5]Radiology and Clinical Neurological Sciences, Western University, London, ON, Canada, [6]Department of Clinical Neurological Sciences, Western University, London, ON, Canada

		A number of recent clinical radiology studies support the central vessel sign (CVS) as a sensitive and specific means of differentiating MS white matter lesions (WML) from non-MS WML. However, these studies have employed varying practices for imaging veins and WMLs. This has led to an inconsistent radiological definition of CVS. Recently, the North American Imaging in Multiple Sclerosis publisheda set of guidelines, which provide grounds for derivation of a more robust radiological definition of CVS. Here we employ these guidelines, together with FLAIR and SWI at high field to arrive at a sensitive and specific radiological definition of CVS.

3300	Computer 106	Cortical T2* and QSM maps at 7T: test-retest reproducibility, similarity and differences.
		Tomohisa Okada[1], Koji Fujimoto[1], Yuta Urushibata[2], Hideto Kuribayashi[2], Tobias Kober[3,4,5], and Tadashi Isa[1]
		[1]Human Brain Research Center, Kyoto University, Kyoto, Japan, [2]Siemens Healthcare K.K., Tokyo, Japan, [3]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Swaziland, [4]Department of Radiology, University Hospital (CHUV), Lausanne, Swaziland, [5]LTS5, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
		R2* and QSM measurement of the cortex is important to investigate human brain pathology. The 7T-MRI has a large potential to provide high-resolution information; however, measurement reliability has not been much investigated. This study investigated test-retest measurement reliability of cortical R2* and QSM values in 16 healthy subjects. High-resolution 3D multi-echo GRE imaging values were mapped onto the cortical surface extracted using 3D MP2RAGE images. Average maps show similar results for both R2* and QSM with larger variance at the frontotemporal base. Except these areas, measurement of cortical R2* and QSM values were found to be reliable at 7T.

3301	Computer 107	Localizing nociresponsive region within area 3a in human cortex using fMRI at 7T
		Rosa M Sanchez Panchuelo[1], Sally Eldeghaidy[1], Francis McGlone[2], Oleg Favorov[3], and Susan Francis[1]
		[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Liverpool John Moores University, Liverpool, United Kingdom, [3]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States
		A component of Brodmann area 3a has been shown to be highly responsive to thermonoxious skin stimulation in monkey studies. Here, we use BOLD fMRI at 7T to map on a fine scale the functional representation of a noxious heat stimulus in human primary somatosensory cortex (S1), and compare this to the hand representation identified from vibrotactile stimulation. Thermonoxious stimulation of both the palm and digits evoked a spatially distinct activation within S1, which extends beyond and partially overlaps with the anterior area responding to vibrotactile activation, consistent with the location of nociresponsive area 3a in monkeys.

3302	Computer 108	Spinal Cord Gray Matter Myeloarchitecture Revealed by 7T Magnetization Transfer Imaging
		Alan C Seifert[1,2,3], Joo-won Kim[1,2,3], and Junqian Xu[1,2,3,4]
		[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [3]Graduate School of Biomedical Sciences, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [4]Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY, United States
		The human spinal cord gray matter contains multiple nuclei and laminae, which are not usually distinguishable in MRI at conventional field strengths. The higher signal-to-noise ratio achievable at 7T provides the increased spatial resolution necessary to resolve these very small gray matter features. Using a wrap-around brainstem/cervical spinal cord RF coil at 7T and a magnetization transfer-prepared multi-echo gradient echo pulse sequence, we resolved three differentially myelinated dorsal horn gray matter structures: the dorsolateral fasciculus, substantia gelatinosa, and nucleus proprius in a single subject at 150-μm in-plane resolution.

3303	Computer 109	Probing Activated Regions in Rat’s Olfactory System by Odor Stimulations through Manganese Enhanced MRI (MEMRI) at 7T
		Bin Zhang[1], Qunchen Yuan[1], Zhen Qin[1], Liujing Zhuang[1], Ping Wang[1,2], and Xiaotong Zhang[1,2]
		[1]Key Laboratory for Biomedical Engineering of Ministry of Education, College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [2]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou, China
		In vivo bioelectronic nose utilizes mammalian olfactory system as a means of odor detection and discrimination. However, electrode localization during implantation relies on the researcher’s experiences, resulting in an unreliable success rate. The goal of this research is to determine the optimal electrode implantation positions for electrophysiological recordings by using the technique of manganese enhanced MRI (MEMRI) at 7T. A small dose of manganese ion was delivered into the rat’s right naris and an odor was delivered to its nose during MRI scanning. With the MRI data, the region activated by the specific odor can be identified in the OB.

3304	Computer 110	Concurrent changes in cerebral temperature, lactate and vasomotion in urethane anesthetized rats. Proton magnetic resonance study at 7T.
		Devashish Das[1,2], Aneurin James Kennerley[1], Ben Babourina Brooks[3], Samuel Harris[1], Luke Boorman[1], Paolo DiCarlo[1], Christopher CJ Martin[1], and Jason Berwick[1]

[1]Psychology, Sheffield University, Sheffield, United Kingdom, [2]Biological Sciences, Sheffield University, Sheffield, United Kingdom, [3]School of Cancer Sciences, University of Birmingham, Birmingham, United Kingdom

Cerebral vasomotion is frequently observed phenomenon that accompanies hypotension (mean arterial blood pressure (MABP) 45-65mmHg) in anesthetised rat models(1,2). Although unclear, this mechanism appears to play, in part, a compensatory role in replenishing oxygen reserves in the anaerobic/hypoxic brain. Although the relationship between temperature and metabolism is always interactive. Brain cell metabolism is a major determinant of brain temperature, minor changes in brain temperature can result in significant changes in neural cell metabolism and therefore in brain function. During hypotension (MABP 45-65mmHg) analysis of acquired 1H-spectra revealed thalamic temperature to be ~1.5-2 °C colder than that of the core body temperature (37±0.5)°C. Further analysis of the 1H-spectra revealed dynamic pool of the lactate in the thalamus during hypotension (MABP 45-65mmHg).

3305 Computer 111

Ultrafast 7T EEG-fMRI for epilepsy using 3D paradigm-free models

Stephen Jones[1], Balu Krishnan[2], Anna Crawford[1], Wanyong Shin[1], Sehong Oh[1], Imad Najm[2], César Caballero-Gaudes[3], and Mark Lowe[1]

[1]Imaging Institute, Cleveland Clinic Foundation, Cleveland, OH, United States, [2]Neurologic Institute, Cleveland Clinic Foundation, Cleveland, OH, United States, [3]3Basque Center of Cognition, Brain and Language, San Sabastian, Spain

There is enormous benefit for non-invasive MRI techniques guiding neurosurgeons to resect tissue causing epilepsy. We extend traditional EEG-fMRI methods in 3 ways: apply 7T to increase BOLD signal; use increased temporal resolution (TR 300ms) from multiband techniques to separate primary from secondary epileptogenic zones; and use paradigm-free mapping to identify interictal spikes obtained during long scans. We test this methodology using isolated finger taps as a surrogate for epileptogenic spikes. Close correspondence between conventional event analysis and paradigm free mapping suggests epileptogenic spikes can be reliably detected if their HRF is similar to a single finger tap.

3306 Computer 112

Evaluation of Diffusion-Weighted Imaging of the Macaque Brains Using Readout-Segmented EPI at 7T

Pinyi Wang[1,2], Jialu Zhang[1,2,3], Meizhen Qian[1,4], Yi Sun[5], Dingxin Wang[3], and Xiaotong Zhang[1,2,6]

[1]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou, China, [2]College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [3]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [4]School of Medicine, Zhejiang University, Hangzhou, China, [5]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China, [6]Key Laboratory for Biomedical Engineering of Ministry of Education, Zhejiang University, Hangzhou, China

		Diffusion-weighted imaging (DWI) is an important tool for clinical diagnosis and neuroscience research. To evaluate DWI with higher spatial resolution and with reduced image distortion at higher field strengths, we conducted macaque brain imaging at 7T. Our results suggest that readout-segmented EPI (rsEPI) has reduced image distortion, high MR signal and image contrast. It is believed that the rsEPI can effectively benefit DWI for macaque brain researches at 7T.

3307	Computer 113	In vivo characterization of cerebellar microglia activation in multiple sclerosis by combined 11C-PBR28 MR-PET and 7 Tesla MRI.
		Valeria Teresa Barletta[1,2], Elena Herranz[1,2], Constantina Andrada Treaba[1,2], Russell Ouellette[1], Marco Loggia[1,2], Ambica Mehndiratta[1], Eric Klawiter[2,3], Jacob Sloane[2,4], and Caterina Mainero[1,2]
		[1]Radiology, Massachusetts General Hospital, Athinoula A. Martinos Center for Biomedical Imaging, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Neurology, Massachusetts General Hospital, Boston, MA, United States, [4]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, United States
		We assessed microglia activation in the cerebellum and its relationship to clinical parameters in 27 subjects with multiple sclerosis (MS) and 18 healthy controls by using integrated 3 Tesla magnetic resonance-positron emission tomography imaging with 11C-PBR28. The MS cohort showed increased cerebellar microglia activation in both lesioned and normal appearing cerebellum. The highest microglia activation was found in lesions, mainly concentrated in the cerebellar white matter in relapsing remitting patients, and extensively involving the cortical grey matter in progressive patients. In MS, the tracer uptake in the cerebellar white matter correlated with neurological disability and impaired cognitive performance.

3308	Computer 114	Comparison between 3D white-matter-suppressed MPRAGE and 3D SPACE FLAIR in the 7T MR imaging of tuberous sclerosis complex
		Kaibao Sun[1,2], Jianfei Cui[3], Bo Wang[1], Zhongwei Chen[1], Yan Zhuo[1,2], Rong Xue[1,2], Shuli Liang[3], and Lin Chen[1,2]
		[1]State Key Laboratory of Brain and Cognitive Science, Beijing MRI Center for Brain Research, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Chinese PLA general hospital, Beijing, China

		Tuberous sclerosis complex (TSC) is a multisystem, autosomal dominant disorder, which was characterized by tubers at the interface of gray and white matters. The 3D SPACE FLAIR sequence has previously been applied to detect the TSC lesions at 7T. The major limitations are its insensitivity to subtle lesions and long acquisition time. 3D white matter suppressed (WMS) MPRAGE was proposed in this study. T1-weighted 3D WMS MPRAGE suppressed the normal white matter signal selectively and made the lesions stand out. In comparison with 3D SPACE FLAIR, 3D WMS MPRAGE could detect more subtle tubers and details within reasonable time.

3309	Computer 115	MR spectroscopy of mouse spinal cord injury at 9.4 Tesla
		Abdullah Ali Asiri[1,2], Gary Cowin[1], Marc Ruitenberg[3], and Nyoman Kurniawan[1]
		[1]Centre for Advanced Imaging, University of Queensland, Brisbane, Australia, [2]Najran University, Najran, Saudi Arabia, [3]School of Biomedical sciences, The University of Queensland, Brisbane, Australia
		This study aims to measure metabolic changes in the acute and chronic stages of a mouse model of spinal cord injury (SCI) using MR spectroscopy. Animal groups consisted of sham, SCI, and SCI with an intravenous immunoglobulin (IVIG) treatment. This study showed that the NAA/Cho ratio can be used as a sensitive marker for chronic injury and testing the efficacy of IVIG to promote recovery.

3310	Computer 116	MRI of whole brain formalin-fixed samples at 9.4T: influence of the fixation agent and its dielectric properties on image quality
		Gisela E Hagberg[1,2], Thomas Shiozawa-Bayer[3], Christian Mirkes[2], Jörn Engelmann[2], Jonas Bause[2], Bernhard Hirt[3], and Klaus Scheffler[1,2]
		[1]Biomedical Magnetic Resonnce, University Hospital Tübingen, Tübingen, Germany, [2]High Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [3]Institute of Clinical Anatomy, University Hospital Tübingen, Tübingen, Germany
		MRI of post mortem samples in formalin is an essential tool for validation purposes and comparison with clinical histology, since fixation preserve several microstructural tissue features. We found that the dielectric properties of the fixative influences image quality attained in whole brain post mortem samples at 9.4T. The standard fixative prevented high quality MRI across the entire sample. By using a high conductivity fixative with less field focussing, a more homogeneous excitation was achieved without any drop outs and T1 mapping could be performed using rapid inversion recovery techniques.

3311	Computer 117	High-resolution neurite orientation dispersion and density imaging of mouse brain using compressed sensing at 9.4T

		Nian Wang[1], Jieying Zhang[2], Gary Cofer[1], Robert J. Anderson[1], Yi Qi[1], and G. Allan Johnson[1]
		[1]Center for In Vivo Microscopy, Department of Radiology, Duke University, Durham, NC, United States, [2]Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China
		To evaluate the potentials of compressed sensing (CS) in quantification of neurite orientation dispersion and density imaging (NODDI) index of ex vivo mouse brain at high resolution (45 μm^3 isotropic). We were able to achieve compression factors of 4X through judicious choice of k-space sampling pattern. The strong heterogeneous microstructure of corpus callosum (CC) regions were illustrated using different diffusion metrics and NODDI index.

3312	Computer 118	Comparison of high resolution ex vivo multi gradient echo sequences at 7T and 11.7T for amyloid load quantification in an Alzheimer's disease mouse model
		Matthieu Gerstenmayer[1], Francoise Geffroy[1], Sébastien Mériaux[1], and Benoit Larrat[1]
		[1]CEA Saclay, Gis sur Yvette, France
		The gold standard to quantify amyloid load in animal models of Alzheimer’s disease is histology. Despite being really reliable, this technique is destructive and still mainly 2D. Here we optimized a full 3D ex vivo protocol to image whole brain of Alzheimer’s disease mouse model. A high resolution Multi Gradient Echo sequence evidences the shortening of T_2* caused by the iron content of amyloid plaques. Plaque detection capabilities were compared between 7T and 11.7T acquisitions for similar scan duration. Unlike the 7T protocol, the 11.7T setup clearly allows amyloid plaque detection and quantification.

3313	Computer 119	Resting state, gluCEST and anatomical MRI approaches at 11.7T for brain aging studies in a non-human primate
		Clément Garin[1], Nachiket Abhay Nadkarni[1], Salma Bougacha[1,2], Jeremy Pepin[1], Julien Flament[1], Jean-Luc Picq[1,3], and Marc Dhenain[1]
		[1]Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA), Fontenay-aux-Roses, France, Fontenay aux roses, France, [2]3U1077, INSERM, Caen, France, [3]Laboratoire de psychopathologie et de neuropsychologie, University of Paris 8, Paris, France

		The gray mouse lemur (Microcebus murinus) is a small non-human primate with rapid maturity. This study focuses on the development of non-invasive MRI tools applied to neurodegenerative processes. We performed three different types of analysis: anatomical volumetric measures, neuronal network assessment with resting-state fMRI and brain glutamate distribution with gluCEST imaging. We found anatomical atrophy and functional deficiency mostly in cortical regions. To our knowledge, this study is the first to characterize the functional and anatomical brain aging process in a non-human primate. Furthermore, the mouse lemur functional and gluCEST maps have never been described before.

3314	Computer 120	Fluorine-19 Magnetic Resonance at 21.1 Tesla to Detect Brain Inflammation
		Sonia Waiczies[1], Jens T. Rosenberg[2], Christian Prinz[1], Ludger Starke[1], Jason M. Millward[1], Paula Ramos Delgado[1], Andreas Pohlmann[1], Andre Kuehne[3], Helmar Waiczies[3], and Thoralf Niendorf[1,4]
		[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [2]The National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL, United States, [3]MRI TOOLs GmbH, Berlin, Germany, [4]Experimental and Clinical Research Center (ECRC), a joint cooperation between the Charité Medical Faculty and the Max Delbrueck Center, Berlin, Germany
		Detection of brain inflammation by fluorine-19 (^{19}F) MRI was studied for the first time at 21.1 T (NHMFL, Tallahassee, FL). Studies on phantoms showed an SNR gain of 2.1 at 21.1 T, when compared to 9.4 T. A dependency between 19F-MR relaxation and magnetic field strength (B_0) was demonstrated. A T_1 reduction and higher SNR per unit time counterbalanced the T_2 shortening-induced loss in ^{19}F MR signal when performing high spatially-resolved MRI of *post mortem* experimental autoimmune encephalomyelitis (EAE) mouse samples at 21.1 T. ^{19}F-signals, not seen at 9.4 T, were revealed in both mouse brain and draining lymph nodes.

Electronic Poster

Cardiac Function & Myocardial Perfusion

Exhibition Hall	Monday 13:45 - 14:45

3315	Computer 1	Temporal changes in cardiac contractility, perfusion and infarct size after human cardiomyocyte transplantation to the infarcted heart of non-human primates.
		Anna V Naumova[1,2,3], William S Kerwin[1], Yen-Wen Liu[2,3,4,5], Billy Chen[2,3,6], Xiulan Yang[2,3,5], Hiroshi Tsuchida [2,3,5], R. Scott Thies[2,3,5], and Charles E Murry[2,3,5,6]

		[1]Radiology, University of Washington, Seattle, WA, United States, [2]Center for Cardiovascular Biology, University of Washington, Seattle, WA, United States, [3]Institute for Stem Cell and Regenerative Medicine, University of Washington, Seattle, WA, United States, [4]Department of Internal Medicine, National Cheng Kung University, Tainan, Taiwan, [5]Pathology, University of Washington, Seattle, WA, United States, [6]Medicine/Cardiology, University of Washington, Seattle, WA, United States
		This study demonstrates structural and functional benefits of human embryonic stem cell derived cardiomyocyte engraftment to the infarcted heart of nonhuman primates. Those benefits were manifested in improved global and regional left ventricle contractile function, improved myocardial perfusion, decrease in infarct size and partial regeneration of the scarred myocardium. The benefit from human cardiomyocyte therapy was durable with the potential for further improvement in function between 1 and 3 months. The functional recovery was larger than were observed previously on small animal models of myocardial infarction, which might be due to the greater physiological match between human and macaque species.

3316	Computer 2	Feasibility of Multi-Thin-Slab Whole-Heart 3D Cine with Isotropic Resolution and High Contrast in Free Breathing
		Peng Lai[1], Haonan Wang[2], Anja C.S Brau[1], and Martin A Janich[3]
		[1]Global MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [2]Global MR Applications and Workflow, GE Healthcare, Waukesha, WI, United States, [3]Global MR Applications and Workflow, GE Healthcare, Munich, Germany
		Conventional 2D cine is hindered by its needs of repeated breathhold and imaging at each individual view, while breathheld 3D cine suffers from limited slice coverage and resolution. This work developed a new 3D cine sequence with free-breathing capability for whole-heart coverage and isotropic resolution and multi-thin-slab acquisition for high blood-to-myocardium contrast.

3317	Computer 3	Evaluation of geometric models for estimating left ventricular (LV) mass in 980 children using cardiac cine magnetic resonance imaging
		Jiming Zhang[1], Carlo Uribe[2], Benjamin Cheong[1,2], Paolo Angelini[2], and Raja Muthupillai[1]
		[1]Diagnostic and Interventional Radiology, Baylor St Luke's Medical Center, Houston, TX, United States, [2]Texas heart institute, Houston, TX, United States
		LV mass computed from commonly used bi-plane and tri-plane ellipsoidal models can deviate significantly when compared to LV mass estimated from a stack of short axis balanced SSFP cine MR images. The results from the study show that by using different geometric assumptions for the shape of the endocardium (Cut-cone+cone) and epicardium (Cut-cone+parabola), it is possible to estimate LV mass with just two projections that is comparable to that obtained from a full stack of short axis slices.

3318	Computer 4	Tissue Phase Mapping for Assessment of Biventricular Myocardial Motion in Pediatric Patients with Repaired Tetralogy of Fallot Alexander Ruh[1], Arleen Li[2], Michael J Rose[3], Haben Berhane[3], Joshua D Robinson[1,4,5], Michael Markl[1,6], and Cynthia K Rigsby[1,3,5] *[1]Department of Radiology, Feinberg School of Medicine, Northwestern University, Chicago, IL, United States, [2]Feinberg School of Medicine, Northwestern University, Chicago, IL, United States, [3]Department of Medical Imaging, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [4]Department of Pediatrics, Division of Pediatric Cardiology, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [5]Department of Pediatrics, Feinberg School of Medicine, Northwestern University, Chicago, IL, United States, [6]Department of Biomedical Engineering, McCormick School of Engineering, Northwestern University, Chicago, IL, United States* The purpose of this study was to assess regional biventricular myocardial function in pediatric patients with repaired tetralogy of Fallot (TOF) by tissue phase mapping (TPM). Segmental left (LV) and right ventricular (RV) peak velocities were calculated in systole and diastole based on an extended AHA 16+10-segment model. Inter-ventricular dyssynchrony was quantified from the correlation between global LV and RV radial, long-axis and circumferential velocity time courses. Compared to age-matched healthy controls, TOF patients exhibited reduced long-axis peak velocities in systole and diastole as well as increased inter-ventricular dyssynchrony for radial and circumferential myocardial motion.

3319	Computer 5	Volumetric Measurements with Real-Time Imaging for Cardiac Stress MRI Shams Rashid[1], Yang Cheng[1], William Schapiro[1], Kathleen Gliganic[1], Ann-Marie Yamashita[1], Marie Grgas[1], Michelle Maragh[1], Jie Jane Cao[1,2], and Yu Yulee Li[1,3] *[1]Cardiac Imaging, St. Francis Hospital DeMatteis Center for Research and Education, Greenvale, NY, United States, [2]Medicine, Stony Brook University (SUNY), Stony Brook, NY, United States, [3]Radiology, Stony Brook University (SUNY), Stony Brook, NY, United States* Cardiac stress MRI is a valuable diagnostic tool for heart disease. However, volumetric measurements are challenging because stress introduces rapid heartbeats and body movements. Real-time MRI is advantageous for this application due to its robustness to motion and ability for ungated imaging during free breathing. Here, we demonstrate an undersampled radial balanced steady state free precession (bSSFP) sequence to acquire real-time cine images at high spatial (1.7 mm) and temporal (40 ms) resolutions, applied in cardiac stress MRI. We show that, compared to standard breath-held bSSFP cine MRI, our technique provides more robust and reliable volumetric measurements.

3320	Computer 6	Global left ventricular myocardial deformation measures by CMR tissue tracking in isolated diastolic dysfunction (DD) spontaneous T2DM rhesus monkeys: comparison with tagging Tong Zhu[1], Li Gong[2], Yushu Chen[1], Yu Zhang[1], Wen Zeng[2], Jie Zheng[3], and Fabao Gao[1,2]

		[1]Department of Radiology, Sichuan University, Chengdu, China, [2]Sichuan Primed Biotech Group Co., LTD, Chengdu, China, [3]Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, MO, United States
		In this study, the myocardial deformation characteristics of early diabetic cardiomyopathy were evaluated by using CMR strain imaging in a spontaneous non-human primate T2DM disease model. We found the early cardiac dysfunction characteristics of diabetic cardiomyopathy, and verified the effectiveness of CMR-tissue tracking in its early diagnosis.

3321	Computer 7	Whole heart First-pass spiral perfusion imaging with 1.25mm resolution at 3T
		Yang Yang[1], Christopher M Kramer[1,2], and Michael Salerno[1,2,3]
		[1]Medicine, University of Virginia, Charlottesville, VA, United States, [2]Radiology, University of Virginia, Charlottesville, VA, United States, [3]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States
		First-pass contrast-enhanced myocardial perfusion imaging is a useful noninvasive tool to evaluate patients with coronary artery disease, but current techniques are still limited in spatial-temporal resolution, and ventricular coverage which reduces the sensitivity to detect perfusion differences between the endocardium and epicardium and quantify ischemic burden. Outer-volume suppression (OVS) can achieve good signal suppression around the heart, but may have SAR limitations at 3T. In this study, we designed a spiral pulse sequence with slice-interleaved or simultaneous multi-slice (SMS) acquisition without OVS to achieve comparable high quality ultra-high 1.25mm resolution perfusion imaging. The sequences were tested in heathy volunteers and demonstrated high image quality.

3322	Computer 8	Impact of native T1 on pixel-wise myocardial blood flow quantification
		Corina Kräuter[1,2], Ursula Reiter[1], Clemens Reiter[1], Albrecht Schmidt[3], Michael Fuchsjäger[1], Rudolf Stollberger[2], and Gert Reiter[4]
		[1]Department of Radiology, Medical University of Graz, Graz, Austria, [2]Institute of Medical Engineering, Graz University of Technology, Graz, Austria, [3]Department of Internal Medicine, Medical University of Graz, Graz, Austria, [4]Research and Development, Siemens Healthineers, Graz, Austria

		Native myocardial T1 varies between subjects and between segments, yet its impact on pixel-wise quantification of myocardial blood flow (MBF) has not been studied. 15 patients with coronary heart disease underwent 3T cardiac magnetic resonance native myocardial T1 mapping and perfusion imaging at rest. Nonlinearity correction for MBF calculation was performed employing literature native T1 values and patient-specific global as well as local native T1, respectively. Since reference T1 revealed substantial individual MBF errors and application of patient-specific global T1 overestimated MBF in perfusion deficit regions compared to local T1, patient-specific local native T1 should be employed for MBF quantification.

3323	Computer 9	Accelerated Cardiac Perfusion MRI with Radial k-space Sampling, Compressed Sensing, and KWIC filtering to Enable Qualitative and Quantitative Analyses of Perfusion.
		Nivedita K. Naresh[1], Hassan Haji-Valizadeh[2], Ali M. Serhal[1], Pascale J. Aouad[1], Daniel C. Lee[1,3], and Daniel Kim[1]
		[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Biomedical Engineering, Northwestern University, Chicago, IL, United States, [3]Cardiology, Northwestern University, Chicago, IL, United States
		First-pass cardiac perfusion MRI is widely used as an important diagnostic tool for cardiovascular disease and extensive efforts are focused on improving spatial coverage, minimizing dark rim artifacts and quantifying absolute myocardial blood flow. In this study, we used a combination of radial k-space sampling, compressed sensing, and KWIC filtering to address these issues. Compared to the conventional perfusion technique, the accelerated method improved spatial coverage, minimized dark rim artifact and enabled quantification of myocardial blood flow.

3324	Computer 10	Low-Rank plus Sparse Matrix Decomposition for Accelerated Radial MS-CAIPIRINHA in First-Pass Myocardial Perfusion Imaging
		Tobias Wech[1,2], Julius Heidenreich[1,2], Daniel Gensler[2,3], Tim Salinger[2,3], Peter Nordbeck[2,3], Daniel Stäb[4], Peter Speier[5], Thorsten Alexander Bley[1], and Herbert Köstler[1,2]
		[1]Department of Diagnostic and Interventional Radiology, University Hospital Würzburg, Würzburg, Germany, [2]Comprehensive Heart Failure Centre, University Hospital Würzburg, Würzburg, Germany, [3]Department of Internal Medicine I, University Hospital Würzburg, Würzburg, Germany, [4]The Centre for Advanced Imaging, The University of Queensland, Brisbane, Germany, [5]Magnetic Resonance, Siemens Healthcare GmbH, Erlangen, Germany
		The anatomical coverage in first-pass myocardial perfusion imaging was extended by applying undersampled radial MS-CAIPIRINHA and a model-based reconstruction exploiting low-rank plus sparse matrix decomposition. The technique was tested in a patient with acute left ventricular myocardial infarction, yielding six short-axis slices from base to apex with a temporal resolution of one heartbeat. The reconstructed images exhibited a quality which is comparable to the conventional approach of acquiring only three slices per RR interval.

3325	Computer 11	Comparison of Dual- and Tri-band Excitation for MS-CAIPIRINHA-accelerated First-Pass Myocardial Perfusion Imaging Tobias Wech[1,2], Tina Urbanek[1,3], Andreas Max Weng[1], Daniel Stäb[4], Peter Speier[5], Thorsten Alexander Bley[1], and Herbert Köstler[1,2] *[1]Department of Diagnostic and Interventional Radiology, University Hospital Würzburg, Würzburg, Germany, [2]Comprehensive Heart Failure Centre, University Hospital Würzburg, Würzburg, Germany, [3]Fakultät Ingenieurwissenschaften, Hochschule für Technik und Wirtschaft des Saarlandes, Saarbrücken, Germany, [4]The Centre for Advanced Imaging, The University of Queensland, Brisbane, Germany, [5]Magnetic Resonance, Siemens Healthcare GmbH, Erlangen, Germany* MS-CAIPIRINHA is a valuable technique to extend the anatomical coverage in myocardial first-pass perfusion imaging. In our previous studies, dual-band excitation was applied in conjunction with three SR-prepared acquisition blocks per RR interval to obtain six 2D-slices with a temporal resolution of one heartbeat. Especially in obese patients, however, the SNR occasionally turned out to be marginal, ultimately complicating the assessment of perfusion defects. In this work, an according approach using tri-band RF excitation was tested with respect to potential SNR benefits.

3326	Computer 12	Radial-CAIPI myocardial first-pass perfusion for high spatiotemporal resolution “iso-phase” multi-slice imaging at multiple cardiac phases per cycle Merlin J Fair[1,2], Peter D Gatehouse[1,2], Ricardo Wage[2], Aleksandra Radjenovic[3], and David N Firmin[1,2] *[1]NHLI, Imperial College London, London, United Kingdom, [2]CRC, Royal Brompton Hospital, London, United Kingdom, [3]BHF Glasgow CRC, University of Glasgow, Glasgow, United Kingdom* A high-resolution myocardial perfusion sequence is implemented with radial-CAIPI to allow simultaneous acquisition of the conventional three myocardial slices, all at identical cardiac phase, which can be repeated for multiple phases of the cardiac cycle and throughout the first-pass. The synchronised cardiac phases and repeat acquisitions aim to enable improved specificity, through better artifact identification.

3327	Computer 13	Dynamic contrast-enhanced and phase contrast MRI of a novel 3D printed cardiac phantom mimicking transmural myocardial perfusion gradients Xenios Milidonis[1], Muhummad Sohaib Nazir[1], Myles Capstick[2], Sita Drost[3], Gertjan Kok[4], Nikola Pelevic[4], Christian Poelma[3], Tobias Schaeffter[5], and Amedeo Chiribiri[1]

		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]ZMT Zurich MedTech AG, Zurich, Switzerland, [3]Laboratory for Aero- and Hydrodynamics, Technische Universiteit Delft, Delft, Netherlands, [4]VSL B.V., Delft, Netherlands, [5]Physikalisch-Technische Bundesanstalt, Berlin, Germany
		In recognition of the lack of a physical standard for the assessment and validation of myocardial perfusion imaging methodologies, a phantom simulating first-pass perfusion has recently been developed. This study builds on this work by introducing a novel 3D printed myocardial compartment with a radial variation in flow that mimics physiological transmural perfusion gradients. Velocity and perfusion rate estimates using phase contrast and dynamic contrast-enhanced MRI of the myocardium, respectively, were found to be repeatable. The myocardium shows potential in multi-modality evaluation and validation of perfusion pulse sequences and quantification algorithms before their introduction into routine clinical use.

3328	Computer 14	MRI-derived myocardial strain in patients with mild cognitive impairment (MCI)
		Heng Ma[1], Jun Yang[1], Haizhu Xie[1], Fang Wang[1], Xiao Xu[1], Wei Bai[1], Jing Liu[1], James C. Carr[2], and Kai Lin[2]
		[1]Radiology, Yuhuangding Hospital, Qingdao University School of Medicine, Yantai, China, [2]Radiology, Northwestern University, Chicago, IL, United States
		Our data show that patients with mild cognitive impairment (MCI) have a lower regional peak myocardial strain and peak systolic strain rate at left ventricle (LV) as compared with healthy controls. Patients with MCI seem to have a heavier burden of subclinical cardiovascular diseases (CVDs).

3329	Computer 15	Fully automated spatio-temporal segmentation approach for myocardium ischemic lesions detection and tissue classification
		Clément Daviller[1], Thomas Grenier[1], Shivraman Giri[2], Pierre Croisille[3], and Magalie Viallon[3]
		[1]Univ Lyon, INSA-Lyon, Université Claude Bernard Lyon 1, UJM-Saint Etienne, CNRS, Inserm, CREATIS UMR 5220, U1206, F-69621, Villeurbanne, France, Villeurbanne, France, [2]Siemens Medical Solutions USA, Inc. Boston, USA., Boston, MA, United States, [3]Univ Lyon, INSA-Lyon, UJM-Saint Etienne, Université Claude Bernard Lyon 1,CNRS, Inserm, CREATIS UMR 5220, U1206, F-42023, SAINT-ETIENNE, France, Saint-Etienne, France

		CMR Perfusion Imaging proved its role in patient triage, identifying visually ischemia and its capability in quantifying heart perfusion1,2, but failed to transfer this technology to clinical routine and to show how this worth information could be used to improve tissue lesions comprehension. Deconvolution techniques are sensitive to noise present on time intensity curves S(t), when observation scale decreases. Automated segmentation prior modelling would be a powerful adjunct. Indeed, prior tissue classification would optimize perfusion quantification accuracy since enabling advanced modelling leading to additional markers while reducing processing time. Such automated method is proposed here.

3330	Computer 16	Rapid Motion Compensation Reconstruction for Dynamic MRI using Pixel Tracking Temporal Total Variation Constraint
		Ye Tian[1,2], Apoorva Pedgaonkar[1], Jason Mendes[1], Mark Ibrahim[3], Brent Wilson[3], Edward DiBella[1], and Ganesh Adluru[1]
		[1]UCAIR, University of Utah, Salt Lake City, UT, United States, [2]Physics and Astronomy, University of Utah, Salt Lake City, UT, United States, [3]Cardiology, University of Utah, Salt Lake City, UT, United States
		We present a novel motion compensation reconstruction method based on spatiotemporal constrained reconstruction (STCR) by tracking the movements of every pixel in each time frame, and constrain the temporal total variation along the pixel tracks. The proposed method can handle both respiratory and cardiac motion, and has comparable reconstruction speed but offers better image quality compared with STCR.

3331	Computer 17	Myocardial microvascular dysfunction in patients with end-stage renal disease and the risk factors for the heart damage in hemodialysis
		Rong Xu[1], Yingkun Guo[1], Zhigang Yang[2], and Huayan Xu[2]
		[1]West China Second University Hospital, Chengdu, China, [2]West China Hospital, Sichuan University, Chengdu, China
		Cardiovascular disease is the major cause of death in patients with chronic kidney disease, this study prospectively enrolled 67 patients with ESRD to quantify evaluate the difference in left ventricular (LV) regional myocardial microvascular function using cardiac magnetic resonance (CMR), and to discuss the factors that may affect myocardial damage in the clinical treatment. The results confirmed that the first-pass perfusion CMR can early defect the myocardial deformation and dysfunction in ESRD patients, and the treatment time may be a risk factor for the cardiovascular disease in the patients with CKD.

3332	Computer 18	Importance of Right Atrial Strain on Right Ventricular Dilation in Pediatric and Adult Patients with Repaired Tetralogy of Fallot: Fast CMR Feature Tracking Study

		Shuang Leng[1], Liwei Hu[2], Xiaodan Zhao[1], Ju Le Tan[1,3], Wen Ruan[1], Ru San Tan[1,3], Yumin Zhong[2], and Liang Zhong[1,3]
		[1]National Heart Centre Singapore, Singapore, Singapore, [2]Shanghai Children Medical Centre, Shanghai Jiaotong University, Shanghai, China, [3]Duke-NUS Medical School Singapore, Singapore, Singapore
		Right ventricular (RV) volume overload is common in patients after initial repair of tetralogy of Fallot (rTOF) and is associated with adverse long-term outcomes. We aimed to determine the effect of right atrial (RA) strain derived from feature tracking cardiovascular magnetic resonance (CMR) on the RV volume in both pediatric and adult rTOF patients. Results revealed that RA strain and strain rates were impaired in rTOF and RA reservoir strain impairment was significantly associated with RV dilatation. Hence, unloading of the RA and augmentation of RA function may be important future therapeutic targets in rTOF.

3333	Computer 19	MR-compatible Echocardiography and Predictive Slice Tracking Towards Ultrasound-driven Cardiovascular MRI
		Lindsey Alexandra Crowe[1], Francesco Santini[2], Laura Gui[1], Pauline Guillemin[1], Orane Lorton[1], Pamina Bernou[1], Myriam Roth[1], Gibran Manasseh[1], Oliver Bieri[2], Jean-Paul Vallée[1], and Rares Salomir[1]
		[1]Division of Radiology, Geneva University Hospitals, Geneva, Switzerland, [2]Radiology, Universitätsspital Basel, Basel, Switzerland
		MR imaging of cardiac valves is challenging as out-of-plane motion limits the use of 2D cine acquisitions. Ultrasound is well accepted as the clinical tool for observing valve motion. Here we suggest a hybrid imaging technology using in-bore ultrasound for direct observation of the motion of interest and subsequent on-the-fly adaptation of the MR slice position. MR-compatibility and workflow of echocardiography in-situ was demonstrated on a volunteer. Dynamic correction of motion in MR images was quantified with a moving phantom. Future-predicting algorithms yielded a reduction of apparent motion amplitude by a factor of twenty and dramatically improved “cine” image sharpness versus uncorrected data.

3334	Computer 20	Systolic and Diastolic Strain Abnormalities are Observed in Spontaneously Diabetic Non-Human Primates with Diastolic Dysfunction and Preserved Ejection Fraction.
		Smita Sampath[1], Li Gong[2], Yushu Chen[3], Chin Han Cheng[1], Zhigang Liang[2], Stephanie Seah[1], Jie Zheng[4], Sarayu Parimal[1], Zhu Tong[3], Zhang Yu[3], Wei Chen[3], Asad Abu Bakar Ali[1], Jeffrey L Evelhoch[5], Wen Zeng[2], Chih-Liang Chin[1], and Fabao Gao[3]
		[1]Translational Biomarkers, MRL, MSD, Singapore, Singapore, [2]Sichuan Primed Shines Bio-tech Co. Ltd., Chengdu, China, [3]Department of Radiology, West China Hospital, Sichuan University, Chengdu, China, [4]Department of Radiology, Washington University School of Medicine, St Louis, MO, United States, [5]Translational Biomarkers, MRL, Merck & Co., Inc., West Point, PA, United States

		Non-human primate (NHP) models of cardiovascular disease or metabolic disorder offer a unique framework to evaluate novel therapeutics. Herein, we perform cardiac strain MRI on a 3T MRI scanner to characterize systolic and diastolic function in naïve and spontaneously diabetic NHPs with diastolic dysfunction (T2DM-DD) and preserved ejection fraction (which may represent an early phenotype of HFpEF). In addition, the naïve animals were imaged twice to perform test-retest analysis of the strain-based biomarkers. Peak strains and peak diastolic strain-rates (both circumferential and longitudinal) are significantly impaired in the T2DM-DD monkeys compared to the naïve monkeys indicating impaired systolic and passive diastolic function. In addition, peak untwist rate is also decreased depicting impairment in active diastolic function as well. The test-retest results in the naïve animals show that all biomarkers, with the exception of peak longitudinal strain, are reproducible.

3335	Computer 21	Cardiac MRI detects functional deterioration prior to apoptosis in a mouse model of doxorubicin-induced cardiotoxicity using tissue phase mapping
		Bradley D Allen[1], Nivedita K Naresh[1], Alexander Ruh[1], Sol Misener[1], Zhuoli Zhang[1], Daniele Procissi[1], and James C Carr[1]
		[1]Radiology, Northwestern University, Chicago, IL, United States
		Doxorubicin-induced cardiotoxicity is an important limiting factor preventing dose-effective cancer treatment, and the associated cardiac sequelae appears to be mediated through cardiac myocyte apoptosis. Multiple studies have suggested there is potential for cardiovascular MRI (CMR) multiparametric analysis to detect doxorubicin-induced cardiotoxicity. In the current study, we performed multiparametric CMR including DENSE strain assessment and tissue phase mapping (TPM) for myocardial velocity measurement in a mouse model of doxorubicin-induced cardiotoxicity. Our results suggest that advanced CMR functional assessment shows promise in identifying treatment-related decrease in myocardial longitudinal systolic and diastolic velocity prior to the onset of cardiac myocyte apoptosis.

3336	Computer 22	The assessment of global and regional strain in patients with preserved ejection fraction after Fontan operation using feature tracking technique as compared with healthy children
		Li-wei Hu[1], Rong-zhen Ouyang[1], and Yu-min Zhong[1]
		[1]Radiology, Shanghai Children's Medical Center, Shanghai, China

		The quantification of myocardial deformation may allow detection of early abnormalities and provide independent prognostic information, as demonstrated in echocardiographic studies.Meanwhile, some studies have suggested that CMR-FT may be evaluated earlier than ejection fraction to detect early abnormalities of the ventricular myocardium in postoperative follow-up of CHD. But, there is still limited experience with cardiac magnetic resonance feature tracking strain analysis in child patients. To the best of our knowledge, the significance of quantifying ventricular myocardial deformation in post-Fontan patients with pEF using CMR-FT has not been investigated. Therefore, the aim of this study was to evaluate the myocardial strain in children with pEF after the Fontan operation using feature tracking technique compared to healthy children.

3337	Computer 23	Hypertrophic Cardiomyopathy: The Potential Value of Tissue-Tracking Strain Analysis
		Lindsay M Griffin[1], Emily L Ferris[1], Scott K Nagle[1], and Christopher J Francois[1]
		[1]Radiology, University of Wisconsin, Madison, WI, United States
		In hypertrophic cardiomyopathy (HCM), myocardium is disorganized, causing contraction abnormalities, perhaps before wall motion abnormalities are visually apparent. Tissue-tracking, a post-processing technique using routinely-acquired cine images, can assess strain, a multidimensional measure of contraction. We assess strain in 19 HCM cases. Global circumferential strain (GCS) and radial strain (GRS) correlated well ($r > -0.85$, $p < 0.0001$) and were worse in those with late gadolinium enhancement ($p < 0.05$). GCS modestly correlated with segment thickness ($r = 0.46$, $p < 0.05$). These data suggest strain may add value as a diagnostic/prognostic tool in assessment of HCM, available without additional imaging time.

3338	Computer 24	Subtle differences in left ventricular cardiotoxicity remodeling between risk groups of cancer survivors based on strain analysis from cine-DENSE MRI
		Delphine Perie-Curnier[1], Denis Corbin[1], Frederik Epstein[2], Daniel Auger[2], Tarik Hafyane[3], and Daniel Curnier[4]
		[1]Mechanical Engineering, Polytechnique Montreal, Montreal, QC, Canada, [2]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [3]Research Center, Montreal Heart Institute, Montreal, QC, Canada, [4]Kinesiology, University of Montreal, Montreal, QC, Canada
		The aim of this study was to evaluate a reliable clinical tool to assess subtle differences in left ventricular cardiotoxicity remodeling in acute lymphoblastic leukemia survivors. Cine-DENSE MRI provided accurate evaluation of heart’s functionality of young cancer survivors in the short-axis view. Significant strain differences between groups were mostly observed in basal septal and apical septal segments while most of the other segments did not show significant differences. The next step of this study will be to include a control group of healthy volunteers.

Electronic Poster

Vascular

Exhibition Hall	Monday 13:45 - 14:45

3339	Computer 25	Three-dimensional MRA Demonstrates Eccentric Enlargement of the Non-Conjoined Cusp-Sinus in Bicuspid Aortic Valve Patients Pascale Aouad[1], Hector I Michelina[2], Ian Murphy[3], James Carr[1], Jeremy Collins[1], and Alex J Barker[1] *[1]Northwestern University, chicago, IL, United States, [2]Department of Cardiovascular Medicine, Mayo Clinic, Rochester, Rochester, MN, United States, [3]AMNCH Tallaght Hospital, Dublin, Ireland* Bicuspid aortic valve is associated with ascending aortic dilatation, including the aortic root. The etiology of this aortopathy is controversial, with contributions proposed to come from both genetic and hemodynamic origins. While the pattern of aortic dilatation has been loosely associated with cusp fusion patterns and valve function, no study has investigated if eccentric sinus dilation is present and whether it varies in relation to the BAV phenotype. Thus, this study uses b-SSFP cine imaging and gated CE-MRA or 3D IR SSFP to assess the structure of the bicuspid aortic valve and identify the presence of a dominant sinus.

3340	Computer 26	MR Venography with Ferumoxytol in Central Venous Occlusion Puja Shahrouki[1,2], John Moriarty[1,2], Biraj Bista[1,2], Sarah Khan[1,2], Stephen Kee[1], Brian DeRubertis[3], Takegawa Yoshida[1,2], Kim-Lien Nguyen[2,4], and J. Paul Finn[1,2] *[1]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Diagnostic Cardiovascular Imaging Laboratory, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Department of Cardiothoracic Surgery, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [4]Division of Cardiology, David Geffen School of Medicine at UCLA and VA Greater Los Angeles Healthcare System, Los Angeles, CA, United States* Treatment of central venous occlusion is guided largely by anatomic considerations determined by pre-procedural imaging. Current approaches to imaging such as ultrasound and conventional cross-sectional imaging of central veins face many technical challenges and may be contraindicated in patients with renal impairment. We demonstrated that ferumoxytol-enhanced MR venography (FE-MRV) is a safe and highly accurate diagnostic tool that can be used as a reliable pre-interventional vascular map.

3341	Computer 27	Whole Body Vascular MR Imaging in Five Minutes for Patients With Claustrophobia Puja Shahrouki[1,2], John Moriarty[1,2], Biraj Bista[1,2], Sarah Khan[1,2], Stephen Kee[1], Brian DeRubertis[3], Takegawa Yoshida[1,2], Kim-Lien Nguyen[2,4], and J. Paul Finn[1,2]

[1]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Diagnostic Cardiovascular Imaging Laboratory, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Department of Cardiothoracic Surgery, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [4]Division of Cardiology, David Geffen School of Medicine at UCLA and VA Greater Los Angeles Healthcare System, Los Angeles, CA, United States

Patients with claustrophobia represent a significant proportion of patients who would otherwise be suitable candidates for MR angiography. With conventional acquisition techniques, examination times for MRA typically exceed 30 minutes and claustrophobic patients are often unwilling or unable to undergo the study. We implemented a new approach to minimize time in the magnet bore for patients with claustrophobia, acquiring comprehensive vascular evaluation of the thorax, abdomen and pelvis in as little as 5 minutes.

3342 | Computer 28

Feasibility and Optimization of Ultra-Short Echo Time MRI for Improved Imaging of IVC Filters

Gesine Knobloch[1], Scott Nagle[1,2,3], Timothy Colgan[1], Tilman Schubert[1], Kevin M. Johnson[1,2], Peter Bannas[1], Nathan Artz[1], Christopher François[1], Mark Schiebler[1], James Holmes[1], and Scott Reeder[1,2,4,5,6]

[1]Department of Radiology, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [2]Department of Medical Physics, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [3]Department of Pediatrics, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [4]Department of Biomedical Engineering, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [5]Department of Medicine, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [6]Department of Emergency Medicine, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States

Monitoring of inferior vena cava (IVC) filters for complications is commonly performed using CTA. It would be desirable to evaluate IVC-filters using MRA to avoid the need for ionizing radiation and to exploit the superior soft tissue contrast of MRA. Unfortunately, conventional contrast enhanced MRA (cMRA) techniques are limited by distortion and signal voids arising from metal in the IVC-filter. In this pilot study, we evaluated the feasibility of ultra-short echo time (UTE) MRA at 3.0T in nine patients with IVC-filters. Results demonstrate feasibility of free-breathing UTE-MRA for the assessment of IVC-filters with comparable IVC-depiction compared to cMRA.

3343 | Computer 29

MR time optimization: 2-year institutional experience in clinically applied high-resolution intracranial vessel wall imaging

Laura Eisenmenger[1], Lizhen Cao[1], Chengcheng Zhu[1], Christopher Hess[1], and David Saloner[1]

[1]Department of Radiology & Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States

		High-resolution intracranial vessel wall imaging (VWI) can provide valuable information not only regarding vascular morphology but also about the presence or absence of vessel wall enhancement; however, VWI acquisition times are often long, limiting routine use in clinical practice. We sought to investigate the use of the VWI in routine clinical practice to evaluate its application within our institution as well as optimize the imaging protocol to meet clinical needs. Our study found post-contrast VWI better demonstrated the vascular pathology compared to pre-contrast VWI. We also found only one case that may have benefited from the addition of pre-contrast VWI; however, the addition of pre-contrast VWI in this case would not have changed clinical management. Our findings suggest that the routine use pre-contrast VWI may not be needed to obtain the imaging necessary for clinical diagnosis and patient management.

3344	Computer 30	MRI and Non-Contrast CT Image Fusion to Guide Vascular Intervention: Feasibility Using Ferumoxytol in Patients with Renal Failure
		Takegawa Yoshida[1,2], Puja Shahrouki[1,2], Kim-Lien Nguyen[1,3], John M. Moriarty[1,2], Stephen Kee[2], and J Paul Finn[1,2]
		[1]Diagnostic Cardiovascular Imaging Laboratory, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Department of Radiology, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Division of Cardiology, David Geffen School of Medicine at UCLA and VA Greater Los Angeles Healthcare System, Los Angeles, CA, United States
		Accurate pre-procedural vascular mapping may be crucial to guide successful intervention. Whereas MRA provides excellent definition of the perfused vascular lumen, it is insensitive to vascular calcification and may fail to image indwelling devices. CTA can address the latter limitations, but may be contraindicated in patients with renal impairment, as is the case for gadolinium based contrast agents (GBCA). Our early results suggest that, in patients with renal failure, 3D fusion of non-contrast CT and ferumoxytol-enhanced MR images leverages the complementary strengths of both modalities while avoiding both iodinated contrast agents and GBCA.

3345	Computer 31	Monitoring intraluminal thrombus (ILT) progression in abdominal aortic aneurysm (AAA) using 3D black blood MRI: a longitudinal analysis
		Chengcheng Zhu[1], Lizhen Cao[1,2], Zhaoying Wen[1,3], David Saloner[1], and Michael D Hope[1]
		[1]Radiology, University of California, San Francisco, San Francisco, CA, United States, [2]Radiology, Xuanwu Hospital, Beijing, China, [3]Radiology, Anzhen Hospital, Beijing, China

		The composition of intraluminal thrombus (ILT) is uniquely identified by MRI and has been suggested as a marker of abdominal aortic aneurysm (AAA) growth. However, the natural history of ILT progression is still unknown. This study followed 25 AAA patients over 19±9 months using repeated high resolution black-blood MRI. We found baseline ILT types did not predict AAA growth, however, AAAs with new ILT formation or fresher ILT during follow-up grew 3 times faster than AAAs without ILT change or older ILT (4.0±2.3mm/year vs. 1.3±2.5 mm/year, p=0.009). Monitoring ILT change provides new insights into the AAA risk assessment.

3346	Computer 32	Particle swarm optimization (PSO) and comparison of a water selective T2 preparation module for simultaneous robust fat suppression and tissue contrast enhancement at 3T
		Lionel Arn[1], Ruud B van Heeswijk[1], Andrew J Coristine[1], Matthias Stuber[1], and Jessica AM Bastiaansen[1]
		[1]Radiology, Lausanne University Hospital (CHUV), Lausanne, Switzerland
		Gradient echo based pulse sequences at 3T may lack the required contrast to distinguish blood from muscle. To overcome this, T_2 preparation (T2-prep) modules are used in cardiac imaging to distinguish the blood pool from the myocardium. To suppress unwanted fat signals, we exploited the additional degrees of freedom that offer the multiple radiofrequency pulses of an adiabatic T2-prep and we used particle swarm optimization (PSO) to develop a T2-prep with robust fat suppression capabilities that works in the presence of flow. Its robustness against B_1 and B_0 inhomogeneities were predicted by the Bloch simulations for a range of fatty tissue frequencies, and could be confirmed experimentally both in phantoms and in volunteers.

3347	Computer 33	Rapid, non-contrast thoracic MRA using a combination of stack-of-star k-space sampling, compressed sensing, and self-navigation of respiratory motion
		Hassan Haji-valizadeh[1], Nivedita K. Naresh[2], Jeremy D. Collins[2], Joshua D. Robinson[3,4], Pascale J. Aouad[2], Ali M. Serhal[2], James C. Carr[2], Cynthia K. Rigsby[4,5], and Daniel Kim[2]
		[1]Biomedical Engineering, Northwestern University, Evanston, IL, United States, [2]Radiology, Northwestern University, Chicago, IL, United States, [3]Division of Pediatric Cardiology, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [4]Department of Medical Imaging, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [5]Radiology, Northwestern University, Feinberg School of Medicine, Chicago, IL, United States
		We sought to highly accelerate high resolution (1.5 mm x 1.5 mm x 1.5 mm) non-contrast thoracic MRA using a combination of compressed sensing, stack-of-stars k-space sampling with variable density, and self-navigation , and we compared its performance against clinical contrast-enhanced MRA in patients with suspected aortic disease.

3348	Computer 34	Application of non-contrast-enhanced MR angiography in hepatic arteriography Xianlun Zou[1], Di Zhu[1], Hao Tang[1], Yaqi Shen[1], Zhen Li[1], and Daoyu Hu[1] *[1]Department of Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China* Accurate evaluation of hepatic arterial anatomy and variants is essential for preoperative planning of hepatic resection, transarterial chemoembolization and liver transplantation. In the present study, we try to explore the value of non-contrast-enhanced MR angiography using spatial labeling with multiple inversion pulses (SLEEK-MRA) in hepatic arteriography, and to compare the results with CT angiography (CTA). Although SLEEK-MRA was inferior to CTA in depicting small branches, it was comparable to CTA for depiction of the common hepatic artery, proper hepatic artery, left hepatic artery and right hepatic artery. As a noninvasive angiography method, SLEEK-MRA is valuable in hepatic arteriography.

3349	Computer 35	Simultaneous acquisition of motion-corrected coronary MRA and respiratory-resolved attenuation maps for whole-heart PET-MR imaging Camila Munoz[1], Radhouene Neji[2], Gastao Cruz[1], René M Botnar[1], and Claudia Prieto[1] *[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare, Frimley, United Kingdom* Motion-compensated attenuation correction is fundamental for accurate quantification in cardiac PET imaging. Here we propose a dual-echo water/fat coronary MR angiography acquisition with a motion-corrected reconstruction framework that simultaneously allows visualisation of the coronary anatomy and produces respiratory-resolved high-resolution attenuation maps. Results from healthy subjects show that the motion correction approach improves vessel contrast and sharpness compared to uncorrected water/fat images. Additionally, respiratory-resolved attenuation maps were obtained from motion fields and water/fat images with good tissue contrast. The proposed scheme can potentially be used for accurate and highly efficient whole-heart motion-corrected cardiac PET-MR imaging ensuring alignment between emission PET, attenuation maps and diagnostic MR data.

3350	Computer 36	Combined Assessment of Peripheral Artery Disease by MRI-based Vascular Calcification Visualization and Quiescent Interval Single-Shot (QISS) MRA Akos Varga-Szemes[1], Taylor M. Duguay[1], Thomas M. Todoran[2], Megha Penmetsa[1], Stephen R. Fuller[1], Carlo N. De Cecco[1], Pal Suranyi[1], Robert R. Edelman[3], Ioannis Koktzoglou[3], and U. Joseph Schoepf[1] *[1]Department of Radiology, Medical University of South Carolina, Charleston, SC, United States, [2]Department of Medicine, Medical University of South Carolina, Charleston, SC, United States, [3]NorthShore University, Evanston, IL, United States*

		The diagnostic accuracy of quiescent-interval single-shot (QISS) MRA to detect peripheral artery disease (PAD) has been shown to be similar to that of CTA. Unlike CTA, standard MR techniques are limited in the detection of vascular calcification. However, proton density-weighted, in-phase 3D stack-of-stars gradient-echo (PDIP-GRE) prototype pulse sequence has been shown to accurately depict calcifications in PAD. In our study, PDIP-GRE MRI provided comparable assessment to CTA. The MRI visualization of lower extremity vascular calcification improved readers' confidence and the diagnostic accuracy of QISS-MRA in detecting significant vascular stenoses. Quantification of vascular calcium with MRI showed good agreement with CTA.

3351	Computer 37	Improved Golden Ratio Radial Arterial Spin Labeling Angiography Reconstruction using k-t Sparsity Constraints
		Mark Chiew[1] and Thomas W Okell[1]
		[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom
		Dynamic arterial spin labeling angiography enables non-invasive visualization of arterial flow patterns, but is often time-consuming to perform. Undersampled radial trajectories help reduce acquisition time, but can result in noise-like aliasing artefacts and reduced spatial fidelity, particularly for a combined angiographic and perfusion golden ratio imaging technique, CAPRIA. An image reconstruction framework leveraging coil information and sparsity in the spatial and temporal frequency domains is presented which reduces aliasing and improves image sharpness in both 2D and 3D data. In addition, scan time reductions up to 10x are shown to be feasible whilst maintaining spatial and temporal information.

3352	Computer 38	Accelerated Non-Rigid Respiratory Motion Corrected Simultaneous Bright- and Black-Blood 3D Whole-Heart Coronary MR Angiography
		Giulia Ginami[1], Aurelien Bustin[1], Gastao Cruz[1], Radhouene Neji[1,2], René M Botnar[1], and Claudia Prieto[1]
		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Frimley, United Kingdom

		A novel 3D whole-heart sequence for simultaneous bright- and black-blood coronary angiography (named *BOOST*) was recently introduced. BOOST alternates the acquisition of two differently magnetization-prepared bright-blood volumes for coronary lumen visualization and from which respiratory motion information can be independently extracted. These datasets are subsequently combined in a PSIR-like reconstruction to obtain a complementary co-registered black-blood volume for thrombus/haemorrhage visualization. BOOST acquisitions, however, require prolonged acquisition times. Here, we accelerate BOOST acquisition by exploiting a variable density Cartesian trajectory that generates incoherent undersampling artefacts. Furthermore, non-rigid respiratory motion correction incorporated in the undersampled reconstruction is exploited for improved sharpness.

3353	Computer 39	Contrast-enhanced magnetic resonance angiography (MRA) in pre-surgical planning of deep inferior epigastric artery perforator flaps: comparison with surgical outcomes
		Sze Yiun Teo[1], Christopher Au[1], and Evan Woo[2]
		[1]Department of Diagnostic and Interventional Imaging, KK Women's and Children's Hospital, Singapore, Singapore, [2]Department of Plastic, Reconstructive and Aesthetic Surgery, KK Women's and Children's Hospital, Singapore, Singapore
		Deep inferior epigastric perforator (DIEP) flap reconstruction is an excellent choice because only the subcutaneous fat is used. DIEP flap reconstruction requires selection of a suitable perforator vessel, which can be highly variable in size and location. Pre-operative imaging can identify these vessels. Doppler sonography is the standard imaging modality, but has mixed results. CT angiography is accurate, but involves ionising radiation. MR angiography is less commonly used, but obviates any radiation exposure. This study shows that MR angiography is an accurate imaging modality to detect the size and location of suitable perforator vessels. Pre-operative knowledge of these vessels allows for optimal surgical planning, reduced area of surgical dissection and shortened dissection times.

3354	Computer 40	Pulmonary venous and coronary artery visualization from isotropic whole-heart kt-accelerated 3D cardiac CINE MRI
		Raluca Gabriela Chelu[1], Hye-Jeong Lee[2], Tara Retson[3], and Albert Hsiao[3]
		[1]Erasmus MC, Rotterdam, Netherlands, [2]Research Institute of Radiological Science, Severance Hospital, Yonsei University College of Medicine, Seoul, Republic of Korea, [3]Altman CTRI, San Diego, CA, United States

		Isotropically-acquired 3D cine cardiac MRI has potential for quantification of cardiac size and function, which has been previously studied. We observed that pulmonary veins and coronary artery origins can be seen with this technique, and sought to further evaluate diagnostic visualization of these vessels. Two observers scored the coronary artery origins and pulmonary veins using a 5-point Likert score. Pulmonary veins were more readily visualized than coronary arteries. Isotropically-acquired 3D cine cardiac MRI enables depiction of vascular anatomy, and potentially may be used for pulmonary venous mapping and depicting coronary anomalies.

3355	Computer 41	Comparison of SPGR Phase-Sensitive Inversion-Recovery and FIESTA Phase-Sensitive Inversion-Recovery MRI at 3.0T for the assessment of Late Gadolinium Enhancement in Patients with Hypertrophic Cardiomyopathy
		Huimin Yin[1], Ying Wang[1], and Lizhi Xie[2]
		[1]Radiology Department, Peking University Third Hospital, Beijing, China, [2]GE Healthcare, China, Beijing, China
		Cardiovascular magnetic resonance(CMR) imaging is now accepted as a valuable tool for the evaluation of many cardiac disease. It is particularly useful for the assessment of cardiomyopathies because it can depict different myocardial enhancement patterns on inversion-recovery(IR) late gadolinium-enhanced(LGE) images. This study would like to compare breath-holding SPGR PSIR with free-breathing FIESTA PSIR sequences and evaluate the feasibility of FIESTA for the assessment of LGE in patients with hypertrophic cardiomyopathy.

3356	Computer 42	Highly Accelerated 3D MR Angiography Using Multi-Channel Blind Deconvolution
		Peizhou Huang[1], Jingyuan Lyu[2], Hongyu Li[3], Yongsheng Chen[4,5], Saifeng Liu[4], Chaoyi Zhang[3], Ukash Nakarmi[3], E. Mark Haacke[4,5], and Leslie Ying[1,3]
		[1]Biomedical Engineering, State University of New York at Buffalo, Buffalo, NY, United States, [2]United-Imaging Healthcare America, Houston, TX, United States, [3]Electrical Engineering, State University of New York at Buffalo, Buffalo, NY, United States, [4]The MRI Institute for Biomedical Research, Detroit, MI, United States, [5]Department of Radiology, Wayne State University, Detroit, MI, United States
		In many clinical applications, the three dimensional (3D) MRA plays an important role because that the 3D MRA can provide plenty of details for more compact anatomic regions with various flow directions. However, the speed limitation of the 3D MRA reconstruction is still an unignorable problem due to the size of the dataset, especially when the dataset has multi channels. With our proposed method, the Multi-Channel Blind Deconvolution (MalBEC), the experiment demonstrate that this method can provide high quality reconstruction image with high acceleration factors using much less time.

3357	Computer 43	Comparison of Time-Resolved 3D Contrast-Enhanced MR Angiography on a Compact 3T Scanner with a Whole-Body 3T Scanner
		Eric G. Stinson[1], Joshua D. Trzasko[1], Erin M. Gray[1], Eric A. Borisch[1], Jeffrey L. Gunter[1], Norbert G. Campeau[1], Matt A. Bernstein[1], John Huston III[1], and Stephen J. Riederer[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		High spatiotemporal resolution contrast-enhanced MR angiography of the whole brain was performed on a compact 3T system with a 32 channel RF coil and compared to a spatial-resolution-matched study on a 60 cm bore whole-body 3T scanner. The quality of images from both scanners was excellent. Higher temporal resolution (4.18 s vs 5.75 s) on the compact 3T scanner was enabled by high performance gradients and increased PNS limits compared to the whole-body scanner.

3358	Computer 44	Efficacy of Gadoterate Meglumine enhanced MRA in evaluating thoracic aortic aneurysm and comparison with Gadobutrol enhanced MRA
		Kaitlin Crawford[1], Ali Serhal[2], Olivia D. Reese[2], Pascale Aouad[2], Matthew Barrett[2], Monica Korell[2], Amir Rahsepar[2], Monda Shehata[2], Ahmadreza Ghasemiesfe[2], Jeremy Collins[2], and James Carr[2,3]
		[1]University of Notre Dame, South Bend, IN, United States, [2]Northwestern University, Chicago, IL, United States, [3]Knight Family Professor of Cardiac Imaging, Chicago, IL, United States
		Contrast enhanced Magnetic resonance imaging plays an important role in the diagnosis and follow-up of patients with thoracic aortic aneurysm (TAA). Gadoterate Meglumine, which has recently become available in the US, is considered one of the safer gadolinium contrast agents with respect to tissue deposition and NSF, due its macrocyclic structure. In this study, we compare the qualitative image quality and quantitative aortic dimensions of Gadoterate Meglumine enhanced MRA and compare it to Gadobutrol enhanced MRA for evaluation of thoracic aortic disease. These preliminary results showed that Gadoterate Meglumine enhanced MRA has comparable image quality to Gadobutrol enhanced MRA and excellent correlation with respect to aortic diameter measurements.

3359	Computer 45	Truncation Artifact in Pulmonary Magnetic Resonance Angiography
		Timothy J Colgan[1,2], Scott K Nagle[1], and Scott B Reeder[1,2,3,4,5]
		[1]Radiology, University of Wisconsin - Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States, [3]Medicine, University of Wisconsin - Madison, Madison, WI, United States, [4]Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States, [5]Emergency Medicine, University of Wisconsin - Madison, Madison, WI, United States

		Pulmonary magnetic resonance angiography is a promising technique for the detection of pulmonary embolism but suffers from central vessel dropout (truncation artifact) that can mimics emboli in medium-sized vessels. Corner-cutting k-space acquisition strategies are suspected to exacerbate this artifact. Simulations and in vivo experiments were used to investigate the relationship between corner-cutting and truncation artifact. Our simulations suggest that eliminating corner-cutting reduces the symmetry and magnitude of the ringing with this artifact but we observed only minor differences in volunteers. We conclude that corner-cutting, which can be used to shorten scan times and/or improve spatial resolution, does not exacerbate the central vessel dropout artifact.

3360	Computer 46	Multiparametric MRI Reveals Blood-Flow Dependent Spatial and Temporal Variations in Murine Venous Thrombosis
		Olivia R Palmer[1], Jie Ma[2], Jose A Diaz[3], and Joan M Greve[1]
		[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Biomedical Engineering and Biostatistics, University of Michigan, Ann Arbor, MI, United States, [3]Surgery, Vascular Surgery, University of Michigan, Ann Arbor, MI, United States
		There is a critical need for a noninvasive method to determine the optimal treatment for patients with deep vein thrombosis (DVT), the 3rd most common cardiovascular disease. We have implemented multiparametric MRI to evaluate spatial and temporal changes in thrombus composition using two murine models of DVT. We show that T2- and T2*-weighted MRI detects blood-flow dependent variations in thrombus composition. Classification in fully occlusive thrombi indicated an increased inflammatory response and more rapid thrombus organization when compared to thrombi developed in the presence of blood flow. This work provides foundational methodology that could eventually inform optimal DVT treatment planning.

3361	Computer 47	Quantification heterogeneous wall displacement and circumferential strain in the thoracic and abdominal aorta by spiral cine DENSE MRI
		John Wilson[1], Xiaodong Zhong[1,2], and John Oshinski[1]
		[1]Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States, [2]Research and Development, Siemens Healthineers, Atlanta, GA, United States
		We used spiral cine DENSE (Displacement Encoding with Stimulated Echoes) MRI in the aortic wall to examine the heterogeneity of displacement and strain at three axial locations along the aorta. The major findings of this study were that spiral cine DENSE MRI is a viable technique for assessing patient-specific aortic wall kinematics in-vivo, that regional displacement and circumferential strain are heterogeneous and vary depending on aortic location, and neither mean nor maximum displacement co-localized with sections of peak circumferential strain.

Electronic Poster

Machine Learning for Image Reconstruction

Exhibition Hall	Monday 13:45 - 14:45

3362	Computer 49	A Recurrent Inference Machine for accelerated MRI reconstruction at 7T

Kai Lønning[1], Patrick Putzky[1], Max Welling[1], and Matthan W.A. Caan[2,3]

[1]Institute for Informatics, University of Amsterdam, Amsterdam, Netherlands, [2]Radiology, Academic Medical Center, Amsterdam, Netherlands, [3]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands

Accelerating high resolution brain imaging at 7T is needed to reach clinically feasible scanning times. Deep learning applies multi-layered neural networks as universal function approximators and is able to find its own compression implicitly. We propose a Recurrent Inference Machine (RIM) that is designed to be a general inverse problem solver. Its recurrent architecture can acquire great network depth, while still retaining a low number of parameters. The RIM outperforms compressed sensing in reconstructing 0.7mm brain data. On the reconstructed phase images, Quantitative Susceptibility Mapping can be performed.

3363	Computer 50	Densely Connected Iterative Network for Sparse MRI Reconstruction

Itzik Malkiel[1], Sangtae Ahn[2], Zac Slavens[3], Valentina Taviani[4], and Christopher J Hardy[2]

[1]GE Global Research, Herzliya, Israel, [2]GE Global Research, Niskayuna, NY, United States, [3]GE Healthcare, Waukesha, WI, United States, [4]GE Healthcare, Menlo Park, CA, United States

We propose a densely connected deep convolutional network for reconstruction of highly undersampled MR images. Eight-channel 2D brain data with fourfold undersampling were used as inputs, and the corresponding fully-sampled reconstructed images as references for training. The algorithm produced notably higher-quality images than state-of-the-art parallel imaging and compressed sensing methods, both in terms of reconstruction error and perceptual quality. The dense architecture was found to significantly outperform a similar network without dense connections.

3364	Computer 51	Reconstruction of synthetic T1 MPRAGE via Deep Neural Network from Multi Echo Gradient Echo images.

Kanghyun Ryu[1], Yoonho Nam[2], Na-young Shin[2], Jinhee Jang[2], Jiyong Park[1], and Dong-Hyun Kim[1]

[1]Yonsei University, Seoul, Republic of Korea, [2]Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea

		We propose to use deep learning to reconstruct synthetic T1-weighted Magnetization prepared rapid gradient echo (MPRAGE) image from multi echo gradient echo (mGRE) images. With our method, high tissue contrast can be achieved without actual MPRAGE scan, which could be utilized for post processing methods, such as tissue segmentation or volumetric quantification. We validated our method’s accuracy by comparing the result of synthetic images with the true image via segmentation and volumetry. Additionally, we tested our method on clinical images containing pathologies not seen in the training set.

3365	Computer 52	Fast and Realistic Super-Resolution in Brain Magnetic Resonance Imaging using 3D Deep Generative Adversarial Networks
		Yuhua Chen[1,2], Feng Shi[2], Yibin Xie[2], Zhengwei Zhou[2], Anthony Christodoulou[2], and Debiao Li[2]
		[1]Department of Bioengineering, UCLA, Los Angeles, CA, United States, [2]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States
		High-resolution magnetic resonance image (MRI) are favorable by clinical application thanks to its detailed anatomical information. However, high spatial resolution typically comes at the expense of longer scan time, less spatial coverage, and lower signal to noise ratio (SNR). Single Image Super-Resolution (SISR), a technique aimed to restore high-resolution (HR) details from one single low-resolution (LR) input image, has been improved dramatically by the recent invention of deep Generative Adversarial Networks(GAN). In this paper, we introduce a new neural networks structure, 3D Densely Connected Super-Resolution GAN (DSRGAN) to realistic restore HR features of structural brain MR images. Through experiments on a dataset with 1,113 subjects, we demonstrate that our network outperforms bicubic interpolation in restoring 4x resolution-reduced images.

3366	Computer 53	MR Image Generation with Deep Learning Incorporating Anatomical Prior Knowledge
		Ki Hwan Kim[1], Won-Joon Do[1], and Sung-Hong Park[1]
		[1]Department of Bio and Brain Engineering, Korea Advanced Institute of Science & Technology (KAIST), Daejeon, Republic of Korea
		We proposed a new convolutional neural network (CNN) to generate high resolution (HR) MR images from highly down-sampled MR images, incorporating HR images in another contrast. Anatomical information from another HR images and adversarial loss functions allowed the proposed model to restore details and edges clearly from the down-sampled images, proved in normal and brain tumor regions. Pre-training with a public database improved performance in real human applications. The proposed methods outperformed several CS algorithms in both pseudo-k-spaces from public data and real k-spaces from human brain data. CNNs can be a good alternative for accelerating routine MRI scanning.

3367	Computer 54	Image Reconstruction of Accelerated Dynamic MRI using Spatiotemporal Dictionaries with Global Sparsity Regularization
		Valery Vishnevskiy[1] and Sebastian Kozerke[1]
		[1]Institute for Biomedical Engineering, ETH Zurich, Zurich, Switzerland
		Adaptive spatiotemporal dictionaries offer improved reconstruction accuracy for dynamic cardiac MRI. However, most modern methods perform local encoding of image patches treating them independently. In order to increase reconstruction quality, we present a convex model that allows global control of encoding sparsity. The proposed method has a single tunable parameter and delivers 9% peak signal-to-noise ratio improvement of reconstruction compared to the state-of-the-art dictionary-based approach. Moreover, the implemented numerical scheme allowed 3-fold reconstruction time reduction.

3368	Computer 55	Parallel Imaging Reconstruction with a Conditional Generative Adversarial Network
		Pengyue Zhang[1,2], Fusheng Wang[1], and Yu Li[2,3]
		[1]Department of Computer Science, Stony Brook University, Stony Brook, NY, United States, [2]Department of Cardiac Imaging, St.Francis Hospital, Greenvale, NY, United States, [3]Department of Radiology, Stony Brook University, Stony Brook, NY, United States
		This work presents a parallel imaging reconstruction framework based on deep neural networks. A conditional generative adversarial network (conditional GAN) is used to learn how to recover anatomical image structure from undersampled data for imaging acceleration. The new approach is shown to be suitable for image reconstruction with high undersampling factors when conventional parallel imaging suffers from a g-factor increase.

3369	Computer 56	Highly-Scalable Image Reconstruction using Deep Neural Networks with Bandpass Filtering
		Joseph Yitan Cheng[1], Feiyu Chen[2], Marcus T. Alley[1], John M. Pauly[2], and Shreyas S. Vasanawala[1]
		[1]Radiology, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford, CA, United States

		To increase the flexibility and scalability of deep convolution neural networks in the context of MRI reconstruction, a framework is proposed using bandpass filtering. The introduction of bandpass filtering enables us to leverage imaging physics while ensuring that the final reconstruction is consistent with known measurements to maintain diagnostic accuracy. We demonstrate this architecture for reconstructing subsampled datasets of contrast-enhanced T1-weighted volumetric scans of the abdomen. Additionally, we demonstrate the generality of the framework through the reconstruction of wave-encoded 2D single-shot fast-spin-echo scans of the abdomen. The proposed technique performs comparably with state-of-the-art techniques while offering the ability for simple parallelization and increase computational speed.

3370	Computer 57	Compressed Sensing MRI Reconstruction using Generative Adversarial Networks with Cyclic Loss.
		Tran Minh Quan[1], Thanh Nguyen-Duc[1], and Won-Ki Jeong[1]
		[1]School of Electrical Computer Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan, Republic of Korea
		Compressed Sensing MRI (CS-MRI) has provided theoretical foundations upon which the time-consuming MRI acquisition process can be accelerated. However, it primarily relies on iterative numerical solvers which still hinders their adaptation in time-critical applications. In addition, recent advances in deep neural networks have shown their potential in computer vision and image processing, but their adaptation to MRI reconstruction is still at an early stage. Therefore, we propose a novel compressed sensing MRI reconstruction algorithm based on a deep generative adversarial neural network with cyclic data consistency constraint. The proposed method is fast and outperforms the state-of-the-art CS-MRI methods by a large margin in running times and image quality, which is demonstrated via evaluation using several open-source MRI databases.

3371	Computer 58	A Learning-based Metal Artifacts Correction Method using Dual-Polarity Readout Gradients
		Kinam Kwon[1], Jaejin Cho[1], Seohee So[1], Byungjai Kim[1], Namho Jeong[1], and HyunWook Park[1]
		[1]KAIST, Daejeon, Republic of Korea
		Metallic implants induce large field perturbations, which generate various types of artifacts according to the spatial encoding mechanisms in MRI. Especially, a frequency encoding dimension is influenced by bulk displacements with off-resonance frequencies and the pixel sizes are distorted in the frequency encoding dimension. In the abstract, a new learning-based method is proposed to map two metal-induced-artifacts images with positive and negative-polarity readout gradients into a metal-induced-artifacts-free image. Simulated data was utilized for training the network instead of real MR data that requires many resources to be collected.

3372	Computer 59	DL-POCS: Deep Learning Augmented POCS Reconstruction for Vastly Undersampled MR Data
		Fang Liu[1], Julia Velikina[1], Richard Kijowski[1], and Alexey Samsonov[1]
		[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States
		We introduced a novel reconstruction framework by combining deep learning (DL) neural network with the Projections Onto Convex Sets (POCS) algorithm, termed DL-POCS. The image restoration from undersampled images was first performed by a convolutional encoder-decoder network. Then the output from deep learning was used as initialization and extra constraints were imposed to promote the POCS reconstruction. We evaluated this approach on vastly undersampled knee MR data and found that this combined approach is superior to each of individual components alone. Our study suggests that deep learning regularized image reconstruction will have a substantial impact on data-driven accelerated MR imaging.

3373	Computer 60	Parallel Imaging and Convolutional Neural Network Combined Fast Image Reconstruction for Low Latency Accelerated 2D Real-Time Imaging
		Ziwu Zhou[1], Fei Han[1], Vahid Ghodrati[1], Yu Gao[1], Yingli Yang[2], and Peng Hu[1]
		[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Radiation Oncology, University of California, Los Angeles, Los Angeles, CA, United States
		Real-time imaging is a powerful technique to exam multiple physiological motions are the same time. Previous literature has described methods to accelerate the real-time imaging acquisition down to 20ms with the help of compressed sensing. However, reconstruction time remains relatively long, preventing its wide clinical use. Recent developments in deep learning have shown great potential in reconstructing high-quality MR images with low-latency reconstruction. In this work, we proposed a framework that combines the parallel imaging, which is a unique feature in MR imaging, with convolution neural network to reconstruct 2D real-time images with low-latency and high-quality.

3374	Computer 61	Combining MR-Physics and Machine Learning to Address Intractable Reconstruction Problems
		Berkin Bilgic[1], Stephen F Cauley[1], Itthi Chatnuntawech[2], Mary Kate Manhard[1], Fuyixue Wang[1], Melissa Haskell[1], Congyu Liao[1], Lawrence L Wald[1], and Kawin Setsompop[1]
		[1]Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]National Nanotechnology Center, Pathum Thani, Thailand

		We are combining Machine Learning (ML) with MR-physics based image reconstruction to tackle intractable problems. We address open problems that are either too stochastic to be modeled (e.g. shot-to-shot phase variations in multi-shot EPI due to physiological noise), or that admit a computationally prohibitive model (e.g. motion correction with simultaneous estimation of motion parameters and image content). Using ML to jumpstart physics-based non-convex reconstructions dramatically improve their efficiency and helps avoid local minima. In return, MR-physics reconstruction keeps ML in check, and avoids using it as a blackbox. Such synergistic combination also provides >2x reduction in RMSE over conventional reconstruction.

3375	Computer 62	MultiNet PyGRAPPA: A Novel Method for Highly Accelerated Metabolite Mapping
		Sahar Nassirpour[1,2], Paul Chang[1,2], and Anke Henning[1,3]
		[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience, Eberhard-Karls University of Tuebingen, Tuebingen, Germany, [3]Institute of Physics, Ernst-Moritz-Arndt University Greifswald, Greifswald, Germany
		In this work, a novel acceleration method (MultiNet PyGrappa) is introduced which enables high in-plane acceleration factors for non-lipid suppressed ^{1}H MRSI data. By using a variable density undersampling scheme and reconstructing the missing data points with multiple neural networks, this method enables a more robust reconstruction of highly undersampled data. High resolution metabolite maps acquired at 9.4T in the human brain using the proposed method are presented.

3376	Computer 63	Assessment of the generalization of learned image reconstruction and the potential for transfer learning
		Florian Knoll[1,2], Kerstin Hammernik[1,2,3], Thomas Pock[3], Daniel K Sodickson[1,2], and Michael P Recht[1,2]
		[1]Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States, [3]Institute of Computer Graphics and Vision, Graz University of Technology, Graz, Austria
		The goal of this study is to assess the influence of image contrast, SNR and image content on the generalization of machine learning in MR image reconstruction. Experiments are performed with patient data from clinical knee MR exams as well as synthetic data created from a public image database. It shows that while SNR is a critical parameter, trainings can be generalized towards a range of SNR values. It also demonstrates that transfer learning can be used successfully to fine-tune trainings from synthetic data to a particular target application using only a very small number of training cases.

3377	Computer 64	Characterization of Sparsely Trained Deep Learning Reconstruction of Noisy MR Fingerprinting Data

		Ouri Cohen[1,2], Bo Zhu[1,2], and Matthew S. Rosen[1,2]
		[1]Radiology, MGH Athinoula A. Martinos Center/Harvard Medical School, Charlestown, MA, United States, [2]Physics, Harvard University, Cambridge, MA, United States
		MR Fingerprinting offers the ability to obtain simultaneous tissue (T1,T2…) and hardware (B1, B0…) parameter maps in a fast acquisition time but is limited by the size of the reconstruction dictionary. In previous work we demonstrated that these issues can be overcome by reconstructing the data using a properly trained neural network. Here we characterize the accuracy of a neural network trained on sparse dictionaries for reconstruction of noisy data.

3378	Computer 65	k-space Aware Convolutional Sparse Coding: Learning from Undersampled k-space Datasets for Reconstruction
		Frank Ong[1] and Michael Lustig[1]
		[1]University of California, Berkeley, Berkeley, CA, United States
		Learning from existing datasets has the potential to improve reconstruction quality. However, deep learning based methods typically require many clean fully-sampled datasets as ground truths. Such datasets can be hard to come by, especially in applications where rapid scans are desired. Here, we propose a method based on convolutional sparse coding that can learn a convolutional dictionary from under-sampled datasets for sparse reconstruction. Recent works have shown close connections between deep learning and convolutional sparse coding. The benefit of convolutional sparse coding is that it has a well-defined forward model, and can be easily extended to incorporate physical models during training. We extend convolutional sparse coding to incorporate the under-sampling forward model. We show that the dictionary learned from under-sampled datasets is similar to the dictionary learned from fully-sampled datasets, and improves upon wavelet transform for l1 regularized reconstruction in terms of mean-squared error.

3379	Computer 66	Constrained Image Reconstruction Using a Kernel+Sparse Model
		Yudu Li[1,2] and Zhi-Pei Liang[1,2]
		[1]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States

		Constrained image reconstruction incorporating prior information has been widely used to overcome the ill-posedness of reconstruction problems. In this work, we propose a novel "kernel+sparse" model for constrained image reconstruction. This model represents the desired image as a function of features "learned" from prior images plus a sparse component that captures localized novel features. The proposed method has been validated using multiple MR applications as example. It may prove useful for solving a range of image reconstruction problems in various MR applications where both prior information and localized novel features exist.

3380	Computer 67	Quantification of relaxation times in MR Fingerprinting using deep learning
		Zhenghan Fang[1], Yong Chen[1], Weili Lin[1], and Dinggang Shen[1]
		[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States
		MRF is a new quantitative MR imaging technique, which can provide rapid and simultaneous measurement of multiple tissue properties. Compared to the fast speed for data acquisition, the post-processing to extract tissue properties with MRF is relatively slow and often requires a large memory for the storage of both image dataset and MRF dictionary. In this study, a convolutional neural network was developed, which can provide rapid estimation of multiple tissue properties in 0.1 sec. The T1 and T2 values obtained in white matter and gray matter are also in a good agreement with the results from pattern matching.

3381	Computer 68	High efficient reconstruction of overlapping-echo detachment (OLED) planar imaging based on deep residual network
		Congbo Cai[1], Chao Wang[2], Xinghao Ding[2], Shuhui Cai[2], Zhong Chen[2], and Jianhui Zhong[3]
		[1]Xiamen University, Xiamen, China, [2]Xiamen University, xiamen, China, [3]University of Rochester, Rochester, NY, United States
		Overlapping-echo detachment (OLED) planar imaging sequence can provide reliable T2 mapping within milliseconds even under continuous object motion. A detachment algorithm based on the sparsity and structure similarity constraints has been used to separate the echo signals to form T2 map. However, the effectiveness of separation is limited and the reconstruction is time consuming. Here, an end-to-end deep convolutional network based on deep residual network was introduced. The results of simulation and in vivo human brain show that it can reconstruct T2 mapping efficiently and reduce the reconstruction time from minutes to milliseconds after deep residual network is trained.

3382	Computer 69	Optimal Regularization Parameter Selection for Constrained Reconstruction Using Deep Learning
		Xi Peng[1,2], Fan Lam[1], Yudu Li[1,3], Bryan Clifford[1,3], Brad Sutton[1,4], and Zhi-Pei Liang[1,3]

		[1]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Shenzhen, China, [3]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [4]Department of Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States
		Regularization is widely used for solving ill-posed image reconstruction problems and an appropriate selection of the regularization parameter is critical in ensuring high-quality reconstructions. While many methods have been proposed to address this problem, selecting a regularization parameter for optimal performance (under a specific metric) in a computationally efficient manner is still an open problem. We propose here a novel deep learning based method for regularization parameter selection. Specifically, a convolutional neural network is designed to predict the optimal parameter from an "arbitrary" initial parameter choice. The proposed method has been evaluated using experimental data, demonstrating its capability to learn the optimal parameter for two different L_1-regularized reconstruction problems.

3383	Computer 70	A Machine Learning Approach for Mitigating Artifacts in Fetal Imaging due to an Undersampled HASTE Sequence
		Sayeri Lala[1], Borjan Gagoski[2], Jeffrey N. Stout[3], Bo Zhao[4], Berkin Bilgic[4], Ellen P. Grant[2], Polina Golland[5], and Elfar Adalsteinsson[6]
		[1]Electrical Engineering and Computer Science, MIT, Cambridge, MA, United States, [2]Boston Children's Hospital, Boston, MA, United States, [3]IMES, MIT, Harvard-MIT Health Sciences and Technology, Cambridge, MA, United States, [4]Athinoula A. Martinos Center for Biomedical Imaging at Massachusetts General Hospital, Boston, MA, United States, [5]Electrical Engineering and Computer Science, MIT CSAIL, Cambridge, MA, United States, [6]Electrical Engineering and Computer Science, Institute for Medical Engineering and Science, MIT, Cambridge, MA, United States
		This work investigates using deep learning to mitigate artifacts in fetal images resulting from accelerated acquisitions. We applied an existing deep learning framework to reconstruct undersampled HASTE images of the fetus. The deep learning architecture is a cascade of two convolutional neural networks combined with data consistency layers. Training and evaluation were performed on coil-combined and reconstructed HASTE images with retrospective undersampling. The datasets derived from imaging of ten pregnant subjects, GA 19-37 weeks, yielding 3994 HASTE slices. This approach mitigates artifacts from incoherent aliasing with residual reconstruction errors in high spatial frequency features in the phase encoding direction.

3384	Computer 71	Single Point Dixon Reconstruction of Whole-Body Scans Using a Convolutional Neural Network
		Jonathan Andersson[1], Håkan Ahlström[1,2], and Joel Kullberg[1,2]
		[1]Department of Radiology, Uppsala University, Uppsala, Sweden, [2]Antaros Medical, BioVenture Hub, Mölndal, Sweden

		Reconstructions of water and fat images are clinically useful for removing obscuring fat signal. It can also be useful in for example obesity related research, measuring for example different adipose depot volumes. Normally reconstructions would be performed using at least two echos, which requires about twice as much time as collecting a single echo. Therefore, using only a single echo would reduce the required scan time drastically. In this abstract a method for reconstruction of water and fat images from a single echo is introduced, using a convolutional neural network. We conclude from visual evaluation that the results are promising.

3385	Computer 72	Artificial Neural Network for Suppression of Metal Artifacts with Slice Encoding for Metal Artifact Correction (SEMAC) MRI
		Sunghun Seo[1], Ki Hwan Kim[1], Seung Hong Choi[2], and Sung-Hong Park[1]
		[1]Magnetic Resonance Imaging Laboratory, Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea, [2]Department of Radiology, Seoul National University Hospital, Seoul, Republic of Korea
		We present a new method of artificial neural network (ANN) to suppress metal artifacts in MR Imaging with Slice Encoding for Metal Artifact Correction (SEMAC). Seven titanium-embedded phantoms were imaged using different SEMAC factors. The acquired data with low and high SEMAC factors were separated into input and label images, respectively, for training. The trained model was tested on separate phantoms. Metal artifacts in low SEMAC factors could be further suppressed visually and quantitatively using the implemented ANN, with the performance being comparable to that of label images. The proposed method reduces scan time necessary for high-quality SEMAC imaging.

Electronic Poster

RF Pulses & Sequences

Exhibition Hall	Monday 13:45 - 14:45

3386	Computer 73	Cardiac B1+ Shimming using ZTE Transmit Phase Mapping
		Rolf F Schulte[1], Haonan Wang[2], Anja CS Brau[3], and Martin A Janich[1]
		[1]GE Healthcare, Munich, Germany, [2]GE Healthcare, Milwaukee, WI, United States, [3]GE Healthcare, Menlo Park, CA, United States

		Two different transmit B_1^+ mapping techniques were implemented and investigated for cardiac B_1^+ shimming at 3T: (1) 2D cardiac-triggered spiral-Bloch-Siegert B_1^+ mapping; (2) 3D Zero-Echo-Time (ZTE) B_1^+ phase mapping. B_1^+ homogeneity was optimised and performance assessed by evaluating the cardiac black-blood fast spin-echo sequence performance in healthy volunteers.

3387	Computer 74	Parcellated shimming for brain imaging with 3D EPI at 7T
		Christopher Mirfin[1], Simon Shah[1], Paul Glover[1], and Richard Bowtell[1]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom
		A novel acquisition strategy to improve the overall B_0 field homogeneity by utilising 2D RF selection with acceleration via parallel transmission in conjunction with parcellated sub-volume shimming is proposed. The method has been demonstrated for brain imaging using a 3D EPI sequence at 7T.

3388	Computer 75	Optimisation of parallel transmission radiofrequency pulses using neural networks
		Christopher Mirfin[1], Paul Glover[1], and Richard Bowtell[1]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom
		Developing fast accurate large-tip-angle radiofrequency pulses and gradient trajectories suitable for ‘online’ use is a challenging problem. In this work we propose a novel method for the sub-second design of RF pulses and gradient trajectories through use of a suitably trained artificial neural network which attempts to learn the required pulse and gradient spoke parameters from B_1^+ field spatial variations. A method for synthesising a large training database is also described. Our initial results highlight some of the challenges of this approach but suggest areas for future development.

3389	Computer 76	Empirical Sequence Design for Combined T2-Preparation and Outer Volume Suppression Preparation Sequence
		David Y Zeng[1], Mario O Malavé[1], Corey A Baron[1,2], Adam B Kerr[1], Phillip C Yang[3], Bob S Hu[1,4], and Dwight G Nishimura[1]
		[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Medical Biophysics, Robarts Research Institute, London, ON, Canada, [3]Cardiovascular Medicine, Stanford University, Stanford, CA, United States, [4]Cardiology, Palo Alto Medical Foundation, Palo Alto, CA, United States

		A new combined T_2-prepared, multidimensional OVS pulse sequence was designed by an empirically-driven method. We defined a T2 prepared OVS module as a tip-down pulse, refocusing sequence, and a selective tip-up pulse. Candidate pulses were proposed for each portion of the module and all possible modules were evaluated by a metric based on Bloch simulations. Multidimensional OVS was achieved by concatenation of modules. The proposed sequence had the lowest metric and was compared against an existing T_2-prepared OVS sequence for *in vivo* (n=5) coronary imaging. The proposed sequence had superior vessel sharpness, SNR, OVS, and qualitative reader scores.

3390	Computer 77	Contrast Preparation Pulses Robust to B1 and B0 Inhomogeneities: an Optimal Control Approach
		Eric Van Reeth[1], Hélène Ratiney[1], Kevin Tse Ve Koon[1], Michael Tesch[2], Denis Grenier[1], Olivier Beuf[1], Steffen J Glaser[2], and Dominique Sugny[3,4]
		[1]CREATIS, Villeurbanne, France, [2]Department of Chemistry, TUM, Munich, Germany, [3]ICB, Dijon, France, [4]TUM, Institute for Advanced Study, Munich, Germany
		This abstract proposes an optimal control strategy for the computation of contrast preparation pulses robust to B1 (+/- 35%) and B0 (+/- 400Hz) inhomogeneities. The problem formulation allows to optimize the compromise between contrast performance and preparation time. An *in vitro* short-T2 enhancing contrast experiment validates the robustness superiority of the proposed preparation compared to a block pulse-based scheme, and shows a good match with simulations.

3391	Computer 78	A Simplified Framework for Contrast Optimization in MRI
		Eric Van Reeth[1], Hélène Ratiney[1], Kevin Tse Ve Koon[1], Michael Tesch[2], Denis Grenier[1], Olivier Beuf[1], Steffen J Glaser[2], and Dominique Sugny[3,4]
		[1]CREATIS, Villeurbanne, France, [2]Department of Chemistry, TUM, Munich, Germany, [3]ICB, Dijon, France, [4]TUM, Institute for Advanced Study, Munich, Germany
		This abstract details the implementation and interest of an adapted parameterization for the computation of contrast preparation schemes in an optimal control framework. It optimally balances the effect of T1 and T2 relaxation, penalizes long preparation sequences in order to improve the compromise between contrast performance and preparation time, and significantly reduces the computation time. As an example, an *in vitro* experiment validates the contrast benefit over an inversion-recovery scheme. Finally, it offers a huge flexibility in terms of achievable contrasts, which is demonstrated *in vivo* by a white-matter enhancement experiment on a rat brain.

3392	Computer 79	Near real-time parallel-transmit pulse design

		Emre Kopanoglu[1]
		[1]School of Psychology / CUBRIC, Cardiff University, Cardiff, United Kingdom
		With many MRI scans lasting several minutes, patient motion is a common problem, especially with uncooperative subjects such as paediatric patients or patients with dementia or Parkinson's. Realizing the finer-resolution that higher field strengths offer through the availability of increased SNR necessitates even longer scans, exacerbating this problem. While prospective motion correction techniques can compensate for motion at lower field strengths, such techniques are not directly applicable at higher field strengths, when more complicated parallel-transmit pulses are used. This study proposes a pulse design technique that can design multi-spoke and simultaneous multi-slice parallel-transmit pulses in less than one second, while adhering to peak-voltage limits, local and global SAR.

3393	Computer 80	16-channel pTx body MRI for reduced field of view lumbar spine and kidney imaging at 7 Tesla
		Sascha Brunheim[1,2], Stephan Orzada[1], Sören Johst[1], Marcel Gratz[1,2], Jessica Kohl[3], Mark E Ladd[1,4], and Harald H Quick[1,2]
		[1]Erwin L. Hahn Institute for MRI, University of Duisburg-Essen, Essen, Germany, [2]High Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany, [3]University of Applied Science Ruhr West, Mülheim an der Ruhr, Germany, [4]Division of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany
		In this work we present in-vivo pTx excitation results in the low flip angle regime with a 16-channel transceiver body array at 7 Tesla. The pTx pulse calculation was based on a jointly fast acquired B0 and single-channel B1+ dataset (B01TIAMO) of the central abdomen. The pTx pulse enabled us to acquire high-resolution reduced field of view images of the distal spinal cord and the unilateral left kidney. The results of the established workflow for abdominal pTx provide promising perspectives, especially for neuroradiological spine imaging.

3394	Computer 81	pTx-PINS pulses for simultaneous multislice excitation using 32 ch Tx array and insertable head gradient
		Mihir Pendse[1], Riccardo Stara[1], Joshua deBever[1], and Brian K Rutt[1]
		[1]Stanford University, Stanford, CA, United States

		We describe a method for combining the PINS method for SMS excitation with pTx to design pulses that achieve both good B1+ uniformity (15% inhomogeneity over whole volume) and significant multiband factors (MB = 16) at ultra high field strengths (7T, 10.5T). This is enabled by the use of advanced hardware including a 6-row 32 channel parallel transmit array and a high performance head gradient (130 mT/m strength, 1500 T/m/s slew rate). We optimized RF shimming over the whole volume and applied the optimized shim weights at each point in the PINS trajectory. We satisfied very demanding pulse requirements (0.4 mm slice thickness, MB=16, total flip angle inhomogeneity = 15%) with a practical pulse duration (<12 ms) which is >2 times shorter compared to using conventional hardware

3395	Computer 82	Universal Parallel Transmit Pulse Design for Local Excitation
		Ole Geldschläger[1], Tingting Shao[1], and Anke Henning[1,2]
		[1]Max-Planck-Institut, Tübingen, Germany, [2]Ernst-Moritz-Arndt-Universität Greifswald, Greifswald, Germany
		This study investigates different parallel transmission (PTx) pulse design methods to find a universal PTx-pulse that excites the same local pattern with a 90 degree flip-angle across different heads. Thus, it abandons prospective the need for time-consuming subject specific B_{1+} mapping and PTx-pulse calculation, during the scan session. The best results were achieved by solving a minimax optimization problem were the maximum normalized root mean square error (NRMSE) over all subjects was minimized. The resulting pulse created magnetization profiles with a maximum NRMSE of around 0.049 across all volunteers.

3396	Computer 83	k-Space Domain Parallel Transmit Pulse Design
		William A Grissom[1]
		[1]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States
		Current parallel transmit pulse design methods are based on a spatial domain formulation that has prohibitive memory and computational requirements when the number of coils or the number of dimensions is large. We describe a k-space domain parallel transmit pulse design method that directly solves for the columns of a sparse design matrix with a much smaller memory footprint than existing methods, and is highly parallelizable. The method is validated with phantom and *in vivo* 7T 8-channel spiral excitations.

3397	Computer 84	Optimal control based design of parallel transmission RF pulses with minimum local SAR
		Armin Rund[1], Christoph Stefan Aigner[2], Lena Nohava[3], Roberta Frass-Kriegl[3], Elmar Laistler[3], Karl Kunisch[1,4], and Rudolf Stollberger[2]

		[1]Institute for Mathematics and Scientific Computing, University of Graz, Graz, Austria, [2]Institute of Medical Engineering, Graz University of Technology, Graz, Austria, [3]Division MR Physics, Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria, [4]Johann Radon Institute for Computational and Applied Mathematics (RICAM), Austrian Academy of Sciences, Linz, Austria
		An optimal control framework for designing parallel transmission RF pulses and gradient shapes is introduced. The optimal control model includes technical constraints and a local SAR model based on the Q-matrix formalism. Second-order optimization methods give RF pulses with enhanced homogeneity of the excitation pattern and/or decreased local SAR. The optimized results are tested in numerical experiments and validated with numerical electromagnetic simulations.

3398	Computer 85	Z-segmentation of a transmit array head coil improves RF ramp pulse design for TOF MRA at 7T
		Gaël Saïb[1], Raphaël Tomi-Tricot[1], Franck Mauconduit[2], Vincent Gras[1], Nicolas Boulant[1], Alexandre Vignaud[1], Edouard Chazel[1], Eric Giacomini[1], Guillaume Ferrand[3], Michel Luong[3], Denis Le Bihan[1], Laurent Le Brusquet[4], and Alexis Amadon[1]
		[1]CEA/DRF/Joliot/NeuroSpin/UNIRS, Gif-sur-Yvette, France, [2]Siemens Healthineers France, Saint-Denis, France, [3]CEA/DRF/IRFU/DACM, Gif-sur-Yvette, France, [4]Laboratoire des Signaux et Systèmes, Université Paris-Saclay/CentraleSupélec/CNRS, Gif-sur-Yvette, France
		In Time-Of-Flight sequences, ramp pulses such as TONE are frequently used to compensate for thru-slab blood saturation in cerebral MRA. At Ultra High Field, parallel transmit fast-k_z spokes can be used to greatly mitigate B_1^+ heterogeneities in the slab selection process. Here we use this technique to design TONE pulses with improved flip angle ramp fidelity and compare the performance achieved with a homemade z-segmented head coil versus a non-segmented commercial array.

3399	Computer 86	Improving arterial spin labelling at ultra-high field using parallel transmission: a simulation study
		Yan Tong[1], Peter Jezzard[1], Thomas Okell[1], and William T Clarke[1]
		[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom
		Implementing ASL at ultra-high field is challenging due to increased B_1^+ and B_0 inhomogeneity. Parallel transmission (pTx) provides additional degrees of freedom to mitigate B_1^+ inhomogeneity. Among various pTx strategies, RF shimming is a simple formulation that modulates the complex weights of each RF channel. RF shimming is particularly robust for applications involving small regions-of-interest. In this study, we explored the possibility of using RF shimming for ASL via simulation, and RF shimming is shown to achieve improved lower NRSME and improved labeling homogeneity over CP mode through simulation.

3400	Computer 87	Investigating the effect of B1 map inaccuracies on advanced pulse design Marjolein Piek[1], Nam Gyun Lee[1], Anouk Marsman[1], Vincent O Boer[1], and Esben Thade Petersen[1,2] *[1]Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark, [2]Center for Magnetic Resonance, Department of Electrical Engineering, Technical University of Denmark, Lyngby, Denmark* B1 inhomogeneities at high field lead to undesired variation of contrast over the images. With advanced RF pulse design, the effect of B1 inhomogeneities on the excitation pattern can be restored. Bloch simulations in combination with advanced pulse design were performed to study the B1 mapping robustness. The results show that there is relatively high variation between four well established B1 mapping methods. From the results it is clear that next to acquisition speed and SNR, the robustness of B1 estimation is also an important factor if the B1 mapping is to be used for advanced RF pulse design.
3401	Computer 88	2D selective excitation with UNFOLD for 4D Flow Imaging Clarissa Wink[1], Jean Pierre Bassenge[1], Giulio Ferrazzi[1], and Sebastian Schmitter[1] *[1]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany* 4D flow MRI allows to quantify the velocity vector field non-invasively in-vivo. However, it still suffers from long acquisition times and low temporal and spatial resolution. Here, we accelerate acquisition time and increase temporal resolution without loss of spatial resolution by combining 2D selective excitation and UNFOLD. 2D selective excitation allows to limit the field-of-view in phase encoding direction and thus acquisition time, whereas UNFOLD grants to increase temporal resolution.
3402	Computer 89	Extending the small tip angle approximation to the non-equilibrium initial condition Bahman Tahayori[1,2,3], Zhaolin Chen[2], Gary Egan[2], and N. Jon Shah [4] *[1]Electrical and Computer Systems Engineering, Monash University, Clayton, Australia, [2]Monash Biomedical Imaging, Monash University, Clayton, Australia, [3]Medical Physics and Biomedical Engineering Department, Shiraz University of Medical Sciences, Shiraz, Iran (Islamic Republic of), [4]Department of Neurology, JARA, RWTH Aachen University, Aachen, Germany* We have applied Volterra series expansion to the Bloch equation and have calculated the kernels for an arbitrary initial condition. We have shown that small tip angle approximation can be extended to the non-equilibrium initial condition. Simulation results illustrated the validity of the extended small tip angle approximation.

3403	Computer 90	Minimum-TR pulse design for rapid gradient echo sequences Samy Abo Seada[1], Arian Beqiri[1], Anthony Price[1], Jo Hajnal[1], and Shaihan Malik[1] *[1]School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom* Use of Multiband and high-TBW RF pulses in SSFP sequences is limited due to their long pulse duration and high RF energy. These two properties are not independent of each other, as shorter RF pulses lead to higher RF energy and often violate SAR limitations when using short repetition times (TR). We show how Time-optimal VERSE can be used to produce pulses that are optimized for minimum TR performance with both single and multi-band examples.

3404	Computer 91	Translating the Human Connectome Project to Marmoset Imaging: 16-Channel Multi-Array Coil and HCP-Style MRI Protocols and Preprocessing Yuki Hori[1], Joonas Autio[1], Masahiro Ohno[1], Yoshihiko Kawabata[2], Yuta Urushibata[3], Katsutoshi Murata[3], Masataka Yamaguchi[1], Akihiro Kawasaki[1], Chiho Takeda[1], Chihiro Yokoyama[1], Matthew F Glasser[4,5], and Takuya Hayashi[1] *[1]Center for Life Science Technologies, RIKEN, Kobe, Japan, [2]Takashima Seisakusho Co. Ltd., Hino, Kiribati, [3]Siemens Healthcare Japan, Tokyo, Japan, [4]Department of Anatomy and Neurobiology, Washington University in St. Louis, St. Louis, MO, United States, [5]St. Luke's Hospital, St. Louis, MO, United States* The common marmoset is increasingly used as a non-human primate model to understand the organization of the brain. Better cross species comparisons can be achieved by adapting methods from the Human Connectome Project. Here, we show a customized 16-channel receiver coil designed for the marmoset brain and present the initial imaging results on a 3T MRI scanner with powerful gradients. The coil had high signal-to-noise ratio and B_1 transmit homogeneity. In-vivo marmoset data, acquired and preprocessed using HCP-style methods, provided high-resolution images, allowing cortical mapping of myelin, thickness, and structural and functional connectivity, enabling high quality cross-species comparisons.

3405	Computer 92	Development of a 24-Channel 3T Multi-Array Coil for functional MRI in awake monkeys Atsushi Yoshida[1], Yoki Hori[1], Kantaro Nishigori[1,2], Masahiro Ohno[1], Yoshihiko Kawabata[3], Yuta Urushibata[4], Katsutoshi Murata[4], Masataka Yamaguchi[1], Joonas Autio[1], Matthew F Glasser[5,6], and Takuya Hayashi[1]

		[1]Center for Life Science Technologies, RIKEN, Kobe, Japan, [2]Sumitomo Dainippon Pharma Co. Ltd, Osaka, Japan, [3]Takashima Seisakusho Co. Ltd., Tokyo, Japan, [4]Siemens Healthcare Japan, Tokyo, Japan, [5]Department of Anatomy and Neurobiology, Washington University Medical School, St. Louis, MO, United States, [6]St. Luke's Hospital, St. Louis, MO, United States
		High-resolution fMRI in awake macaques may address compelling questions for how the brain is dynamically organized to create behaviors. Here, we developed a 24-channel multi-array receive coil for awake macaques and a 3T MRI scanner. High performance of the coil was confirmed by assessing noise correlation, B0/B1 field and SNR. Preliminary resting-state fMRI data, preprocessed with the Human Connectome Project pipeline, revealed a number of functional network components, some of which replicated previous findings. Our system may be useful for multi-modal cortical mapping of task-dependent and resting functional activity.

3406	Computer 93	Accelerated spin-echo fMRI using generalized SLIce Dithered Enhanced Resolution Simultaneous MultiSlice (gSlider-SMS) with 'complex-basis' RF-encoding
		SoHyun Han[1], Congyu Liao[1,2], Mary Kate Manhard[1], Berkin Bilgic[1,3], Fuyixue Wang[1,4], Anna I. Blazejewska[1,3], Maaike van den Boomen[1], William A. Grissom[5], Jonathan R. Polimeni[1,3,6], and Kawin Setsompop[1,3,6]
		[1]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Department of Biomedical Engineering, Zhejiang Uninversity, Hangzhou, Zhejiang, China, [3]Department of Radiology, Harvard Medical School, Boston, MA, United States, [4]Medical Engineering & Medical Physics, Harvard-MIT Division of Health Sciences and Technology, Cambridge, MA, United States, [5]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [6]Harvard-MIT Division of Health Sciences and Technology, Cambridge, MA, United States
		High spatiotemporal resolution spin-echo (SE) fMRI acquisition is challenging due to the longer repetition times (TR) compared to conventional gradient-echo (GE) fMRI. In this study, we developed a new method, dubbed ‘complex-basis’ gSlider, which utilizes the spatiotemporal phase-smoothness of SE-fMRI time frames to accelerate the slice coverage of SE-fMRI acquisitions. We further combined ‘complex-basis’ gSlider with conventional SMS to boost the slice-acceleration as well. The proposed method showed comparable tSNR and a two-fold increase in slice-acceleration when compared with standard SE-SMS-EPI. This method would be beneficial for applications requiring high resolution SE-fMRI with whole-brain coverage

3407	Computer 94	A Bootstrap Analysis of Diffusion MRI Parameters Derived from Simultaneous Multislice Diffusion MRI
		Adam Scott Bernstein[1,2], Loi V Do[2], Nan-kuei Chen[2], and Theodore P Trouard[2]
		[1]NICHD, National Institutes of Health, Rockville, MD, United States, [2]Biomedical Engineering, University of Arizona, Tucson, AZ, United States

		In this study, we design a unique bootstrapping method to approximate the distributions of diffusion MRI parameters derived from scans that utilize simultaneous multislice techniques compared to the distribution of parameters fit from a single slice EPI sequence. While there are no statistically significant differences between accelerated and non-accelerated datasets, there are some subtle differences that may warrant closer inspection.

3408	Computer 95	Sharing Radial GRAPPA Weight Sets Across k-Space to Decrease Memory Requirements for Real-Time Imaging
		Evan Cummings[1], Dominique Franson[1], Jesse Hamilton[1], and Nicole Seiberlich[1]
		[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States
		This study examines the feasibility of reconstructing multiple neighboring k-space points from a single non-Cartesian GRAPPA weight set. This approach reduces both the time to calibrate the GRAPPA weights and the memory needed to store the weights with minimal loss of image quality in the reconstructed images.

Electronic Poster

Image Analysis

Exhibition Hall	Monday 13:45 - 14:45

3409	Computer 97	The average sheep: multi-modal population atlases and variability maps
		Stephen John Sawiak[1], Nicholas Perentos[1], Lucy Johnson[1], and A Jennifer Morton[1]
		[1]University of Cambridge, Cambridge, United Kingdom
		We present a sheep atlas from 160 subjects from high-resolution MRI images. Aided by histology, cortical and subcortical regions were labelled for surgical planning and anatomical localisation. Templates for voxel-based morphometry were produced for SPM/DARTEL approaches. To demonstrate the use of the atlas and software, we analysed post mortem volumetric changes in repeatedly scanned brains from in vivo to 12 weeks post mortem.

3410	Computer 98	Assessing the Relation between Image Quality Metrics and Brain Volume in a Scan-Rescan Dataset

		Ricardo A. Corredor-Jerez[1,2,3], Jonas Richiardi[1,2,3], Mário João Fartaria[1,2,3], Bénédicte Maréchal[1,2,3], Adrian Tsang[4], Robert Bermel[5], Stephen E. Jones[5], Izlem Izbudak[6], Ellen M Mowry[6], Yvonne W. Lui[7], Lauren Krupp[7], Elizabeth Fisher[4], and Tobias Kober[1,2,3]
		[1]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [2]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [3]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [4]Biogen, Cambridge, MA, United States, [5]Cleveland Clinic, Cleveland, OH, United States, [6]Johns Hopkins University, Baltimore, MD, United States, [7]New York University, New York, NY, United States
		Satisfactory image quality is essential to accurately assess brain volume using automated methods for evaluating neurodegenerative diseases. Variations in image quality may cause volume estimation errors hard to distinguish from disease-induced changes. We studied the relationship between brain volume estimations and image quality metrics in a scan-rescan study. Two segmentation methods were used to quantify brain volume in FLAIR and MPRAGE images. Volume estimations on MPRAGE varied less with hardware, compared to the estimations on FLAIR. We found a significant correlation between hardware and several image quality metrics, suggesting that these can be used to render volume estimations more hardware-independent.

3411	Computer 99	Multi-atlas based Detection and Localization (MADL) of White Matter Hyperintensities: Relationship with Amyloid Accumulation and Vascular Risks
		Dan Wu[1], Kenichi Oishi[1], Anja Soldan[2], Corinne Pettigrew[2], Chenfei Ye[1], Michael I Miller[3], Marilyn Albert[2], and Susumu Mori[1]
		[1]Radiology, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [2]Neurology, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [3]Biomedical Engineering, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States
		Recent findings suggest white matter hyperintensities (WMH) that appear on FLAIR images may play a role in the evolution of Alzheimer’s disease (AD). Here, we developed a novel algorithm that simultaneously detects and locates WMH, based on a FLAIR atlas database and a multi-atlas fusion algorithm. The method showed a respectful WMH detection accuracy. We also investigated region-specific WMH load in participants for whom amyloid imaging and vascular data were available. The results suggested that posterior WMH is related to amyloid deposition; whereas anterior and parietal WMH is associated with vascular risk factors.

3412	Computer 100	Surface Uniform Random Partition for Atlas-free Brain Network Analysis
		Teng Zhang[1], Pan Sun[2], Lin Shi[1], Queenie Chan[3], and Defeng Wang[4]

		[1]Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Shatin, Hong Kong, [2]Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Shatin, Hong Kong, [3]Philips Healthcare, Hong Kong, Hong Kong, [4]Research Center for Medical Image Computing, Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Shatin, Hong Kong
		Random partition is the cornerstone of atlas-free brain network analysis which can be used for multiscale analysis and comparison of cohorts with different brain sizes. The random parcels should be uniform to avoid additional variability from different parcel areas. In this study a uniform random partition of meshed surface is proposed considering geodesic distances and parcel areas. The partition results showed that proposed method can partition surface into any given number of parcels with similar areas. With repeating network analysis using proposed uniform parcels, results showed low intra-subject variations of global network measures.

3413	Computer 101	Can brain MRI skull-stripping methods be further improved using manual segmentation as ground-truth for validation?
		Roberto Souza[1], Oeslle Lucena[2], Letícia Rittner[2], Roberto Lotufo[2], and Richard Frayne[1]
		[1]Seaman Family Magnetic Resonance Research Centre, Calgary, AB, Canada, [2]Medical Image Computing Lab, Campinas, Brazil
		Automatic skull-stripping (SS) methods have reached a high level of accuracy compared to expert manual segmentation (typically defined as the “ground-truth”), but SS is still an active research area with many methods being proposed every year. In this work, we use twelve T1-weighted brain magnetic resonance (MR) images with each image having two different manual segmentations performed by experts, and four state-of-the-art SS methods to assess if it is possible to evaluate further accuracy improvements to SS. Our results indicate that at the current level of SS accuracy, this is not possible using single expert manual segmentation.

3414	Computer 102	Lifespan study by cross-sectional case-control comparisons in sliding age windows: test of ASD heterogeneity with One-Class Classifiers
		Piernicola Oliva[1], Alessia Giuliano[2], Paolo Bosco[2], Elisa Ferrari[3], Michela Tosetti[4], Filippo Muratori[4], Calderoni Sara[4], and Alessandra Retico[2]
		[1]University of Sassari and National Institute for Nuclear Physics, Cagliari, Italy, [2]National Institute for Nuclear Physics, Pisa, Italy, [3]University of Pisa, Physics Department and National Institute for Nuclear Physics, Pisa, Italy, [4]IRCCS Stella Maris Foundation, Pisa, Italy

		Cross-sectional studies reported inconsistent findings on distinctive neuroanatomical characteristics of Autism Spectrum Disorders (ASD). We set up a lifespan study through a series of machine-learning-based case-control comparisons made on sub-cohorts obtained by partitioning a large structural MRI data sample (age range: 2-25 years) in subsamples with partially-overlapping narrower age ranges (3-4 years). We implemented One-Class Support Vector Machines on these sub-cohorts, obtaining the temporal evolution of the case-control separation ability, which is related to the detectability of neuroimaging-based biomarkers. Distinctive common features characterize children with ASD under 5 years of age; the heterogeneity of the ASD condition dominates from adolescence.

3415	Computer 103	An image-based method for undistorted image estimation from distorted brain EPI image with field inhomogeneity
		Seiji Kumazawa[1], Takashi Yoshiura[2], Takumi Tanikawa[1], and Yuji Yaegashi[1]
		[1]Hokkaido University of Science, Sapporo, Japan, [2]Kagoshima University, Kagoshima, Japan
		Our purpose was to develop an image-based method for undistorted image estimation from the distorted EPI image using T1 weighted image. Our basic idea to estimate the field inhomogeneity map is to reproduce the distorted EPI image, and estimates the undistorted image using the estimated field inhomogeneity map based on the signal equation in a single-shot EPI k-space trajectory. The value of the NRMSE between the measured EPI and synthesized EPI was 0.017, and both images were in good agreement. Results demonstrate that our proposed method was able to perform a reasonable estimation of the field inhomogeneity map and undistorted EPI image.

3416	Computer 104	MRIQC Web-API: Crowdsourcing image quality metrics and expert quality ratings of structural and functional MRI
		Oscar Esteban[1], Ross W Blair[1], Dylan M Nielson[2], Jan C Varada[3], Sean Marrett[3], Adam G Thomas[2], Russell A Poldrack[1], and Krzysztof J Gorgolewski[1]
		[1]Dept. of Psychology, Stanford University, Stanford, CA, United States, [2]Data Science and Sharing Team, National Institute of Mental Health, Bethesda, MD, United States, [3]Functional Magnetic Resonance Imaging Facility, National Institute of Mental Health, Bethesda, MD, United States
		The MRIQC Web-API is a resource for scientists to train new automatic quality classifiers. The MRIQC Web-API has collected more than 30K sets of image quality measures automatically extracted from BOLD and T1-weighted scans using MRIQC. MRIQC is an automated MRI Quality Control tool, and here we present an extension to crowdsource these quality metrics along with anonymized metadata and manual quality ratings. This new resource will allow a better understanding of the normative values and distributions of these quality metrics, help determine the relationships between image quality and metadata such as acquisition parameters and finally, provide a cost-effective, easy way to annotate the quality of a large number of cross-site MR scans.

3417	Computer 105	Collaborative volumetric magnetic resonance image rendering on consumer-grade devices
		Andrew Dupuis[1,2], Dominique Franson[1], Yun Jiang[3], Jeff Mlakar[2], Henry Eastman[2], Vikas Gulani[3], Nicole Seiberlich[1], and Mark A. Griswold[1,2,3]
		[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Interactive Commons, Case Western Reserve University, Cleveland, OH, United States, [3]Department of Radiology, School of Medicine, Case Western Reserve University, Cleveland, OH, United States
		We present a system for intra- or post-acquisition 3D rendering of volumetric MRI datasets for independent or collaborative use on AR/VR and mobile platforms. Consumer-grade head mounted displays, phones, and computers are used to provide 3D visualizations. Datasets can be windowed and leveled in the same manner as classic visualizations, and arbitrary slices can be selected and viewed in real time in the context of the whole volume. Real world dimensionality and spatialization is retained. Using this system, multiple users can interact with a dataset collaboratively using current AR/VR platforms or any modern cellphone, tablet, or laptop.

3418	Computer 106	Quantification of Morphometry and Intensity Features of Intracranial Arteries from 3D TOF MRA: A Reproducibility Study
		Li Chen[1], Mahmud Mossa-Basha [2], Daniel S Hippe [2], Jie Sun[2], Niranjan Balu[2], Kristi D. Pimentel[2], Thomas S Hatsukami[3], Jenq-Neng Hwang[1], and Chun Yuan[2]
		[1]Electrical Engineering, University of Washington, Seattle, WA, United States, [2]Radiology, University of Washington, Seattle, WA, United States, [3]Surgery, University of Washington, Seattle, WA, United States
		The aim is to evaluate the reproducibility of intracranial artery feature extraction (iCafe) technique for quantitative analysis of intracranial arteries from 3D time-of-flight (TOF) magnetic resonance angiography (MRA). Twenty-four patients with known intracranial artery stenosis were recruited and underwent two separate MRA scans within 2 weeks. Each dataset was processed blindly using iCafe. Eight morphometry and intensity features were acquired from each artery. The inter-scan reproducibility of iCafe was excellent with intra-class correlation coefficients between 0.92-0.98 and within-subject coefficients of variation between 3.2-8.6% across all features, showing iCafe is a reliable technique for intracranial artery feature quantification from TOF MRA.

3419	Computer 107	An automatic system for asymmetry vein analysis in patients with acute ischemic stroke
		Hanjing Kong[1], Wenjian Huang[1], Mei Yang[1], Weihai Xu[2], Yining Huang[3], and Jue Zhang[1,4]
		[1]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [2]Department of Neurology, Peking Union Medical College Hospital, Beijing, China, [3]Department of Neurology, Peking University First Hospital, Beijing, China, [4]College of Engineering, Peking University, Beijing, China

		Asymmetry veins in patients with acute ischemic stroke are associated with infarct growth and clinical outcome. However, due to the lack of effective segmentation and quantification methods, these studies focus only on medullary or cortical veins. In this study, an automatic image processing system was developed for asymmetry analysis in medullary and cortical veins using the magnitude data of SWI.

3420	Computer 108	Quantitative Micro-Vasculature Volume Assessment of Intra Tumoral Susceptibility Signal (ITSS) in differentiating Grade-III from IV glioma
		Rupsa Bhattacharjee[1,2], Prashant Budania[1], Pradeep Kumar Gupta[3], Rakesh Kumar Gupta[3], Sunita Ahlawat[4], and Anup Singh[1,5]
		[1]Centre for Biomedical Engineering, Indian Institute of Technology, Delhi, New Delhi, India, [2]Philips Health Systems, Philips India Limited, Gurgaon, India, [3]Department of Radiology and Imaging, Fortis Memorial Research Institute, Gurgaon, India, [4]SRL Diagnostics, Fortis Memorial Research Institute, Gurgaon, India, [5]Biomedical Engineering, AIIMS, New Delhi, Delhi, India
		Angiogenesis transforms gliomas from low-to-high-grade. Vasculature-properties are of essential prognostic-value within grade-III and IV glioma as compared to grade-II. High-resolution susceptibility-weighted imaging (SWI) improves the diagnostic accuracy1. Existing Semi-quantitative methods are user-dependent which manually counts intra-tumoral-susceptibility-signal-intensities (ITSS); a combination of haemorrhage and vasculature. Haemorrhage contributes to false ITSS-count and subsequently to misclassification of tumor-grading. We propose a non-invasive segmentation-based-quantitative approach that calculates the R2-Star relaxivity maps of ITSS, automatically removes haemorrhages from ITSS based on high-R2-Star relaxivity of haemorrhage and finally calculate microvasculature volume within glioma. The proposed-method scores over the existing semi-quantitative method in-terms-of ITSS-estimation and grading-accuracy.

3421	Computer 109	SeedNet: a sliding-window convolutional neural network for radioactive seed detection and localization in MRI
		Jeremiah Sanders[1], Steven Frank[2], and Jingfei Ma[1]
		[1]Imaging Physics, MD Anderson Cancer Center, Houston, TX, United States, [2]Radiation Oncology, MD Anderson Cancer Center, Houston, TX, United States
		Radioactive seed localization is an essential step in quantifying the dose delivered to the prostate and surrounding anatomy after low-dose-rate prostate cancer brachytherapy. Currently, dosimetrists spend hours manually localizing the radioactive seeds in postoperative images. In this work, we investigated a novel sliding-window convolutional neural network approach for automatically identifying and localizing the seeds in MR images. The method doesn’t rely on prior knowledge of the number of seeds implanted, strand placements, or needle-loading configurations. In initial testing, the proposed approach achieved a recall of 100%, precision of 97%, and processing time of ~0.5-1.5 minutes per patient.

3422	Computer 110	An improved automatic localization method for abnormal lumbar vertebrae using MR Images Fei Gao[1], Shui Liu[2], Xiaodong Zhang[2], Jue Zhang[1,3], Xiaoying Wang[2,3], and Jing Fang[1,3] *[1]College of Engineering, Peking University, Beijing, China, [2]Department of Radiology, Peking University First Hospital, Beijing, China, [3]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China* In this study, we provide an automatic lumbar localization method efficient for abnormal vertebrae based on the local context information of lumbar MR images. The localization results indicate the efficiency of the proposed method for lumbar vertebrae with various abnormalities.

3423	Computer 111	An objective tool for diagnosing Prostate Cancer and Benign Prostatic Hyperplasia: Radiomics Featuresextracted from Diffusion-weighted Imaging Lihua Chen[1], Ailian Liu[1], Yan Guo[2], Xin Li[3], and Dan Guo[1] *[1]The First Affiliated Hospital of DaLian Medical University, Dalian, China, [2]GE Healthcare, China, ShenYang, China, [3]GE Healthcare, China, GuangZhou, China* Prostate cancer is the second most common cancer for men, and it has high leading cause of cancer death among men. The term radiomics has attracted increased attention in recent years, and it is the process of the conversion of medical images into high-dimensional, mineable data via high-throughput extraction of quantitative features, followed by subsequent data analysis for decision support.The aim of this study was to evaluate radiomics as a tool to distinguish PCa from BPH based on diffusion-weighted imaging (DWI) sequence without subjective factors.

3424	Computer 112	User-defined, scanner-integrated, and real-time MRI image analysis in a cloud-based computing environment Refaat E Gabr[1], William J Allen[2], Getaneh B Tefera[1], Xiaojun Sun[1], Renjie He[1], Manickam Kumaravel[1], Matthew W Vaughn[2], and Ponnada A Narayana[1] *[1]Diagnostic and Interventional Imaging, University of Texas Health Science Center at Houston, Houston, TX, United States, [2]Texas Advacnced Computing Center, University of Texas at Austin, Austin, TX, United States*

		To enhance the utility of quantitative MRI, we propose a flexible platform for high-performance cloud computing integrated with the MRI scanner. Jetstream, an NSF-sponsored open science platform for high-performance computing resources, was integrated into a clinical 3.0T MRI system for executing user-defined image analysis using the graphical pipeline environment (GRAPE) tool. Integration was achieved through the Agave platform. This framework was used for real-time quantitative T1 mapping for cartilage tissue assessment. Seamless scanner integration enabled immediate access to the results to the interpreting clinician, providing valuable quantitative information which can be incorporated in clinical practice.

3425	Computer 113	mridata.org: An Open Archive for Sharing MRI Raw Data
		Frank Ong[1], Shahab Amin[1], Shreyas Vasanawala[2], and Michael Lustig[1]
		[1]University of California, Berkeley, Berkeley, CA, United States, [2]Radiology Department, Stanford University, Stanford, CA, United States
		Current machine learning techniques for image reconstruction require large number of datasets for training, yet the number of public MRI raw datasets is limited. We present mridata.org as an open archive for researchers to share their MRI raw data. The website is designed to facilitate sharing MRI datasets, with features including automatic ISMRMRD conversion from uploaded vendor specific files. We hope that with contributions from many researchers, this website can provide more datasets to train and validate machine learning models for MRI reconstruction.

3426	Computer 114	qMapIt, a multi-parametric analysis platform for ImageJ
		Michael Gerhard Kaul[1] and Gerhard Adam[1]
		[1]Department for Diagnostic and Interventional Radiology and Nuclear Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany
		Workstations are expensive and the access is often limited. We developed several ImageJ-plugins to build the basis for a multi-parametric imaging platform for ImageJ. ImageJ is a flexible and extendable image processing software that runs with Windows, MacOS and Linux. With qMapIt the researcher has a graphical user interface to selectively import DICOM files and to perform multi-core supported data analysis. Whether relaxation time analysis for T1, T2, T2*, T1ρ, or various diffusion models, or velocity mapping, or vessel size imaging, or pharmacokinetic modelling you name it. Every step can also be addressed in a macro script to automate the workflow. To reduce programming overhead and to speed up the plugin development a fitting and visualisation framework is embedded.

3427	Computer 115	Pipeline for Registering Histological Sections to MRI Volumes

Istvan N. Huszar[1], Karla L. Miller[1], Menuka Pallebage-Gamarallage[2], Olaf Ansorge[2], Christopher Mirfin[3], Mattias P. Heinrich[4], and Mark Jenkinson[1]

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Post-mortem MRI–histology comparisons provide great potential to advance our understanding of disease, and validating the source of MRI signals, that is necessary for the development of novel imaging methods to study neurodegeneration. A semi-automated prototype of a registration pipeline is reported, that was designed for conventional sparse histological sampling. Use of the pipeline is demonstrated by inserting individual 25 x 25 mm histological sections to their respective locations in whole-brain MRI data. The registration accuracy is approximately 1 mm.

3428 Computer 116

Automated breast segmentation with high reproducibility of MR-based breast density measurement

Jie Ding[1], Arjun Anilkumar[2], Patricia A Thompson[3,4], Maria I Altbach[5,6], Jean-Philippe Galons[5,6], Cynthia A Thomson[5], Alison T Stopeck[4,7], and Chuan Huang[1,2,8,9]

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Breast density(BD) is a significant risk factor for breast cancer and serves as a biomarker of risk in clinical trials. Breast segmentation is the first and an important step for accurate and reproducible BD estimation. However, the conventional manual segmentation is labor-intensive and bias-prone. Based on fat-water decomposition MRI, we developed an automated breast segmentation method and validated it against manual segmentation using 50 test-retest scans. The BD measures using our automated segmentation were very comparable to results from manual segmentation, and exhibited extremely high test-retest reproducibility. Our automated segmentation yielded more reproducible BD measures than the manual segmentation method.

3429 Computer 117

Feature Extraction and Analysis for Characterization of Breast Lesion Type using Multi-parametric MRI

Snekha Thakran[1], Subhajit Chatterjee[1,2,3], Rakesh Kumar Gupta[4], and Anup Singh[1,5]

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		Quantitative analysis of T_1-perfusion data provides estimation of hemodynamic and physiological parameters of tissue. Texture analysis uses mathematical approach to distinguish the spatial distribution of signal intensity variations. In this study, we computed different texture and quantitative parameters in terms of characterizing histological types (lobular and ductal) of invasive breast cancer. Experimental results revealed that combination of texture and quantitative features provided highest sensitivity and specificity to differentiate IDC and ILC breast lesions.

3430	Computer 118	Detection of Liver Fibrosis using Strain-Encoding MRI and Support Vector Machine
		Inas A Yassine[1,2], Mai Wael[1], Mohamed Elmahdy[2], Tamer Basha[2], Ahmed S Fahmy[1,2], Ralph Sinkus[3], Theo Heller[4], Ahmed M Gharib[5], and Khaled Z Abd-Elmoniem[5]
		[1]*School of communication and Information Technology, Nile University, Cairo, Egypt,* [2]*Systems and Biomedical Engineering Department, Cairo University, Cairo, Egypt,* [3]*Biomedical Engineering Department, King's College, London, United Kingdom,* [4]*Liver Diseases Branch, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, United States,* [5]*Biomedical and Metabolic Imaging Branch, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, United States*
		This study proposes a device-free semi-automatic liver fibrosis identification system based on Strain Encoded (SENC) MRI. SENC-MRI was applied to quantify liver deformation induced by the heart motion over the cardiac cycle. Twenty-two patients with different stages of biopsy proven liver fibrosis and ten healthy subjects were imaged using SENC-MRI. A Support Vector Machine (SVM) classification system was used to classify the strain and strain rate for both the patients and healthy subjects. Based on leave-one-out cross validation. Strain and strain rate were more robust than the peak-to-peak value based classification, which has bias towards the sensitivity. The proposed method showed classification accuracy of 87.5% with sensitivity and specificity of 90.0% and 90%, respectively.

3431	Computer 119	A Methodology Towards Registering Prostate Histology and Radiologic Imaging to Validate Prostate Cancer Detection in 2D
		Brandon Caldwell[1,2], Meltem Uyanik[2], Michael Abern[1], Virgilia Macias[3], Cristian Luciano[2], and Richard Magin[2]
		[1]*Urology, University of Illinois at Chicago College of Medicine, Chicago, IL, United States,* [2]*Bioengineering, University of Illinois at Chicago, Chicago, IL, United States,* [3]*Pathology, University of Illinois at Chicago College of Medicine, Chicago, IL, United States*

		In-vivo radiological imaging is used globally to detect possible cancers and inform treatment decisions, but difficulties arise when attempting to compare radiological findings to the gold-standard of diagnosis, histopathology. Standard imaging protocols have documented success but to determine the reliability of new imaging sequences and modalities, correlation to histopathology must be made. Several methods have been proposed for registration in both 2D and 3D, but these have shown limited effectiveness and often require unique equipment or proprietary algorithms. In this study, we attempt to complete an accurate registration in 2D in order to validate different imaging modalities.

3432	Computer 120	Combined Visual Analysis of Myocardial Strain and Intra-Ventricular Blood Flow
		Chitiboi Teodora[1], Anja Hennemuth[2], Lennart Tautz[3], and Leon Axel[1]
		[1]New York University School of Medicine, New York, NY, United States, [2]Charité Universitätsmedizin Berlin, Berlin, Germany, [3]Fraunhofer MEVIS, Bremen, Germany
		Intra-ventricular blood flow dynamics are closely related to both ventricle and valve geometry and to the contraction pattern of the myocardial wall. The interaction mechanisms between contraction forces inside the myocardium and hydrodynamic forces are highly complex and have not yet been fully understood, especially in the presence of pathology. We propose a visual analysis framework for the integrated assessment of ventricle and valve morphology, blood flow and local myocardial function. This is a first step to enable better understanding of the different mechanical factors involved in hypertrophic cardiomyopathy (HCM) and their combined contributions to the formation of obstructive HCM.

Electronic Poster

Velocity & Flow

Exhibition Hall	Monday 14:45 - 15:45

3433	Computer 1	Quantification of 3D aortic wall shear stress using k-t accelerated 4D flow MRI in under 2 minutes: a two center study
		Emilie Bollache[1], Kristopher Knott[2], Redha Boubertakh[2], Ryan Scott Dolan[1], Claudia Camaioni[2], Saadullah Ahmed-Villiers[2], Thomas Treibel[2], James C Carr[1], Pim van Ooij[3], Jeremy D Collins[1], Julia Geiger[4], James Moon[2], Alex J Barker[1], Steffen E Petersen[2], and Michael Markl[1,5]
		[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Barts Heart Centre, London, United Kingdom, [3]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands, [4]University Children's Hospital, Zurich, Switzerland, [5]Department of Biomedical Engineering, Northwestern University, Chicago, IL, United States

		Our aims were to study the feasibility at two centers of a newly developed k-t accelerated non-navigator gated 2-minute aortic 4D flow MRI sequence and to evaluate its wall shear stress (WSS) estimates. Eleven and 14 healthy volunteers, as well as 10 and 6 patients were scanned at Northwestern University and Barts Heart Centre, respectively. Despite an underestimation of distal aortic WSS in patients when compared to conventional 4D flow, our measurements were sensitive to expected aging and disease-related variations. We confirmed that aortic 4D flow MRI in 2 minutes is feasible and provides consistent WSS measurements.

3434	Computer 2	Quantitative evaluation of compressed sensing reconstruction in mouse phase contrast 4D-flow Magnetic Resonance Imaging
		Moritz Braig[1], Marius Menza[1], Jochen Leupold[1], Li Feng[2], Pierre LeVan[1], Juergen Hennig[1], Axel J Krafft[1], and Dominik von Elverfeldt[1]
		[1]Radiology, Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States
		Preclinical 4D-flow measurements remain challenging due to long acquisition times. This study presents a retrospective analysis of 4D-flow measurements with a radial 3D phase contrast sequence in combination with an advanced compressed sensing reconstruction. We evaluate the impact of different undersampling factors regarding peak velocities, flow, wall shear stress values and streamline analysis. We could show that high acceleration factors for preclinical phase contrast imaging can be used without substantially degrading the quantitative results. Our findings might enable high resolution 4D-flow acquisitions in less than one hour.

3435	Computer 3	Exploring vessel inward normal computation for 4D flow based wall shear stress estimation in complex vessel geometries.
		Judith Zimmermann[1,2], Daniel Demedts[3], Michael Markl[4], Christian Meierhofer[2], Heiko Stern[2], and Anja Hennemuth[3,5]
		[1]Department of Computer Science, Technical University of Munich, Munich, Germany, [2]Department of Pediatric Cardiology and Congenital Heart Defects, German Heart Center Munich, Munich, Germany, [3]Fraunhofer MEVIS Institute for Medical Image Computing, Bremen, Germany, [4]Departments of Radiology and Biomedical Engineering, Northwestern University Feinberg School of Medicine, Chicago, IL, United States, [5]Institute for Computational and Imaging Science in Cardiovascular Medicine, Charité Universitätsmedizin Berlin, Berlin, Germany

		Wall shear stress (WSS) is a hemodynamic parameter which can be estimated from 4D flow MRI. The aim of this work was to advance the surface inward normal computation for complex (i.e. cone-shaped) vessel geometries and thus to improve the accuracy of wall shear stress estimates. We propose a Gauss gradient field approach to adapt to complex vessel courses and evaluate our method using synthetic flow data and selected patient data. Results show that correct inward normal definition is crucial for reliable WSS estimates, in particular in cases where complex vessel geometries are present.

3436	Computer 4	On the Influence of Intravoxel Velocity Distributions on the Noise of Phase Contrast Velocimetry
		Simon Schmidt[1], Sebastian Flassbeck[1], Mark E. Ladd[1], and Sebastian Schmitter[1,2]
		[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany
		In this work we investigate the influence of intravoxel velocity distributions on the velocity noise in phase contrast velocimetry. Intravoxel velocity distributions are directly measured via Fourier velocity encoding and subsequently fitted by Gaussian distributions. Taking intravoxel dephasing due to a finite distribution width into account, a noise-optimized VENC is calculated for phantom flow measurements and in-vivo data at 7 Tesla.

3437	Computer 5	Whole-heart 4D phase-contrast MRI for clinical cardiovascular flow analysis: a comparison and validation on an imaging pulse sequence aspect
		Shuo Zhang[1,2], Jun-Mei Zhang[1,3], Jennifer Ann Bryant[1], Bao Ru Leong[1], Pankaj Garg[4], Rob van der Geest[5], Ru San Tan[1,3], and Liang Zhong[1,3]
		[1]National Heart Centre Singapore, Singapore, Singapore, [2]Philips Healthcare Singapore, Singapore, Singapore, [3]Duke-NUS Medical School Singapore, Singapore, Singapore, [4]Division of Biomedical Imaging, University of Leeds, Leeds, United Kingdom, [5]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands
		Whole-heart 4D phase-contrast magnetic resonance imaging (4D PC-MRI) provides qualitative and quantitative cardiovascular flow information. Recent technological advances in acquisition have rendered its clinical adoption without breath hold or respiratory gating. However, with different acquisition methods available their accuracy and influence in flow measurement are not well studied. We report our result in comparison of different commercially available imaging pulse sequences with validation to conventional 2D PC-MRI in healthy volunteers and patients with congenital heart disease.

3438	Computer 6	Feasibility of 4D phase-contrast MRI for the assessment of blood flow in the fetal aorta using Doppler ultrasound gating: preliminary results

Fabian Kording[1], Bjoern P Schoennagel[1], Christian Ruprecht[1], Daniel Giese[2], Einar Heiberg [3], Manuela Tavares[4], and Jin Yamamura[1]

[1]Department of Diagnostic and Interventional Radiology and Nuclear Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [2]Department of Radiology, University Hospital Cologne, Cologne, Germany, [3]Lund University, Lund, Sweden, [4]University Medical Center Hamburg-Eppendorf, Hamburg, Germany

Fetal magnetic resonance imaging (MRI) is increasingly used as a second-line imaging tool for prenatal evaluation. The recet Doppler ultrasound trigger method enables the use of cardiovascular imaging techniques which may be usefull to improve prenatal cardiovascular imaging. This work investigates the use of 4D phase contrast measurements for the visualisation and quantification of fetal blood flow in the great vessels. In a small study group (n=2) it was shown for the first time that 4D flow measurements are feasible in the fetal vessels which may be beneficial for visualization and quantification of complex congenital cardiovascular malformations.

3439 | Computer 7

Magnetic Particle Imaging based 4D flow analysis technique using regional MRI data evaluation – initial in vivo results of a beating rodent heart

Jochen Franke[1,2], Heinrich Lehr[1], and Volkmar Schulz[2]

[1]Preclinical Imaging, Bruker BioSpin MRI GmbH, Ettlingen, Germany, [2]Physics of Molecular Imaging Systems, University RWTH Aachen, Aachen, Germany

A dual-modal cardiovascular in vivo assessment in rodents was performed using a highly integrated Magnetic Particle Imaging – Magnetic Resonance Imaging hybrid system. 4D velocity flow field estimation of a beating rodent heart was extracted from the pulsed tracer information within the MPI dataset of a non-toxic tracer bolus. By means of co-registered morphological MRI data acquired at 0.5 T, an anatomical regional velocity flow field evaluation was performed for the four heart chambers individually.

3440 | Computer 8

Dual-venc and single-venc 4D Flow MRI in cerebral aneurysms in comparison to image-based CFD modeling

Joseph Christopher Muskat[1], Sean Rothenberger[1], Ahmadreza Baghaie[1], Sameer A Ansari[2], Craig Goergen[1], Susanne Schnell[3], Michael Markl[3,4], and Vitaliy Rayz[1]

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		Blood flow in two cerebral aneurysms was measured with 4D Flow MRI and simulated with image-based Computational Fluid Dynamics (CFD). A dual-venc 4D Flow MRI sequence with a shared reference scan was used in addition to a standard, single-venc 4D Flow acquisition in order to improve the dynamic range of measured velocities. Comparison of the MRI-measured and CFD-simulated flow fields showed that the 4D Flow and CFD methods can complement each other by eliminating modeling errors and augmenting imaging resolution. The dual-venc 4D Flow MRI provided valuable information on recirculating flow patterns that was not available from the single-venc data.

3441	Computer 9	Modeling Physiological Flow Variation in Total Cavopulmonary Connection with Physical Model Experiments and 4D Flow MRI
		David R Rutkowski[1,2], Ryan Valk[3], Christopher J François[2], and Alejandro Roldán-Alzate[1,2,4]
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		The total cavopulmonary connection (TCPC) is a successful treatment for single ventricle defect, however, long term complications, such as exercise intolerance still occur. To examine the effects of exercise conditions on TCPC fluid dynamics, in vitro experiments using 4D Flow MRI were conducted at high and low flow conditions. Significant difference in pulmonary flow distribution between conditions was found, and flow patterns and structures were characterized. After further development these models may provide a useful tool for analyzing and predicting changes in a variety of patient specific TCPC anatomy.

3442	Computer 10	Blood Velocity Measurement by RF Phase Gradient Differences between Receiver Coils: Initial Work towards Stenotic Jet Velocity
		Jonathan Wagner[1], Peter David Gatehouse[2], and David Nigel Firmin[2]
		[1]Imperial College, London, United Kingdom, [2]Cardiac MRI, Royal Brompton Hospital, London, United Kingdom
		Fluid velocity was measured in vitro using the difference between spatial phase responses of array coils in 1993 by Famili, Wright and Porter. Aiming at application to cardiovascular stenotic jets, this abstract re-investigates their method with newer coil arrays and adds a multi-echo approach enabling aortic velocity measurement in normal subjects, with moderate results.

3443	Computer 11	Self-Gated Golden-Angle Spiral 4D Flow MRI
		Rene Bastkowski[1], Kilian Weiss[1,2], David Maintz[1], and Daniel Giese[1]

		[1]Radiology, University Hospital of Cologne, Cologne, Germany, [2]Philips GmbH Healthcare, Hamburg, Germany
		A time efficient fully self-gated 4D flow sequence is presented that operates at predictable scan times and allows for a retrospective binning into an arbitrary number of cardiac and/or respiratory states. The acquisition time is fixed independently of the subjects' physiology. Data is reconstructed using conjugate-gradient-SENSE. Feasibility is shown in 10 healthy volunteers and results are compared to a standard Cartesian 4D flow sequence.

3444	Computer 12	Evaluation of aortic viscous energy loss, kinetic energy and association with pumping function in congenital patients with transposition of great arteries using time-varying aortic geometry: Volumetric 4D Flow MRI Analysis
		Covadonga Terol Espinosa de los Monteros[1], Roel L.F. Van der Palen[1], Arno A.W. Roest[1], Pieter J. Van den Boogaard[2], Lucia J.M. Kroft[2], Westenberg J.M. Jos[2], and Mohammed S.M. Elbaz[2]
		[1]Pediatric Cardiology, Leiden University Madical Ceneter, Leiden, Netherlands, [2]Radiology, Leiden Univeristy Medical Center, Leiden, Netherlands
		Aortic hemodynamic energetics including kinetic energy (KE) and non-turbulent viscous energy loss (EL) and the association with cardiac function were evaluated in 8 TGA patients after arterial switch operation (ASO) and in 8 healthy individuals by 4D flow MRI. EL was significantly increased in TGA compared to healthy volunteers and aortic regions of highest levels indicate influence of complex ASO-related aortic geometry on blood flow efficiency. Significant positive correlation between aortic EL and cardiac index was found. Understanding the impact of ASO on aortic blood flow efficiency might enable insights on ways to improve operative procedure for TGA in future.

3445	Computer 13	CArtesian sampling with Variable density and Adjustable temporal resolution (CAVA)
		Adam Rich[1], Ning Jin[2], Yingmin Liu[3], Lee C. Potter[4], Orlando P. Simonetti[3,5,6], and Rizwan Ahmad[1,3]
		[1]Department of Biomedical Engineering, The Ohio State University, Columbus, OH, United States, [2]Siemens Medical Solutions, Columbus, OH, United States, [3]Dorothy M. Davis Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States, [4]Electrical and Computer Engineering, The Ohio State University, Columbus, OH, United States, [5]Division of Cardiovascular Medicine, Department of Internal Medicine, The Ohio State University, Columbus, OH, United States, [6]Department of Radiology, The Ohio State University, Columbus, OH, United States

		We present a variable density Cartesian sampling method that allows retrospective adjustment of temporal resolution, providing added flexibility for real-time applications where optimal temporal resolution may not be known in advance. This method, called CArtesian sampling with Variable density and Adjustable temporal resolution (CAVA), is validated using real-time, free-breathing phase-contrast MRI data from four volunteers. Diagnostic quality images were successfully recovered at different temporal resolutions. Also, flow quantification based on CAVA was in good agreement with the breath-held segmented acquisition. In summary, CAVA provides a Cartesian alternative to Golden Angle-based radial sampling and can benefit a wide range of 2D real-time applications.

3446	Computer 14	4D Flow MRI velocity encoding effects on in vitro aortic dissection false lumen velocity distribution
		Sylvana García-Rodríguez[1], Philip Corrado[2], Jon Wrobel[3], Timothy Aaron Ruesink[4], Alejandro Roldán-Alzate[1,4], and Christopher Jean François[1]
		[1]Department of Radiology, University of Wisconsin - Madison, Madison, WI, United States, [2]Department of Medical Physics, University of Wisconsin - Madison, Madison, WI, United States, [3]School of Medicine, University of Wisconsin - Madison, Madison, WI, United States, [4]Department of Mechanical Engineering, University of Wisconsin - Madison, Madison, WI, United States
		Selecting the appropriate velocity sensitivity is critical in assessing flow within the false lumen of aortic dissections, where low velocities are dominant. This study compares effects of two VENC settings on velocity distribution within the false lumen of 3D printed aortic dissection models. We observed significant changes in velocity distributions depending on the VENC selected for the 4D Flow MRI acquisition. This difference tends to be accentuated at lower flow rates and would have important implications on calculations of other hemodynamic parameters, including wall shear stress, kinetic energy and vorticity, which may be predictors of outcomes in aortic dissection patients.

3447	Computer 15	Rapid, real-time phase-contrast MRI using a combination of radial k-space sampling and compressed sensing with spatially varying regularization weights
		Hassan Haji-valizadeh[1], Bradley D. Allen[2], Roberto Sarnari[3], Matthew Barrett[4], and Daniel Kim[2]
		[1]Biomedical Engineering, Northwestern University, Evanston, IL, United States, [2]Radiology, Northwestern University, Chicago, IL, United States, [3]Radiolgy, Northwestern University, Chicago, IL, United States, [4]Cardiology, Northwestern University, Chicago, IL, United States
		We sought to develop a compressed sensing reconstruction method for radial k-space derived real-time phase contrast that uses spatially varying regularization to reduce flickering artifacts without significant loss in quantified flow accuracy, and evaluate its performance with respect to clinical breath-hold phase contrast in patients undergoing aortic valve evaluation with cardiovascular MRI.

3448	Computer 16	Pseudo Spiral Compressed Sensing for Aortic 4D flow MRI: a Comparison with k-t Principal Component Analysis
		Lukas M. Gottwald[1], Eva S. Peper[1], Qinwei Zhang[1], Bram F. Coolen[2], Gustav J. Strijkers[2], R. Nils Planken[1], Aart J. Nederveen[1], and Pim van Ooij[1]
		[1]Radiology, Academic Medical Center, Amsterdam, Netherlands, [2]Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Netherlands
		In this study, 8-fold pseudo spiral compressed sensing (CS) accelerated aortic 4D flow MRI was compared with 8-fold k-t principal component analysis (k-t PCA) acceleration. Scan times were approximately 7 minutes at 50% respiratory navigator efficiency. Image quality of the peak systolic phase contrast magnitude images was scored slightly higher for CS than for k-t PCA and time-resolved velocity pathline trajectories were similar. Quantitative hemodynamic differences in velocity and wall shear stress were found but these were small and can be attributed to a combination of acquisition strategy and physiological variation. CS can be used to accelerate 4D flow MRI.

3449	Computer 17	Vortex Flow in Left Ventricle Interrupts Efficient Ejection: Demonstration by Vortex Flow Map of Cardiac Cine Magnetic Resonance Imaging
		Masateru Kawakubo[1], Kenji Fukushima[2], Risako Nakao[3], Eri Watanabe[3], Yamato Shimomiya[4], Yasuhiro Goto[5], Hitoshi Tadenuma[5], Masami Yoneyama[6], and Michinobu Nagao[2]
		[1]Department of Health Sciences, Faculty of Medical Sciences, Kyushu University, Fukuoka, Japan, [2]Department of Diagnostic Imaging & Nuclear Medicine, Tokyo Women's Medical University, Tokyo, Japan, [3]Department of Cardiology, The Heart Institute of Japan, Tokyo Women's Medical University, Tokyo, Japan, [4]Clinical Application Development Marketing Division, Ziosoft Inc., Tokyo, Japan, [5]Department of Radiological Service, Tokyo Women's Medical University, Tokyo, Japan, [6]Philips Electronics Japan, Ltd., Tokyo, Japan
		Quantitative characterization of vortex flow might be a novel objective tool for evaluating left ventricular (LV) function. We developed the novel technique of vortex flow map (VFM). The VFM based on MR feature tracking can calculate the temporal displacement of the pixels on standard cine MRI. In this study, we analyzed the association with the VFM in LV and ejection fraction. As a result, it is indicated that the strong 3-dimensional vortex flow appears and impairs efficient LV ejection in severe heart failure. And the VFM is a useful tool for the evaluation of the efficiency of LV ejection.

3450	Computer 18	A dedicated MRI flow laboratory for quantitative flow measurements and method development
		Martin Bruschewski[1] and Sven Grundmann[1]
		[1]Institute of Fluid Mechanics, University of Rostock, Rostock, Germany

		A unique MRI flow laboratory is currently being commissioned at the University of Rostock. The laboratory is specifically designed for quantitative measurements in technical flows. The MRI system, a whole-body Magnetom Trio (Siemens, Erlangen, Germany), will be integrated into various flow circuits with water and other fluids. This MRI system is not intended for clinical trials. Instead, the research focuses on the development and validation of flow quantification methods for medical and technical applications. The long-term aim is to make MRI more available to the field of fluid mechanics research and flow engineering.

3451	Computer 19	Assessment of Pulmonary Artery Mean Pressure with MRI and 4D Flow Vortex Assessment.
		Lindsey Alexandra Crowe[1], Anne-Lise Hachulla[1], Gabriel Guglielmi[1], Maurice Beghetti[2], Frederic Lador[3], and Jean-Paul Vallée[1]
		[1]Division of Radiology, Geneva University Hospitals, Geneva, Switzerland, [2]Division of Pediatric Cardiology, Geneva University Hospitals, Geneva, Switzerland, [3]Division of Pneumology, Geneva University Hospitals, Geneva, Switzerland
		Flow vortices have been observed in patients with elevated pulmonary artery pressure. We investigated 4D flow MRI and software packages to quantify vortex duration. This parameter was assessed compared to other MRI derived measurements to provide a potential non-invasive alternative to right heart catheterization.

3452	Computer 20	Effect of gravity on inferior vena cava and abdominal aortic flow: evaluation using multi-posture MRI
		Yoshisuke Kadoya[1], Tosiaki Miyati[1], Naoki Ohno[1], Satoshi Kobayashi[1], and Toshifumi Gabata[1]
		[1]Kanazawa University Graduate School of Medical Sciences, Kanazawa, Japan
		Inferior vena cava flow (IVCF) and abdominal aortic flow (AAF) are seems to be affected by gravity, ie., it depends on the body posture. We validated the effect of gravity on IVCF and AAF in supine and upright positions using an original multi-posture MRI. IVCF/AAF mean velocity, IVCF/AAF maximum velocity, mean IVCF/AAF, maximum IVCF/AAF in the upright position were significantly lower than those in the supine position. The cross-sectional area of IVC was significantly lower than those in the supine position, but that of AA was not significantly changed. Both IVCF and AAF decrease in the upright position.

3453	Computer 21	Experimental Validation of 4D Flow MRI for the Assessment of Recirculation and Acceleration using Tomographic Particle Image Velocimetry
		Rafael Medero[1] and Alejandro Roldán-Alzate[1,2,3]

		[1]Mechanical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [2]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States
		4D flow MRI has shown to be a feasible tool for the assessment of hemodynamics in different vascular territories, however reliable validation using gold standard fluid dynamics experiments is needed for improvement of its accuracy and precision. Particle image velocimetry (PIV) is an experimental technique widely used in engineering analysis of fluids. PIV measures flow velocity by optically tracking the movement of laser-illuminated particles. The purpose of this study was to validate 4D Flow MRI for the assessment of flow recirculation and acceleration using tomographic PIV.

3454	Computer 22	4D flow MRI: Preliminary in vivo results comparing two commercially available analysis software platforms
		Christopher J François[1], Lindsay M Griffin[1], Niti R Aggarwal[2], and Mark L Schiebler[1]
		[1]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Cardiovascular Medicine, University of Wisconsin-Madison, Madison, WI, United States
		Main pulmonary artery (MPA) and ascending aorta flow was quantified from 4D flow MRI using two commercially available software programs. Flow measurements made in three locations in each of these vessels were internally consistent with negligible bias for both programs. Furthermore, differences in mean MPA and aorta flow between programs were also negligible. These preliminary results are encouraging in affirming the reproducibility and reliability of flow measurements from clinical 4D flow MRI acquisitions.

3455	Computer 23	4D Flow MRI assessment of hypertrophic cardiomyopathy –the comparison with pressure gradient measured by Doppler ultrasound-
		Kotomi Iwata[1], Tetsuro Sekine[1], Masaki Tachi[1], Yoichi Imori[2], Minako Takeda[1], Yasuo Amano[3], Makoto Obara[4], Yoshio Matsumura[1], and Shin-ichiro Kumita[1]
		[1]Radiolody, Nippon Medical School, Tokyo, Japan, [2]Cardiology, Nippon Medical School, Tokyo, Japan, [3]Radiology, Nihon University, Tokyo, Japan, [4]Philips Electronics Japan Ltd., Tokyo, Japan
		The purpose of this study was to compare the flow abnormality based on 4D Flow MRI data with the PG measured by Doppler ultrasound. we enrolled 9 patients who underwent echocardiography followed by 4D Flow MRI. Helical grade of HOCM group was higher than that of HNCM group (2.33±0.47 vs. 1.33±0.47, p=0.032). There was no significant difference between HG and each characteristic of HCM (PG, septal thickness, septum/free wall ratio and the presence of SAM). 4D Flow MRI can visualize abnormal helical flow of ascending aorta in patients with hypertrophic obstructive cardiomyopathy.

3456	Computer 24	Regional distribution of Local 3D Pulse Wave Velocity with and without Aortic Arch Replacement in Pediatric Patients with Single Ventricle Amol S. Pednekar[1], Matthew Goette[1], Prakash Masand[1], and Cory Noel[2] *[1]Radiology, Texas Children's Hospital, Houston, TX, United States, [2]Cardiology, Texas Children's Hospital, Houston, TX, United States* PC-CMR permits precise discrete 3D aortic pulse wave velocity (PWV) measurements as a surrogate for changes in vascular stiffness and ventricular-vascular interaction. In this preliminary study, global PWVs are 50% higher in 3 single ventricle (SV) patients with reconstructed arch (RA) than 3 patients with native arch (NA). Furthermore, the regional distribution of PWVs in SV-RA indicates rapid deceleration (50-70%) from proximal to distal aorta that is absent in SV-NA. The abnormal shape, large caliber change, and prosthetic material of reconstructed aortas may be additional explanatory variables. Regional distribution of local PWVs could potentially predict development of abnormal ventricular-vascular interaction.

Electronic Poster

Atherosclerosis & Vessel-Wall Imaging

Exhibition Hall	Monday 14:45 - 15:45

3457	Computer 25	High Spatiotemporal Resolution Dynamic Contrast Enhanced (DCE) For Assessing Vascular Inflammation: Initial Clinical Experience Nan Wang[1,2], Anthony Christodoulou[1], Yibin Xie[1], Zixin Deng[1,2], Bill Zhou[1,3], Zhaoyang Fan[1,3], Wei Yu[4], and Debiao Li[1,2] *[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Medicine, University of California, Los Angeles, Los Angeles, CA, United States, [4]Department of Radiology, Anzhen Hospital, Beijing, China* Dynamic contrast enhanced (DCE) MRI is a promising technique for quantitatively assessing the inflammation of atherosclerosis. However, current applications are facing demanding sampling challenges, and compromises have to be made among spatial resolution, coverage and temporal resolution. We recently proposed a 3D DCE protocol based on Low Rank Tensor (LRT) framework to achieve high spatiotemporal resolution, adequate anatomical coverage and dynamic T1 mapping. In this work, we demonstrated the in vivo feasibility on both healthy subjects and patients with known atherosclerosis.

3458	Computer 26	An inverse association between microvasculature and intraplaque hemorrhage in atherosclerotic carotid lesions: an MR imaging study Geneviève Crombag[1,2], Raf van Hoof[1], Floris Schreuder[3], Martine Truijman[4], Sylvia Heeneman[5], Paul Nederkoorn[6], Werner Mess[2,7], Robert van Oostenbrugge[2,4], Jan-Willem Daemen[8], Mat Daemen[9], Joachim Wildberger[1,2], and Eline Kooi[1,2] *[1]Radiology & Nuclear Medicine, Maastricht University Medical Center, Maastricht, Netherlands, [2]Cardiovascular Research Institute Maastricht, Maastricht, Netherlands, [3]Department of Neurology & Donders Institute for Brain Cognition & Behaviour, Radboud University Medical Centre, Nijmegen, Netherlands, [4]Neurology, Maastricht University Medical Center, Maastricht, Netherlands, [5]Pathology, Maastricht University Medical Center, MAastricht, Netherlands, [6]Neurology, Amsterdam Medical Center, Amsterdam, Netherlands, [7]Clinical Neurophysiology, Maastricht University Medical Center, Maastricht, Netherlands, [8]Surgery, Maastricht University Medical Center, Maastricht, Netherlands, [9]Pathology, Amsterdam Medical Center, Amsterdam, Netherlands* The presence of intraplaque haemorrhage (IPH) has been related to plaque rupture, plaque progression, and predicts cerebrovascular events. However, the mechanisms leading to IPH are not fully understood. The dominant view is that IPH is caused by leakage of erythrocytes from immature microvessels. 101 patients underwent MRI of the symptomatic carotid plaque for detection of IPH and dynamic contrast-enhanced MRI for assessment of plaque microvasculature. A decreased vessel wall Ktrans was found for IPH positive patients. No difference in adventitial Ktrans was found in patients with and without IPH. Not only leaky plaque microvessels, but additional factors may contribute to IPH development.

3459	Computer 27	Decreased plaque microvasculature in symptomatic carotid plaques: a DCE-MRI study Geneviève Crombag[1,2], Raf van Hoof[1], Floris Schreuder[3], Martine Truijman[4], Tobien Schreuder[5], Narender van Orshoven[6], Werner Mess[2,7], Paul Hofman[1], Robert van Oostenbrugge[2,4], Joachim Wildberger[1,2], and Eline Kooi[1,2] *[1]Radiology & Nuclear Medicine, Maastricht University Medical Center, Maastricht, Netherlands, [2]Cardiovascular Research Institute Maastricht, Maastricht, Netherlands, [3]Department of Neurology & Donders Institute for Brain Cognition & Behaviour, Radboud University Medical Centre, Nijmegen, Netherlands, [4]Neurology, Maastricht University Medical Center, Maastricht, Netherlands, [5]Neurology, Zuyderland Medical Center, Sittard, Netherlands, [6]Zuyderland Medical Center, Sittard, Netherlands, [7]Clinical Neurophysiology, Maastricht University Medical Center, Maastricht, Netherlands* Rupture of a vulnerable atherosclerotic plaque can lead to thrombus formation and, subsequently, to ischemic events. Intraplaque microvessels are thought to play an important role in atherogenesis, since they may facilitate entrance of red blood cells and inflammatory cells into the plaque tissue due to increased endothelial permeability. Symptomatic patients underwent DCE-MRI to assess plaque microvasculature. A significantly lower vessel wall Ktrans was found in the symptomatic carotid plaque compared to the contralateral asymptomatic side. The decrease in vasa vasorum in the symptomatic plaques might be due to a higher amount of necrotic tissue on this side.

3460	Computer 28	Feature Extraction using Convolutional Networks for Identifying Carotid Artery Atherosclerosis Patients in a Heterogeneous Brain MR Dataset Mariana Bento[1], Luis A. Souto Maior Neto[2], Marina Salluzzi[3], Yunyan Zhang[1], and Richard Frayne[1] *[1]Departments of Radiology and Clinical Neuroscience, Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada, [2]Biomedical Engineering, University of Calgary, Calgary, AB, Canada, [3]Calgary Image Processing and Analysis Centre, Foothills Medical Centre, Calgary, AB, Canada* Analysis of pathology in patients from heterogeneous datasets using machine learning techniques provide valuable information for identifying patients with carotid artery atherosclerosis disease. We propose and evaluate a method to automatically identify these patients based only on MR brain imaging findings in a dataset also containing multiple sclerosis patients and healthy control subjects. The features extracted using convolutional networks were discriminative, showing high accuracy rates (>96%) to distinguish between the three classes: atherosclerosis patients, multiple sclerosis patients or healthy controls. The method may help specialists in the diagnosis (specially in critical cases), and evaluation of disease activity.

3461	Computer 29	Investigating the estimated intracranial wall thickness on MRI vessel wall images: what voxel size do we need? Kees M. van Hespen[1], Jaco J.M. Zwanenburg[2], Anita A. Harteveld[2], Peter R. Luijten[2], Jeroen Hendrikse[2], and Hugo J. Kuijf[3] *[1]Center for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [2]Department of Radiology, UMC Utrecht, Utrecht, Netherlands, [3]Image Sciences Institute, UMC Utrecht, Utrecht, Netherlands* We investigated the influence of voxel size on the accuracy and precision of intracranial vessel wall thickness measurements on MR images. Circle of Willis specimens were scanned at ultra-high resolution (0.11mm). Downsampling these images showed that distinguishing thin (0.35-0.45mm), medium (0.65-0.75mm) and thick (0.95-1.05mm) vessel walls requires voxel sizes below 0.55-0.66mm, although thickness measurements showed considerable bias at those resolutions. Unbiased measurements required a voxel size of 0.2mm or less. A clinically used MRI protocol (0.8mm), could only correctly measure vessel walls thicker than 0.9mm. In summary, current intracranial vessel wall MRI protocols provide limited quantification of vessel wall thickness.

3462	Computer 30	Precision and Accuracy of Coronary Cross-Sectional Area MRI Measurements Used to Measure Coronary Endothelial Function Michael Schär[1], Sahar Soleimanifard[1], Gabriele Bonanno[1,2], Jérôme Yerly[3,4], Allison G Hays[2], and Robert G Weiss[1,2]

[1]Division of MR Research, Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Division of Cardiology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland

Coronary endothelial function (CEF) can be measured noninvasively with MRI by quantifying changes in coronary artery cross-sectional area in response to isometric handgrip exercise. Those area changes are only a few imaging pixels because of MRI's limited spatial resolution. Here we show with both numerical simulations and phantom measurements that 8-fold Fourier interpolation enables sub-pixel area measurement precision. Second, area measurement precision and accuracy can be further improved with smaller acquisition voxels as long as the signal-to-noise ratio remains above 30. Third, the currently used CEF-MRI protocol distinguishes area-changes of less than 5% at SNR measured in vivo.

3463 Computer 31

3D dual-contrast vessel wall imaging of the aortic arch

Zhaoyang Fan[1,2], Qi Yang[1,3], Guoxi Xie[4], Xiaoming Bi[5], Shlee Song[1], Marcel Maya[1], and Debiao Li[1,2]

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Atherosclerotic disease of the aortic arch has been considered a potential cause of cryptogenic stroke. Vessel wall MR imaging can directly probe atherosclerotic lesions to provide assessment of plaque burden and instability. However, its clinical adoption for the aortic arch is hindered primarily by long imaging time that is associated with the needs for large spatial coverage, high spatial resolution, compensation of motion, and multiple image contrasts. In this work, we proposed a fast 3D dual-contrast vessel wall MR technique that is potentially useful for detecting intraplaque hemorrhage and calcification as well as measuring plaque burden at the aortic arch.

3464 Computer 32

Quantitatively monitoring therapeutic response in patients with symptomatic intracranial atherosclerotic disease using 3D MR plaque imaging

Zhaoyang Fan[1,2], Qi Yang[1,3], Feng Shi[1], Shlee Song[1], Konrad Schlick[1], Mercel Maya[1], Nestor Gonzalez[1], and Debiao Li[1]

[1]Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]University of California, Los Angeles, CA, United States, [3]Xuanwu Hospital, Beijing, China

		Intracranial atherosclerotic disease (ICAD) is one of the most common causes of ischemic stroke worldwide. Despite intensive medical management, which is the current standard of care, the rate of recurrent stroke is 13% in the first year and as high as 35% in certain populations by 2 years. Initial and follow-up evaluations of these patients rely exclusively on assessments of clinical risk factors and, in some circumstances, the degree of luminal stenosis on imaging, which may overlook subtle non-luminal changes within ICAD lesions. In the present work, we sought to assess the feasibility of quantitatively monitoring regression or progression of intracranial atherosclerotic plaques using 3D VWI.

3465	Computer 33	Quantitative and Noninvasive MRI of the Endothelial Permeability and Function in Carotid Atherosclerosis
		Alkystis Phinikaridou[1], Justinas Silickas[2], Begoña Lavin[1], Marcelo Andia[3], Alberto Smith[2], Prakash Saha[2], and René Botnar[2]
		[1]Biomedical Engineering, King's College London, London, United Kingdom, [2]King's College London, London, United Kingdom, [3]Pontificia Universidad Católica de Chile, Santiago, Chile
		Over the past two decades, the central role of the endothelium in the initiation, progression, and clinical sequelae of atherosclerosis has been recognized. Increased endothelial permeability and impaired function precedes and portends the development of atherosclerotic lesions and their clinical manifestations. We have previously shown that quantitative assessment of albumin leakage into the vessel wall, using a clinically approved albumin-binding contrast agent, and endothelial-dependent dysfunction associated with lesion progression and instability in animal models. Here, we translated this technique in man to test whether endothelial permeability and dysfunction associate with carotid atherosclerosis risk in patients undergoing endarterectomy.

3466	Computer 34	Automatic segmentation of the aortic arterial wall in a pre-clinical rabbit model of atherosclerosis: preliminary experience with a convolutional neural network
		Daniel Samber[1], Claudia Calcagno[1], Edmund Wong[1], Venkatesh Mani[1], Cheuk Tang[1], and Zahi A. Fayad[1]
		[1]Icahn School of Medicine at Mount Sinai, New York, NY, United States
		The task of manually evaluating medical images can be onerous, plagued by subjective bias, and subject to human error. In this study we apply a convolutional neural network (CNN) for automated image segmentation of the atherosclerotic vessel wall, a notoriously challenging and time consuming segmentation task. Our CNN shows a classification accuracy of 90% on testing data, and a intersection over union (IoU) weighted by the number of pixels in each class of 86%, indicating excellent segmentation. Our results suggest that, if appropriately optimized this method has the potential deliver faithful and automatic segmentation of the arterial vessel wall.

3467	Computer 35	Head and Neck Vascular Calcification Imaging using Zero Echo Time
		Jianmin Yuan[1], Florian Wiesinger[2], Pascal Ruetten[1], Ilse Patterson[3], Martin Janich[2], Ana Beatriz Solana[2], Gaspar Delso[4], Scott Reid[5], Jonathan Gillard[1], and Martin Graves[1,3]
		[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]ASL Europe, GE Healthcare, Munich, Germany, [3]Department of Radiology, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom, [4]ASL Europe, GE Healthcare, Cambridge, United Kingdom, [5]ASL Europe, GE Healthcare, Pollards Wood, United Kingdom
		Calcification is an important factor in carotid plaque development and rupture. Current standard method for detecting plaque calcification is CT angiography (CTA). The purpose of this study is to introduce a new MRI method using zero echo time sequence for detection of carotid vessel wall calcification with high sensitivity. The protocol was optimized in volunteers and then applied to patient scan. The results demonstrate that carotid plaque calcification can be detected with high accuracy using proposed protocol compared with contrast-weighed images.

3468	Computer 36	Quantitative Assessment of Carotid Artery Atherosclerosis by Three-Dimensional Magnetic Resonance Imaging and 2D Ultrasound: A Comparison Study
		Huiyu Qiao[1], Ying Cai[2], Qiang Zhang[1], Lingyun Huang[3], Manwei Huang[4], Chun Yuan[1,5], and Xihai Zhao[1]
		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China, [2]Department of Radiology, Taizhou People's Hospital, Taizhou, China, [3]Clinical Sites Research Program, Philips Research China, Shanghai, China, [4]Department of Ultrasound, China Meitan General Hospital, Beijing, China, [5]Department of Radiology, University of Washington, Seattle, WA, United States
		The size of carotid atherosclerotic plaques is associated with ischemic cerebrovascular events. Both 3D MR vessel wall imaging and 2D ultrasound can measure carotid plaques. To improve the work flow of screening for subclinical carotid atherosclerosis, this study sought to compare the quantitative measurements of carotid plaque between 3D MR and 2D ultrasound imaging. Excellent agreement was found between MR and ultrasound imaging in measuring carotid artery maximum wall thickness. Although there was moderate to strong correlation between MR and ultrasound imaging, the plaque area measured by MR imaging was more than two folds than that measured by ultrasound imaging.

3469	Computer 37	PD-T2-Shuffled Volumetric ISotropic Turbo spin echo Acquisition (VISTA) for 3D Simultaneous Multi-contrast Intracranial Vessel Wall Imaging
		Shuo Chen[1], Zechen Zhou[2], Haikun Qi[1], Chun Yuan[1,3], and Rui Li[1]

		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China, [2]Philips Research North America, Cambridge, MA, United States, [3]Vascular Imaging Lab, Department of Radiology, University of Washington, Seattle, WA, United States
		The aim of this study was to develop a PD-T2-shuffled VISTA technique, which can provide co-registered 3D high multi-contrast intracranial vessel wall images with high scan efficiency. Phantom study and healthy volunteers study were performed to validate the feasibility of the proposed method. The results showed that middle cerebral artery vessel wall was clearly depicted on different weighed images of PD-T2-shuffled VISTA.

3470	Computer 38	Imaging uptake of plasma macromolecules in the arterial wall
		Marta Dazzi[1], René Botnar[2], and Peter Weinberg[1]
		[1]Department of Bioengineering, Imperial College London, London, United Kingdom, [2]Biomedical Engineering, King's College London, London, United Kingdom
		Elevated endothelial permeability is a precursor to atherosclerosis. Imaging macromolecule uptake in the artery wall can be used to detect and investigate early structural and functional endothelial dysfunction. Current techniques make use of destructive post-mortem analysis of tissue, limiting studies to animal models only. MR imaging of the transport of an albumin-binding contrast agent (Gadofosveset) could be used instead. We employed a mathematical model to differentiate between the bound and unbound fraction of the contrast agent thus making this method a promising non-invasive technique to measure permeability in humans for the first time.

3471	Computer 39	Quantification of Wall Shear Stress in the Carotid Arteries of Naïve and Dyslipidemic Non-Human Primates
		Smita Sampath[1], Weiwei Luo[2], Ying-Hua Chu[3], Fa-Hsuan Lin[3], Michael Klimas[4], Elaine Manigbas[5], Willy Gsell[5,6], Kirsten Jacobsen[7], Eric Gifford[2], Asad Abu Bakar Ali[1], Jeffrey L Evelhoch[4], and Chih-Liang Chin[1]
		[1]Translational Biomarkers, MRL, MSD, Singapore, Singapore, [2]Bioinformatics, MRL IT, MSD, Singapore, Singapore, [3]National Taiwan University, Taipei, Taiwan, [4]Translational Biomarkers, MRL, Merck & Co., Inc., West Point, PA, United States, [5]Imaging, Maccine Pte. Ltd., Singapore, Singapore, [6]MoSAIC, Biomedical MRI, Department of Imaging and Pathology, KU Leuven, Leuven, Belgium, [7]Early Discovery Pharmacology, MRL, MSD, Singapore, Singapore

		Herein, we quantified regional carotid wall shear stress (WSS) in 9 naïve NHPs on a normal diet and 4 dyslipidemic NHPs on a high fat diet. A custom-built carotid coil was used to achieve high-resolution imaging. Image analysis was performed including 3D structural and velocity interpolation, contour extraction and through-plane velocity projection. Velocity gradients at the contours were computed to quantify WSS. Animals on high fat diet showed enlarged common carotid arteries (diameter: 2.717 ± 0.195 mm) and lower WSS (0.1478 ± 0.0522 N/m2) compared to animals on a normal diet (diameter: 2.132 ± 0.203 mm, 0.2209 ± 0.0817 N/m2).

3472	Computer 40	A Phantom Study to Compare the Theoretical Accuracy and Precision of CT Angiography versus Radial MRI for the Assessment of Coronary Endothelial Function
		Jerome Yerly[1,2], Fabio Becce[1], Danilo Gubian[3], Ruud van Heeswijk[1,2], Francis R Verdun[4], Reto Meuli[1], and Matthias Stuber[1,2]
		[1]Diagnostic and Interventional Radiology, Lausanne University Hospital (CHUV and UNIL), Lausanne, Switzerland, [2]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [3]Direction des Constructions, Ingénierie, Technique et Sécurité (CIT-S), Lausanne University Hospital (CHUV and UNIL), Lausanne, Switzerland, [4]Institute of Radiation Physics, Lausanne University Hospital (CHUV and UNIL), Lausanne, Switzerland
		CT angiography (CTA) and MRI are non-invasive imaging modalities to assess coronary endothelial function (CEF). However, the performance of these techniques has yet to be quantitatively compared. Images of an in vitro phantom that simulates a physiological range of coronary artery cross-sectional areas (CSAs) were acquired using both CTA and MRI. CSAs were automatically measured and compared to the known nominal values. Statistical analysis suggests that MRI is capable of detecting significantly smaller CSA differences than CTA (2.25±0.80% vs. 7.42±0.63% for a 3-mm baseline diameter; p<0.0001), which is well within the range of physiological vasomotor responses of proximal coronary arteries.

3473	Computer 41	Does the amount of signal change depend on calcium concentration in lipid-rich core plaque?
		Yuki Kanazawa[1], Kotaro Baba[2], Tosiaki Miyati[3], Masafumi Harada[1], Hiroaki Hayashi[1], Ikuho Kosaka[2], Mitsuharu Miyoshi[4], Michael Carl[5], and Yuki Matsumoto[6]
		[1]Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan, [2]School of Health Sciences, Tokushima University, Tokushima, Japan, [3]Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan, [4]Global MR Applications and Workflow, GE Healthcare Japan, Hino, Japan, [5]GE Healthcare, San Diego, CA, United States, [6]Graduate school of Health Science, Tokushima University, Tokushima, Japan

		The purpose of this study was to quantitatively detect calcification in LRNC plaques using multi-component analysis with UTE imaging. A phantom experiment was performed using a four echo-UTE sequence. The phantom consists of six different concentrations of hydroxyapatite (as calcification) and mayonnaise (as a lipid). The bi-exponential analysis with UTE enabled a split into two components of short- and long T_2^*successfully. R_2^* derived from each dataset increased with increasing concentrations of hydroxyapatite. In conclusion, multi-component T_2^* analysis with UTE makes it possible to evaluate calcification in atherosclerotic plaques.

3474	Computer 42	Dynamic MRI of Nitroxide Radical for TEMPOL kinetics and Redox State Assessment in Porcine Aortic Wall
		Maxim Terekhov[1], Mihaela Pali[1], Christian Wittke[1], David Lohr[1], Anja Schroeder[2], Sueleyman Erguen[3], Alma Zernecke-Madsen[4], Heike Walles[2], and Laura Maria Schreiber[1]
		[1]Chair of Cellular and Molecular Imaging, Comprehensive Heart Failure Center, University Hospital Wuerzburg, Wuerzburg, Germany, [2]Translational Center Regenerative Therapies, Fraunhofer Institute for Silicate Research, Wuerzburg, Wuerzburg, Germany, [3]Institute of Anatomy and Cell Biology, University Wuerzburg, Wuerzburg, Germany, [4]Institute for Experimental Biomedicine II, University Hospital Wuerzburg, Wuerzburg, Germany
		Reactive oxygen species (ROS) plays a key role in vascular disease. The physiological mechanisms regulating vascular local oxidative stress (LOS) are not completely understood. Nitroxide radicals like TEMPOL have been used in basic science NMR studies of ROS and LOS. Therefore, we developed a technique for dynamic imaging of nitroxide radicals to assess their kinetics and redox state of tissue.

3475	Computer 43	Quantification of endothelial permeability in the mouse aortic root with 3D self-gated T1 mapping: disease progression and treatment with statins
		Raphael Soler[1], Zahi Fayad[1], Christopher Faries[1], Gustav Strijkers[1,2], and Claudia Calcagno[1]
		[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands
		Quantification of endothelial permeability in the mouse aortic root with 3D self-gated T1 mapping: disease progression and treatment with statins

3476	Computer 44	Feasibility of coronary artery wall imaging using 3D turbo spin-echo (black blood -T1-VISTA) in children with Kawasaki disease

		Koji Matsumoto[1,2], Hajime Yokota[3], Hiroki Mukai[3], Naoki Saito[4], Yoshitada Masuda[1], Takashi Uno[3], and Tosiaki Miyati[2]
		[1]Department of Radiology, Chiba University Hospital, Chiba, Japan, [2]Division of Health Sciences, Graduate School of Medial Science, Kanazawa University, Kanazawa, Japan, [3]Diagnostic Radiology and Radiation Oncology, Graduate School of Medicine, Chiba University, Chiba, Japan, [4]Department of Pediatrics, Chiba University Hospital, Chiba, Japan
		We evaluate feasibility of three-dimensional turbo spin echo imaging (BB-T1-VISTA) as coronary artery wall imaging for Kawasaki disease. BB-T1-VISTA could visualize the proximal regions of the coronary artery appropriately. BB-T1-VISTA with axial orientation produced the highest reproducibility to magnetic resonance coronary angiography (MRCA). Although BB-T1-VISTA showed significantly smaller diameter than MRCA, the limits of agreement were small in the proximal regions with normal diameter. By contrast, the larger aneurysms were, the larger bias became between MRCA and BB-T1-VISTA. BB-T1-VISTA has a potential to evaluate wide range of the coronary artery at once and was feasible in regions with small diameter.

3477	Computer 45	Infarct Pattern and Large Artery Atherosclerosis Features Revealed by Combined Intra- and Extra-cranial Vessel Wall Imaging in Patients with Non-cardiac Acute and Sub-acute Ischemic Stroke
		Na Zhang[1], Jinhao Lyu[2], Lei Zhang[1], Lin Jia[3], Wenxiao Jia[3], Hairong Zheng[1], and Xin Liu[1]
		[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Radiology, Chinese PLA General Hospital, Beijing, China, [3]XinJiang Medical University, Urumchi, China
		Infarct pattern referring single or multiple infarction lesions of patients with ischemic stroke is a feasible imaging marker to predict future stroke recurrence. The aim of this study was to detect large artery atherosclerosis features resulting in single or multiple infarction lesions in patients with non-cardiac acute and sub-acute ischemic stroke using the combined intra- and extra-cranial vessel wall MR imaging method. The results demonstrated that in large artery atherosclerosis, infarct pattern may be associated with the vulnerability of atherosclerotic plaques, and this combined imaging method can be used to explore the vascular pathology and predict recurrence of ischemic stroke.

3478	Computer 46	DCE-MRI of Intracranial Artery Athoersclerosis: Quantitative Change After 6-month Statin Therapy.
		Huijun Chen[1], Jiaqi Dou[1], Le He[1], Chunyao Wang[1], Haikun Qi[1], Qiang Zhang[1], and Xihai Zhao[1]
		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua university, Beijing, China

		Dynamic contrast-enhanced MRI (DCE-MRI) has been proven to be able to quantify the inflammation and neovasculature in the atherosclerotic plaque of carotid artery. However, few studies has focus on the DCE-MRI of intracranial artery atherosclerosis, which is another major cause of cerebral ischemic events. This study found that the K^{trans} of intracranial artery calculated from DCE-MRI was significantly lower at follow-up comparing with baseline after 6-month statin therapy, suggesting DCE-MRI a good tool for therapeutic response evaluation for intracranial artery atherosclerosis

3479	Computer 47	“3D-Stars” Cine MRI for the Coronary Arteries: Initial Steps towards Volumetric Endothelial Function Assessment
		Gabriele Bonanno[1,2], Davide Piccini[3,4], Jérôme Yerly[4,5], Sahar Soleimanifard[1,2], Li Pan[6], Xiaoming Bi[7], Allison G Hays[1], Matthias Stuber[4,5], Robert G Weiss[1,2], and Michael Schär[2]
		[1]Division of Cardiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [4]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [5]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [6]Siemens Healthineers, Baltimore, MD, United States, [7]Siemens Healthineers, Los Angeles, CA, United States
		Recently, 2D coronary cine MRI has been shown to noninvasively assess coronary endothelial dysfunction, which is an early manifestation of atherosclerosis and a predictor of future acute events. However, atherosclerosis is a diffuse process, whereas this 2D approach provides local functional measures. Here, we present a free-breathing golden-angle 3D stack-of-stars cine sequence with isotropic spatial resolution combined with respiratory self-gating and 5D-GRASP reconstruction to image the proximal and mid segments of the right coronary artery. We call this new method ***“3D-Stars”*** and show feasibility to obtain volumetric cross-sectional area measures that can be used in future endothelial function studies.

3480	Computer 48	Influence of Field Strength on the Appearance of Peripheral Vascular Calcifications using Magnetic Resonance Imaging
		Ali Serhal[1], Ioannis Koktzoglou[2,3], Pascale Aouad[1], James Carr[1], Shivraman Giri[4], Omar Morcos[5], and Robert R Edelman[1,2]
		[1]Radiology, Feinberg School of Medicine, Northwestern University, Chicago, IL, United States, [2]Radiology, NorthShore University HealthSystem, Evanston, IL, United States, [3]Radiology, Prtizker School of Medicine, University of Chicago, Chicago, IL, United States, [4]Siemens Healthineers, Chicago, IL, United States, [5]Surgery, NorthShore University HealthSystem, Evanston, IL, United States

		A major deficiency of MR angiography compared with CT angiography (CTA) has been its inability to detect and characterize peripheral vascular calcifications. Recently, MRI using a proton density-weighted, in-phase stack of stars technique proved capable of identifying these calcifications. However, the diamagnetic susceptibility and short T2* of calcifications have the potential to cause clinically relevant, field strength-dependent changes in lesion appearance with MRI. Since the impact of field strength on the appearance of vascular calcifications is unknown, we performed a two-center clinical study which demonstrated that MRI accurately depicts peripheral vascular calcifications at both 1.5 Tesla and 3.0 Tesla.

Electronic Poster

Machine Learning for Image Analysis

Exhibition Hall	Monday 14:45 - 15:45

3481	Computer 49	AUTO-DCE-MRI: A Deep-Learning Augmented Liver Imaging Framework for Fully-Automated Multiphase Assessment and Perfusion Mapping
		Li Feng[1], Fang Liu[2], Henry Rusinek[1], Bari Dane[1], Henry Brody[1], Teodora Chitiboi[1], Daniel K Sodickson[1], Ricardo Otazo[1], and Hersh Chandarana[1]
		[1]Center for Advanced Imaging Innovation and Research (CAI2R) and Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Department of Radiology, University of Wisconsin School of Medicine, Madsion, WI, United States
		This work proposes and tests a novel dynamic contrast-enhanced liver MRI framework called AUTO-DCE-MRI, which allows for simultaneous multiphase assessment and automated perfusion mapping from a single continuous free-breathing data acquisition. A deep convolutional neural network is trained to automatically select the abdominal aorta and the main portal vein. For low temporal-resolution multiphase assessment, the contrast bolus information is extracted from the aorta to guide image reconstruction of desired contrast phases. For high temporal-resolution perfusion analysis, the arterial/venous input functions are generated from the automatically selected regions in the aorta and main portal vein for pharmacokinetic modeling.

3482	Computer 50	Supervised Machine Learning with Blind Source Separation (BSS) reveals distinct networks of pathological changes in brain magnetic susceptibility (QSM): Application to multiple sclerosis.
		Ferdinand Schweser[1,2], Juliane Damm[1], Niels P Bergsland[1,3], Michael G Dwyer[1], Akshay V Dhamankar[1], Bianca Weinstock-Guttman[4], and Robert Zivadinov[1,2]

		[1]Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, The State University of New York, Buffalo, NY, United States, [2]Center for Biomedical Imaging, Clinical and Translational Science Institute, University at Buffalo, The State University of New York, Buffalo, NY, United States, [3]MR Research Laboratory, IRCCS, Don Gnocchi Foundation ONLUS, Milan, Italy, [4]BairdMS Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, The State University of New York, Buffalo, NY, United States
		Conventional region-of-interest (ROI) or voxel-based analyses of quantitative susceptibility maps (QSM) do not provide insights on the mechanistic and temporal independence of tissue alterations between subjects. In this study, we combined Blind Source Separation (BSS) with a Machine Learning strategy to reveal specific, independent disease-related networks of tissue alterations. Our analysis identified anatomically localized independent networks of pathological susceptibility alterations in multiple sclerosis (MS) without *a priori* information on age, sex, disease, or anatomy.

		Machine learning for prostate cancer Gleason score prediction using radiomics of T2-weighted imaging, diffusion weighted imaging and T2-mapping
		Jussi Toivonen[1,2], Ileana Montoya Perez[1,2], Parisa Movahedi[1,2], Harri Merisaari[1,2], Janne Verho[2], Pekka Taimen[3], Peter J Boström[4], Tapio Pahikkala[1], Hannu J Aronen[2], and Ivan Jambor[1,2]
3483	Computer 51	*[1]Department of Future Technologies, University of Turku, Turku, Finland, [2]Department of Diagnostic Radiology, University of Turku, Turku, Finland, [3]Department of Pathology, University of Turku, Turku, Finland, [4]Department of Urology, Turku University Hospital, Turku, Finland*
		We extensively evaluated large number radiomics of prostate T2-weighted imaging, diffusion weighted imaging and T2-mapping. The highest overall performance estimate (AUC = 0.88) we obtained for the model utilizing a small subset of texture features from the ADCm, K, and T2w parameters. These features included texture descriptors based on gray-level co-occurrence matrix, Gabor transform, and the Zernike and Hu moments.

3484	Computer 52	An integrative deep learning model to distinguish between normal and atherosclerotic carotid arteries on black-blood vessel wall MRI
		Jiayi Wu[1,2], Jingmin Xin[1], Jie Sun[2], Zechen Zhou[3], Baocheng Chu[2], Dongxiang Xu[2], and Chun Yuan[2]
		[1]Institute of Artificial Intelligence and Robotics, Xi'an Jiaotong University, Xi'an, China, [2]Department of Radiology, University of Washington, Seattle, WA, United States, [3]Philips Research North America, Cambridge, Cambridge, MA, United States

		Vessel wall (VW) MRI has been used to characterize atherosclerotic plaques but the review process is complex. To facilitate the translation of VWMRI into clinical application, we utilized deep convolutional neural networks (CNN) to distinguish between normal and atherosclerotic carotid arteries automatically in black-blood (BB) VWMRI. Trained with a dataset that contains both normal and diseased carotid arteries with expert labeling, an integrative deep CNN model was developed and yielded better automatic diagnosis accuracy of carotid atherosclerosis (85.18%) compared with other existing methods. This model may be used as an initial screening to separate normal from diseased arteries.

3485	Computer 53	Deep learning analysis of cardiac MRI for unsupervised classification of heart disease
		Carlo Biffi[1,2], Ozan Oktay[1], Wenjia Bai[1], Giacomo Tarroni[1], Antonio De Marvao[2], Martin Rajchl[1], Stuart Cook[2,3], Declan O'Regan[2], and Daniel Rueckert[1]
		[1]Department of Computing, Imperial College London, London, United Kingdom, [2]Cardiovascular Magnetic Resonance Imaging and Genetics, MRC London Institute of Medical Sciences, London, United Kingdom, [3]Graduate Medical School, Duke-National University of Singapore, Singapore, Singapore
		Magnetic resonance imaging provides detailed assessment of cardiac structure and function. However, conventional manual phenotyping reduces the rich biological information to few global metrics. A learning-based approach providing more complex phenotypic features could offer an objective data-driven means of disease classification. In this work, we exploit a convolutional variational autoencoder model to learn low-dimensional representations of cardiac remodelling which are easily visualisable on a template shape and readily applicable in classification models. This approach yielded 91,7% accuracy in the discrimination among healthy, hypertrophic and dilated cardiomyopathy subjects, and shows promise for unsupervised classification of pathologies associated with ventricular remodelling.

3486	Computer 54	Automated segmentation of abdominal organs in T1-weighted MR images using a deep learning approach: application on a large epidemiological MR study
		Thomas Küstner[1,2], Marc Fischer[1], Sarah Müller[2], Daniel Guttmann[1], Konstantin Nikolaou[1], Fabian Bamberg[1], Bin Yang[2], Fritz Schick[1], and Sergios Gatidis[1]
		[1]University of Tübingen, Tübingen, Germany, [2]University of Stuttgart, Stuttgart, Germany
		In this study we implemented and validated an automated method for segmentation of T1-weighted MR images using a deep learning approach. We applied the algorithm two 80 training and 20 validation data sets drawn from an epidemiological MR study and observed high accuracy compared to manual tumor segmentation. This approach can potentially contribute to efficient analysis of large epidemiological MR studies in the future.

3487	Computer 55	Fully Automatic Proximal Femur Segmentation in MR Images using 3D Convolutional Neural Networks Siyuan Xiang[1], Gregory Chang[2], Stephen Honig[3], Kyunghyun Cho[4], and Cem M. Deniz[5,6] *[1]Center for Data Science, New York University, New York, NY, United States, [2]Department of Radiology, Center for Musculoskeletal Care, New York University Langone Medical Center, New York, NY, United States, [3]Osteoporosis Center, Hospital for Joint Diseases, New York University Langone Medical Center, New York, NY, United States, [4]Courant Institute of Mathematical Science & Center for Data Science, New York University, New York, NY, United States, [5]Department of Radiology, Center for Advanced Imaging Innovation and Research (CAI2R) and Bernard and Irene Schwartz Center for Biomedical Imaging, New York University Langone Medical Center, New York, NY, United States, [6]The Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States* MRI has been successfully used in structural imaging of trabecular bone micro architecture in vivo. In this project, we develop supervised convolutional neural network for automatically segmental proximal femur from structural MR images. We found that the proposed method provides accurate segmentation without any post-processing, bringing trabecular bone micro architecture analysis closer to clinical practice.

3488	Computer 56	Explanatory Auxiliary Generative Adversarial Network for Prostate Cancer Lesion Awareness with Very-Weak Supervision Ruiming Cao[1,2], Xinran Zhong[1], and Kyunghyun Sung[1] *[1]Radiology Department, University of California, Los Angeles, Los Angeles, CA, United States, [2]Computer Science, University of California, Los Angeles, Los Angeles, CA, United States* Although supervised deep convolutional neural network has shown good performance regarding lesion detection and classification using multi-parametric MRI, it is still limited by high data label requirement. In this work, we proposed a model called explanatory auxiliary generative adversarial network (ExpA-GAN), which generates heatmap for object detection under very-weak supervision (no ground truth location). The model was trained and evaluated in a public TCIA prostate dataset. Among 50 testing slices enclosing the whole prostate, the proposed model achieves 0.169 normalized distance for lesion detection, showing the potential to improve lesion detection using limited labeled data.

3489	Computer 57	Cascaded 3D fully convolutional neural network for segmenting amygdala and its subnuclei Yilin Liu[1], Brendon Nacewicz[1], Gregory Kirk[1], Andrew Alexander[1], and Nagesh Adluru[1] *[1]University of Wisconsin Madison, Madison, WI, United States*

		We address the problem of segmenting subcortical brain structures that have small spatial extent but are associated with many neuropsychiatric disorders and neurodegenerative diseases. Specifically, we focused on the segmentation of amygdala and its subnuclei. Most existing methods including deep learning based focus on segmenting larger structures and the existing architectures do not perform well on smaller structures. Hence we designed a new cascaded fully convolutional neural network with architecture that can perform well even on small structures with limited training data. Several key characteristics of our architecture: (1) 3D convolutions (2) deep network with small kernels (3) no pooling layers.

3490	Computer 58	MR Image Synthesis Using A Deep Learning Based Data-Driven Approach
		Fang Liu[1] and Alan McMillan[1]
		[1]*Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States*
		In this study, we demonstrate MR image synthesis using deep learning networks to generate six image contrasts (T1- and T2-weighted, T1 and T2 FLAIR, STIR, and PD) from a single multiple-dynamic multiple-echo (MDME) sequence. A convolutional encoder-decoder (CED) network was used to map axial slices of the MDME acquisition to the six different image contrasts. The synthesized images provide highly similar contrast and quality in comparison to the real acquired images for a variety of brain and non-brain tissues and demonstrate the robustness and potential of the data-driven deep learning approach.

3491	Computer 59	Arterial spin labeling (ASL)-based radiomics features for predicting perfusion territory changes after carotid endarterectomy: a pilot study
		Tianye Lin[1], Chencui Huang[2], Jianxun Qu[3], Bing Wu[3], Panli Zuo[2], Xiangfei Chai[2], and Feng Feng[4]
		[1]*Radiology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, China,* [2]*. Huiying Medical Technology Co., Ltd, Beijing, China,* [3]*GE Healthcare, MR Research China, Beijing, China,* [4]*Peking Union Medical College Hospital, Beijing, China*
		To investigate whether radiomics can be apply to cerebrovascular disease and to develop features based on ASL for predicting perfusion territory change after carotid endarterectomy (CEA). A total of 1029 features were derived from ASL images, and 14 features were selected when comparing the differences between the two groups (select K best $P<0.05$). The selected features in difference are in agreement with visual inspection of collateral flow based on arterial transit artifact (ATA) on ASL.

3492	Computer 60	Perfusion MRI in stroke as a regional spatio-temporal texture

		Noëlie Debs[1], Mathilde Giacalone[1], Pejman Rasti[2], Tae-Hee Cho[1], Carole Frindel[1], and David Rousseau[2]
		[1]CREATIS UMR 5220, U1206, University of Lyon, Lyon, France, [2]LARIS, UMR INRA IRHS, Université d'Angers, Angers, France
		We tackle the clinical issue of predicting the final lesion in stroke from early perfusion magnetic resonance imaging. We demonstrate here the value of exploiting directly the raw perfusion data by encoding the local environment of each voxel as a spatio-temporal texture. As an illustration for this approach, the textures are characterized with Haralick coefficients computed on co-occurrence matrices and a standard support vector machine classifier is used for the classification. This simple machine learning classification scheme demonstrates good results while working on raw perfusion data.

3493	Computer 61	Predicting Contrast Agent Enhancement with Deep Convolution Networks
		Thomas Christen[1], Enhao Gong[1], Jia Guo[1], Michael M. Moseley[1], and Greg Zaharchuk[1]
		[1]Radiology, Stanford University, Stanford, CA, United States
		In this study, we tested whether deep convolutional neural networks (CNNs) could predict what an image would look like if a contrast agent was injected in the body. We trained a network to use information contained in a non-contrast MR brain exam and create a synthetic T1w image acquired after gadolinium injection. Multiple datasets including patients with tumors were used for training. Great similarities were found between the predicted and the actual images acquired after contrast agent injection. If further validated, this approach could have great clinical utility in patients who cannot receive contrast.

3494	Computer 62	Automatic Segmentation of Carotid Vessel Wall Using Convolutional Neural Network
		Li Chen[1], Jie Sun[2], Wei Zhang[3], Thomas S Hatsukami[4], Jianrong Xu[3], Jenq-Neng Hwang[1], and Chun Yuan[2]
		[1]Electrical Engineering, University of Washington, Seattle, WA, United States, [2]Radiology, University of Washington, Seattle, WA, United States, [3]Radiology, Renji Hospital, Shanghai, China, [4]Surgery, University of Washington, Seattle, WA, United States
		Accurate vessel wall segmentation on black-blood MRI is an important but difficult task. Using previously annotated carotid vessel wall contours by human reviewers, a convolutional neural network (CNN) was trained to predict vessel wall region from the combination of T1-weighted and time-of-flight images. Compared with human segmentation results, the CNN-based model achieved a Dice similarity coefficient of 0.86±0.06 and a correlation coefficient of 0.96 (0.94, 0.97) in measuring vessel wall area. Fast and accurate vessel wall segmentation may help fully realize the potential of vessel wall MRI in monitoring atherosclerosis progression or regression in serial studies and clinical trials.

3495	Computer 63	3D Texture Analysis on fMRI to Detect Alterations in the Striatal Network of an Alcohol-Preferring Rat Model
		Silvia Ruiz-España[1], Rafael Ortiz-Ramón[1], Úrsula Pérez-Ramírez[1], Antonio Díaz-Parra[1], Roberto Ciccocioppo[2], Santiago Canals[3], and David Moratal[1]
		[1]Center for Biomaterials and Tissue Engineering, Universitat Politècnica de València, Valencia, Spain, [2]School of Pharmacy, University of Camerino, Camerino, Italy, [3]Instituto de Neurociencias, Consejo Superior de Investigaciones Científicas - Universidad Miguel Hernández, Sant Joan d' Alacant, Spain
		We propose an approach that uses 3D texture features extracted from fMRI to detect changes in the striatal network induced by alcohol drinking. Scans of eighteen alcohol-preferring rats before and after 30 days of alcohol consumption were analyzed. Data were preprocessed and a group independent component analysis was performed to identify striatal network; in total 36 volumes of interest were studied. Texture analysis was performed using 43 texture features and six predictive models. An AUC of 0.927±0.089 (sensitivity=84.25%, specificity=81.75%) was obtained for the best model (random forests). The proposed method was able to accurately identify subjects with alcohol use disorders.

3496	Computer 64	Estimating Inclusion Stiffness with Artificial Neural Networks in Magnetic Resonance Elastography
		Jonathan M. Scott[1], Matthew C. Murphy[1], Arvin Arani[1], Christopher G. Schwarz[1], Armando Manduca[1], John Huston III[1], and Richard L. Ehman[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		Magnetic Resonance Elastography stiffness estimates in intracranial tumors correlate with intraoperative assessment of tumor consistency, but the spatial kernel-based stiffness calculation of Direct Inversion (DI) creates challenges for small or heterogeneous tumors. The objective of this study is to evaluate an artificial neural network based inversion technique (NNI) in the assessment of small stiff inclusions in a brain phantom. This study shows that NNI can resolve inclusions as small as 1.75cm in diameter with a contrast to noise ratio higher than that of DI. Furthermore, preliminary clinical results show agreement with intraoperative findings.

3497	Computer 65	Classification of Adipose Tissues using Machine Learning
		Brandon Campbell[1,2], Gregory Simchick[1,2], Hang Yin[3], and Qun Zhao[1,2]
		[1]Physics and Astronomy, University of Georgia, Athens, GA, United States, [2]Bio-Imaging Research Center, University of Georgia, Athens, GA, United States, [3]Biochemistry and Molecular Biology, University of Georgia, Athens, GA, United States

		Previous classification techniques for determining the quantification of white adipose tissue and brown adipose tissue have relied on using fat fraction and proton relaxation times using fixed peak spectroscopic models. Machine learning algorithms have proven to be highly accurate for image segmentation but their accuracies rely heavily on input datasets. By using the recently proposed Multi-Varying MR Spectroscopy model an increase in dataset specificity can be applied to each voxel by addition of varying fat peak intensity values. Using this new dataset, four machine learning models were compared.

3498	Computer 66	Automated Zonal Prostate Segmentation with 2.5D Convolutional Neural Networks
		Alex Bratt[1], Kevin Seals[2], and Daniel Margolis[3]
		[1]Department of Radiology, Weill Cornell Medicine/New York Presbyterian Hospital, New York, NY, United States, [2]Department of Radiology, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Radiology, Weill Cornell Medicine, New York, NY, United States
		Accurate delineation of anatomical boundaries on prostate MR is crucial for cancer staging and standardized assessment. Unfortunately, manual prostate segmentation is time consuming and prone to inter-rater variability while existing automated segmentation software is expensive and inaccurate. We demonstrate a novel fully-automated zonal prostate segmentation method that is fast and accurate using a convolutional neural network. The network is trained using a dataset of 149 T2-weighted prostate MR volumes that were manually annotated by radiologists. Our method improves upon prior related work, achieving a full-gland Dice score of 0.92 and zonal Dice score of 0.88.

3499	Computer 67	MR Intensity Normalization: Influence on Supervised Machine Learning Algorithms using Textural and Convolutional Features
		Mariana Bento[1], Marina Salluzzi[2], Leticia Rittner[3], and Richard Frayne[1]
		[1]Departments of Radiology and Clinical Neuroscience, Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada, [2]Calgary Image Processing and Analysis Centre, Foothills Medical Centre, Calgary, AB, Canada, [3]School of Electrical and Computer Engineering, University of Campinas, Campinas, Brazil
		Supervised machine learning techniques have been used in medical imaging and aim to reduce subjectivity and improve quantitative results. When handling heterogeneous MR datasets, most algorithms require pre-processing, such as intensity normalization. Here, the influence of MR normalization techniques on supervised classification is evaluated using handcrafted textural and convolutional features. These features combined can differentiate control subjects from atherosclerosis patients using only imaging scans. Non-significant statistical difference in classification was found across intensity normalization methods, demonstrating little influence of this pre-processing step on the supervised classification outcome.

3500	Computer 68	How easily can an existing stroke outcome deep learning model become attuned to new acquisition protocols and patient cohorts?
		Anne Nielsen[1,2], Mikkel Bo Hansen[1], Soren Christensen[3], Maarten Lansberg[3], Greg Zaharchuk[4], and Kim Mouridsen[1]
		[1]Center of Functionally Integrative Neuroscience and MINDLab, Department of Clinical Medicine, Aarhus University, Aarhus, Denmark, [2]Cercare Medical, Aarhus, Denmark, [3]Department of Neurology, Stanford University, Stanford, CA, United States, [4]Department of Radiology, Stanford University, Stanford, CA, United States
		Acute ischemic stroke is a major disease and one of the leading causes of adult death and disability. Final outcome prediction is hampered by the heterogeneity and physiological complexity of stroke progression. Convolutional neural networks have shown promising results in final outcome predictions. However, less attention has been paid to the generalizability of the results across patient cohorts. We test the applicability of an existing neural network trained on two clinical studies to completely independent cohort from the DEFUSE 2 trial. We examine how a few additional patients can be used to obtain performance comparable to the original studies.

3501	Computer 69	Bi-exponential modeling of prostate diffusion weighted MR imaging acquired using high b values: clinical evaluations of advanced post-processing methods
		Parisa Movahedi[1,2], Harri Merisaari[1,3], Ileana Montoya Perez[1,2], Jussi Toivonen[1,2], Pekka Taimen[4], Peter J. Boström[5], Janne Verho[1], Hannu J. Aronen[1,6], Tapio Pahikkala[2], and Ivan Jambor[1,6]
		[1]Department of Diagnostic Radiology, University of Turku, Turku, Finland, [2]Department of Future Technologies, University of Turku, Turku, Finland, [3]Turku PET Center, University of Turku, Turku, Finland, [4]Department of Pathology, Turku University Hospital, Turku, Finland, [5]Department of Urology, Turku University Hospital, Turku, Finland, [6]Medical Imaging Center of Southwest Finland, Turku University Hospital, Turku, Finland
		The aim of this study was to evaluate various mathematical methods for enhanced parameter estimation of bi-exponential DWI (12 b values 0-2000 s/mm2) of prostate cancer. Least Squares (LSQ), Bayesian Shrinkage (BS) and Maximum Penalized Likelihood Estimation (MPLE) fitting methods were evaluated in the terms of Coefficients of Variation (CV), Contrast to Noise Ratio (CNR) and the Area under the curve (AUC) between tumor and non-tumor prostate tissue. BS and MPLE methods improved AUC and CNR values of bi-exponential model parameters and also decreased CV values in comparison with the commonly used LSQ fitting method.

3502	Computer 70	Pelvic Organ Segmentation with Sample Attention based Stochastic Connection Networks
		Dong Nie[1,2], Li Wang[2], Jun Lian[3], and Dinggang Shen[2]

[1]Department of Computer Science, UNC-Chapel Hill, Chapel Hill, NC, United States, [2]Department of Radiology and BRIC, UNC-Chapel Hill, Chapel Hill, NC, United States, [3]Department of Radiation Oncology, UNC-Chapel Hill, Chapel Hill, NC, United States

Accurate segmentation of pelvic organs is important for prostate radiation therapy. Modern radiation therapy starts to use magnetic resonance image (MRI) as an alternative to CT image, because of the superior soft tissue contrast of MRI and also no risk of radiation exposure. In this abstract, we propose a novel deep network architecture, called “Sample Attention based Stochastic Connection Networks” (SASCNet), to delineate pelvic organs from MRI in an end-to-end fashion. Our proposed network has two main contributions: 1) We propose a novel randomized connection module and adopt it as a basic unit to combine the shallower and deeper layers in the fully convolutional networks (FCN); 2) We propose a novel adversarial attention mechanism to automatically dispatch sample importance so that we can avoid the domination of easy samples in training the network. Experimental results show that our SASCNet achieves competitive segmentation accuracy.

3503 Computer 71

Fully Convolutional Networks for Automated Segmentation of Abdominal Adipose Tissue Depots in Water-Fat MRI

Taro Langner[1], Anders Hedström[2], Håkan Ahlström[1,2], and Joel Kullberg[1,2]

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The segmentation and quantification of human adipose tissue depots offers new insights into the development of metabolic and cardiovascular disease but is often hindered by the need for time-consuming and subjective manual input. We propose an automatic method that uses a convolutional neural network for the segmentation of both visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT). The network was applied to two-dimensional slices of 90 water-fat MRI scans of the abdomen. In a 10-fold cross-validation it reached average dice scores of 0.979 (VAT) and 0.987 (SAT), with average absolute quantification errors of 0.8% (VAT) and 0.5% (SAT).

3504 Computer 72

Analysis of longitudinal MRI changes using mixed effects models on deformation tensors

Nagesh Adluru[1], Hyunwoo J Kim[1], Molly Prigge[2], Nicholas T Lange[3], Erin D Bigler[4], Janet E Lainhart[1], Andrew L Alexander[1], and Vikas Singh[1]

[1]University of Wisconsin Madison, Madison, WI, United States, [2]University of Utah, Salt Lake City, UT, United States, [3]Harvard Medical School, Cambridge, MA, United States, [4]Brigham Young University, Provo, UT, United States

		Mixed effects models that include fixed and factor-specific (also known as random) effects offer a natural framework for studying longitudinal MRI data. This work extends mixed effects models to the setting where the responses lie on curved spaces such as the manifold of symmetric positive definite matrices. By treating the subject-wise diffeomorphic deformations between consecutive time points as a field of Cauchy deformation tensors, our framework can facilitate longitudinal analysis that respects the geometry of such data. While the existing body of work dealing with regression models on manifold-valued data is inherently restricted to cross-sectional studies, the proposed mixed effects formulation significantly expands the operating range of longitudinal analyses.

Electronic Poster

Image Reconstruction Potpourri

Exhibition Hall	Monday 14:45 - 15:45

3505	Computer 73	Improving Parallel Imaging by Jointly Reconstructing Multi-Contrast Data
		Berkin Bilgic[1], Tae Hyung Kim[2], Congyu Liao[1], Mary Kate Manhard[1], Lawrence L Wald[1], Justin P Haldar[2], and Kawin Setsompop[1]
		[1]Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States
		We propose a general joint reconstruction framework to accelerate multi-contrast acquisitions further than currently possible with conventional parallel imaging. Our joint parallel imaging techniques simultaneously exploit similarities between echoes/phase-cycles/contrasts, virtual coil concept, partial Fourier acquisition, complementary sampling across images along with limited support and smooth phase constraints. These permit highly accelerated 2D, Simultaneous MultiSlice and 3D acquisitions as well as improved calibrationless parallel imaging from multiple contrasts. Our algorithms, JVC-GRAPPA and J-LORAKS, provide over 2-fold improvement in reconstruction error compared to conventional GRAPPA, with improved mitigation of artifacts and noise amplification.

3506	Computer 74	Parameter Optimization of Wave-CAIPI Based on Theoretical Analysis
		Zhilang Qiu[1], Haifeng Wang[1], Leslie Ying[2], Xin Liu[1], and Dong Liang[1]
		[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Biomedical Engineering and Department of Electrical Engineering, University at Buffalo, The State University of New York, Buffalo, NY, United States

		Wave-CAIPI is an novel 3D imaging technique with corkscrew trajectory in k-space to reduce g-factor penalty and speed up MRI acquisitions. The sinusoidal gradient parameters of Wave-CAIPI, amplitude and cycles, play an important role since they determine the point spread function of the trajectory and thus the final reconstruction. However, how to choose the optimal sinusoidal gradient parameters which leads to the minimal g-factor has not been exploited. In this work, we theoretically analyzed the influence of the sinusoidal gradient parameters on g-factor. An optimization algorithm which can be automatically conducted is then proposed to optimize these parameters for achieving minimal g-factor penalty. The simulations show that using the optimized sinusoidal gradient parameters can achieve lower g-factor penalty in Wave-CAIPI reconstructions.

3507	Computer 75	Nonlinear GRAPPA Reconstruction with Virtual Coil Conception
		Haifeng Wang[1], Yuchou Chang[2], Leslie Ying[3], Xin Liu[1], and Dong Liang[1]
		[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Computer Science and Technology Engineering, University of Houston-Downtown, Houston, TX, United States, [3]Department of Biomedical Engineering and Department of Electrical Engineering, The State University of New York, Buffalo, NY, United States
		Nonlinear GRAPPA is a kernel-based approach for improving parallel imaging reconstruction, by reducing noise-induced error. Virtual coil conception has been applied into the reconstruction process for parallel acquisitions, by generating virtual coils containing conjugate symmetric k-space signals from actual multiple-channel coils. In this work, we proposed a hybrid method to combine nonlinear GRAPPA and virtual coil conception for incorporating additional image- and coil-phase information into the reconstruction process. The experiments of in vivo human brain data show that the proposed method can reduce more noise and artifacts than the traditional GRAPPA and original Nonlinear GRAPPA methods.

3508	Computer 76	A Method for Automatically Determining an Optimal Kernel Size in ESPIRiT Reconstruction
		Jong Bum Son[1], Colleen Costelloe[2], Tao Zhang[1,3], and Jingfei Ma[1]
		[1]Imaging Physics Department, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Diagnostic Radiology Department, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [3]GE Healthcare Technologies, Waukesha, WI, United States

ESPIRiT is a hybrid-domain parallel imaging method which can estimate the coil-sensitivity information from the k-space calibration matrix. In ESPIRiT, the calibration matrix is constructed by sliding a window through the fully sampled data region of auto-calibrating signals. Presently, the kernel size of the sliding window determining the performance of ESPIRiT reconstruction is empirically chosen, even though an optimal value may vary depending on a combination of scan parameters and scan configurations. In this work, we developed an automatic data-driven method for determining an optimal kernel size in ESPIRiT to reduce the performance variation of ESPIRiT reconstructions.

3509 | Computer 77

Improved Parallel Imaging Reconstruction of EPI using Inversely Distortion Corrected FLASH as Calibration Data

Mengye Lyu[1,2], Yilong Liu[1,2], and Ed X. Wu[1,2]

[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China

For parallel imaging reconstruction of EPI, EPI based calibration scan may suffer from ghost artifacts, whereas non-EPI based calibration scan such as FLASH cannot provide consistent geometric distortion. In this study, we propose to employ dual-echo FLASH as the calibration scan, such that B0 field maps can be derived to match FLASH images to EPI images and the reconstruction artifact related to inconsistent distortion can be minimized.

3510 | Computer 78

Accelerated reconstruction for calibrationless parallel imaging using grouped joint nonlinear inversion and its application in myelin water imaging

Zhe Wu[1], Hongjian He[1], Yi Sun[2], and Jianhui Zhong[1,3]

[1]Center for Brain Imaging Science and Technology, Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China, [3]Department of Imaging Sciences, University of Rochester, Rochester, NY, United States

The simultaneous estimation of images and coil sensitivities using joint nonlinear inversion (JNLINV) has been shown to be effective for calibrationless parallel imaging for multi-echo data. However, the number of unknowns grows with increasing number of echoes, so the reconstruction procedure could be lengthy. This study proposes an improved method called grouped JNLINV (gJNLINV) to enhance the reconstruction efficiency. Its reconstruction time is ~1/3 of that with JNLINV while preserving a similar root-mean-square error (RMSE) and increasing the fidelity of the coil sensitivities. We further demonstrate the application of gJNLINV on a 32-echo GRE data set for myelin water imaging.

3511 | Computer 79

In-Plane Signal Leakage (L-factor) Maps from TGRAPPA

		R. Allen Waggoner[1], Kenichi Ueno[2], Hideto Kuribayashi[3], and Keiji Tanaka[1,2]
		[1]Laboratory for Cognitive Brain Mapping, RIKEN-Brain Science Institute, Wako-shi, Japan, [2]Support Unit for Functional Magnetic Resonance Imaging, RIKEN-Brain Science Institute, Wako-shi, Japan, [3]Siemens Healthcare KK, Tokyo, Japan
		Residual aliasing is a well-documented problem for multiband reconstructions, but it can be an important issue with in-plane acceleration methods as well. With GRAPPA in particular, the residually aliased signal can be distributed fairy randomly, making it appear as g-factor noise. We demonstrate that the use of TGAPPA permits not only the elimination of the residually aliased signal but also the determination of L-factor maps, which can be a potentially useful tool in understanding how to minimize residual aliasing.

3512	Computer 80	Parallel Imaging Reconstruction Algorithm Mitigating SNR Loss Using Phase Distribution for Fast Spin Echo Sequence
		Kosuke Ito[1] and Masahiro Takizawa[1]
		[1]Hitachi, Ltd. Healthcare Business Unit, Tokyo, Japan
		Parallel imaging is widely used in clinical routine practice. However, SNR degradation occurs due to undersampling and higher g-factor in higher acceleration factor. In this study, a new algorithm of parallel imaging reconstruction mitigating noise enhancement for fast spin echo sequence was proposed. The algorithm uses information of phase distribution of unaliased image, aliasing image, and folded image. SNR was compared in vivo T2 weighted image between full sampling, conventional parallel imaging, and proposed method. And higher SNR was demonstrated.

3513	Computer 81	Whole-Volume, High-Resolution, In-Vivo Signal-to-Noise Ratio and G-factor Superiority, and Structural Similarity Index Differences, of Compressed Sensing SPACE and CAIPIRINHA SPACE over GRAPPA SPACE
		Neil Kumar[1], Sheil Kumar[2], and Jan Fritz[3]
		[1]Radiology, Johns Hopkins Hospital, Baltimore, MD, United States, [2]Microsoft Corporation, Redmond, WA, United States, [3]Johns Hopkins Hospital, Baltimore, MD, United States

		Compressed Sensing, CAIPIRINHA, and GRAPPA techniques reduce MRI acquisition times. We used a 3-dimensional sliding region-of-interest analysis tool to perform parameter-controlled, whole-volume average signal-to-noise ratio and g-factor comparison, and g-factor structural similarity index measurements (SSIM) of the above techniques in the setting of 3 Tesla knee MRI. We demonstrate g-factor superiority of CS SPACE over CAIPIRINHA SPACE and g-factor superiority of CAIPIRINHA SPACE over GRAPPA SPACE in living subjects. Post-processing, including pre-scan normalize and distortion correction, improves g-factors and causes variation in the g-factor SSIM results between the techniques.

3514	Computer 82	Reduced-FOV k-space Variant Radial Parallel Imaging Reconstruction for Real-time Cardiac MR
		Yu Yulee Li[1,2], Shams Rashid[1], Yang Cheng[1], William Schapiro[1], Kathleen Gliganic[1], Ann-Marie Yamashita[1], Marie Grgas[1], Michelle Maragh[1], and Jie Jane Cao[1,3]
		[1]Cardiac Imaging, St. Francis Hospital DeMatteis Center for Cardiac Research and Education, Greenville, NY, United States, [2]Radiology, Stony Brook University (SUNY), Stony Brook, NY, United States, [3]Medicine, Stony Brook University (SUNY), Stony Brook, NY, United States
		Radial imaging is k-space variant, but mostly uses k-space invariant methods in image reconstruction. This permits reconstructing images with lower computation complexity at a cost of performance. Here a k-space variant parallel imaging reconstruction technique is developed to reconstruct Cartesian data directly from multi-channel radial samples with affordable computation. It is demonstrated that this technique offers the ability to collect real-time images with a temporal resolution of 40ms and a spatial resolution of 1.7mm. The new technique outperforms those gridding-based methods with k-space invariant algorithms in a stress cardiac test.

3515	Computer 83	Radial acquisition and PFT reconstruction allow for retrospective selection of spatial resolution in fMRI studies
		Banfshe Shafiei Zargar[1] and Abbas Nasiraei Moghaddam[1,2]
		[1]Biomedical Engineering, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran (Islamic Republic of), [2]School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran (Islamic Republic of)
		Aiming for fine resolution is always a challenging compromise between various parameters. We have investigated a method for retrospective adjustment of resolution in reconstruction step. Our study of fMRI data indicates that an adjustable pixel size is obtainable in a selected central region during the PFT (Polar Fourier Transform) reconstruction of a radially acquired K-space. Preserving the functional sensitivity, this improvement of resolution results in finer activation detection and higher functional CNR.

3516	Computer 84	Comparison of leading reconstruction techniques for real-time speech MRI Weiyi Chen[1], Yongwan Lim[1], Yannick Bliesener[1], Shrikanth S. Narayanan[1], and Krishna S. Nayak[1] *[1]Electrical Engineering, University of Southern California, Los Angeles, CA, United States* Real-time MRI (RT-MRI) has revolutionized the study of human speech production. Two state-of-the-art reconstruction techniques have been adopted by different groups to accelerate real time imaging, constrained SENSE, and regularized nonlinear inversion. In this study, we describe our best performing implementations of both classes of reconstructions, and compare performance on common data from spiral RT-MRI of human speech at 1.5T.

3517	Computer 85	Partial Fourier Acquisitions in Myocardial First Pass Perfusion Revisited Tobias J Hoh[1], Jonas Walheim[1], Mareike Gastl[1,2], Alexander Gotschy[1,2], and Sebastian Kozerke[1] *[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Department of Cardiology, University Hospital Zurich, Zurich, Switzerland* The inflow of a paramagnetic contrast agent (CA) in cardiac dynamic contrast-enhanced (DCE) MRI effects the local phase of magnetization. In this work the impact of phase variations on Partial Fourier (PF) reconstruction is simulated for k-space zero filling, homodyne (HR) and projections onto convex sets (POCS) reconstruction and consequently assessed in in-vivo first-pass perfusion. CA induced phase variations in DCE MRI are seen to compromise HR and POCS reconstruction of PF data to an extent where they do not convey any benefit over simple zero-filling reconstruction.

3518	Computer 86	Optimization-Based Simultaneous Combination and Unwrapping for MR Phase Imaging John S H Baxter[1,2], Zahra Hosseini[1,2], Olivia W Stanley[1,3], Ravi S Menon[1,3], Maria Drangova[1,2,3], and Terry M Peters[1,2,3] *[1]Imaging Research Laboratories, Robarts Research Institute, London, ON, Canada, [2]Graduate Program in Biomedical Engineering, Western University, London, ON, Canada, [3]Medical Biophysics, Western University, London, ON, Canada*

		MRI phase allows for the extraction of inherent tissue contrasts arising from differences in magnetic susceptibility. However, in order to enhance signal-to-noise ratio and accelerate acquisition, modern MRI uses multiple receiver coils. Extracting susceptibility information relies on combining phase information from these multiple channels. Once combined, phase unwrapping beyond the [$$$-\pi$$$, $$$\pi$$$] range allows for further processing and visualization. These processes can be sensitive to noise and errors which are compounded during serial processing, motivating more robust integrated algorithms. This paper introduces simultaneous combination and unwrapping (SCAU) that simultaneously estimates channel phase offset images and a combined unwrapped image.

3519	Computer 87	Reconstruction of Accelerated DCE-MRI Guided by Image Quality Metrics
		James A Rioux[1,2,3], Nathan Murtha[4], Chris V Bowen[1,2,3,5], Sharon E Clarke[1,2,3], and Steven D Beyea[1,2,3,5]
		[1]Biomedical Translational Imaging Centre, Nova Scotia Health Authority, Halifax, NS, Canada, [2]Diagnostic Radiology, Dalhousie University, Halifax, NS, Canada, [3]Physics and Atmospheric Science, Dalhousie University, Halifax, NS, Canada, [4]Physics, Carleton University, Ottawa, ON, Canada, [5]Biomedical Engineering, Dalhousie University, Halifax, NS, Canada
		Golden-angle sampling allows arbitrary retrospective selection of temporal resolution in dynamic MRI scans. To select the fastest temporal resolution that preserves time course fidelity, we propose the use of image quality metrics (IQMs). We demonstrate multiple IQMs that correlate strongly with the accuracy of fitted pharmacokinetic parameters up to at least an acceleration factor of R=12. For a fixed undersampling factor, these metrics can also inform the selection of reconstruction parameters such as regularization weights for compressed sensing. This approach may enable rational, individual-level tuning of temporal resolution following a prospectively accelerated DCE-MRI scan.

3520	Computer 88	PEC-GRAPPA Reconstruction of Simultaneous Multislice EPI with Slice-Dependent 2D Nyquist Ghost Correction
		Zheyuan Yi[1,2], Yilong Liu[1,2], Mengye Lyu[1,2], and Ed X. Wu[1,2]
		[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China
		Nyquist ghost correction is challenging for simultaneous multislice (SMS) EPI due to the slice-dependent 2D phase error between positive and negative echoes. For this problem, phase error correction SENSE (PEC-SENSE) has been proposed recently, which incorporates slice-dependent 2D phase error maps into coil sensitivity maps. In this study, we extend the concept of PEC-SENSE to k-space based implementation termed as PEC-GRAPPA. It outperforms 1D LPC based GRAPPA reconstruction and requires less tuning than PEC-SENSE such as excluding background areas.

3521	Computer 89	Optimal Partial Fourier MRI reconstruction: Homodyne vs POCS Venkata Suryanarayana kadimesetty[1] and Harsh kumar Agarwal [1] *[1]Health and Medical Equipment, Samsung R&D Institute India Bangalore Pvt. Ltd., Bangalore, India* Partial Fourier MRI (PF-MRI) is a common fast MRI technique to reduce the scan time. While POCS PF-MRI is known to produce MRI images with least amount of RMSE error, homodyne PF-MRI is popularly used in clinical practice. In this abstract we did digital phantom experiments to show that for smoothly varying phase, such as for FSE, POCS localises the error while an over-/under-estimation in image intensity is observed for Homodyne PF-MRI technique. However for fast varying phase such as for GRE, error is localised for Homodyne compared to POCS PF-MRI technique.

3522	Computer 90	Easy-to-Implement and Rapid Image Reconstruction of Accelerated Cine and 4D Flow MRI Using TensorFlow Valery Vishnevskiy[1], Jonas Walheim[1], Hannes Dillinger[1], and Sebastian Kozerke[1] *[1]Institute for Biomedical Engineering, ETH Zurich, Zurich, Switzerland* Many MR image reconstruction algorithms can be formulated as optimization problems and solved with gradient-based optimization methods of choice. In this work, we present and analyze the performance of the TensorFlow framework for modeling and solving MR image reconstruction problems. We test our approach on undersampled cine cardiac and 4D flow datasets. It is demonstrated that MR image reconstruction is easy to implement in TensorFlow, TensorFlow performs comparably to sophisticated optimization algorithms with theoretical convergence guarantees, and that TensorFlow is as fast as or faster compared to standard MR reconstruction toolboxes.

3523	Computer 91	A Python-based MRI Reconstruction Toolbox, “MRIPY”, for Compressed Sensing, Parallel Imaging and Machine Learning Peng Cao[1], Xucheng Zhu[1], Jing Liu[1], Yan Wang[1], and Peder Larson[1] *[1]Department of Radiology and Biomedical Imaging, University of California at San Francisco, San Francisco, CA, United States* A python-based open-source package, “MRIPY” combines the existing MRI reconstruction methods, i.e. compressed sensing and parallel imaging, with deep neural networks that are implemented in the Tensorflow software.

3524	Computer 92	Uniform Combined Reconstruction (UNICORN) of Multi-channel Surface-coil Data at 7T without use of a Reference Scan Venkata Veerendranadh Chebrolu[1], Peter Kollasch[1], Vibhas Deshpande[2], John Grinstead[3], Thomas Benner[4], Robin Heidemann[4], Daniel Spence[5], Joel Felmlee[5], Matthew Frick[5], and Kimberly K Amrami[5] *[1]Siemens Healthineers, Rochester, MN, United States, [2]Siemens Healthineers, Austin, TX, United States, [3]Siemens Healthineers, Portland, OR, United States, [4]Siemens Healthineers, Erlangen, Germany, [5]Mayo Clinic, Rochester, MN, United States* An algorithm for correcting the intensity non-uniformity in MR images without the use of a calibration/reference scan was proposed and its efficacy was demonstrated at ultra-high-field in musculoskeletal MRI. The algorithm was shown to provide better sensitivity in the inferior/superior regions of the knee compared to state-of-the-art inhomogeneity correction filters. Without the use of a reference scan, the algorithm was also shown to provide image uniformity equivalent to calibration based methods.

3525	Computer 93	MR Fingerprinting using a Gadgetron-based reconstruction Wei-Ching Lo[1], Yun Jiang[2], Dominique Franson[1], Mark Griswold[1,2], Vikas Gulani[1,2], and Nicole Seiberlich[1,2] *[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Radiology, University Hospitals Cleveland Medical Center at Case Western Reserve University, Cleveland, OH, United States* Gadgetron-based online MRF reconstruction enables rapid generation of quantitative tissue property maps directly at the scanner before completing acquisition of the following slice. This technique can facilitate multicenter clinical studies and facilitate easier and direct comparisons of quantitative maps from different scanners.

3526	Computer 94	Sparsely Sampled Cardiac Diffusion Tensor Imaging Using Phase-Corrected Joint Low-Rank and Sparsity Constraints Sen Ma[1,2], Christopher T Nguyen[2,3], Anthony G Christodoulou[2], Sang-Eun Lee[2,4,5,6], Hyuk-Jae Chang[4,5,6], and Debiao Li[1,2] *[1]Department of Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States, [2]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Cardiovascular Research Center, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States, [4]Severance Cardiovascular Hospital, Seoul, Republic of Korea, [5]Yonsei-Cedars-Sinai Integrative Cardiovascular Imaging Research Center, Yonsei University, Seoul, Republic of Korea, [6]College of Medicine, Yonsei University, Seoul, Republic of Korea*

		We propose to sparsely sample in vivo cardiac diffusion tensor imaging (CDTI) by combining a phase-corrected low-rank model and sparsity constraint. The proposed method was evaluated on 7 hypertrophic cardiomyopathy patients. Helix angle and mean diffusivity maps were compared against employing single constraint, and changes in helix angle transmurality and mean diffusivity were evaluated using Wilcoxon signed rank test to statistically determine the highest achievable acceleration factors preserving CDTI measurements with no significant difference. Our framework shows promise in accelerating acquisition window while preserving myofiber architecture features, and may allow higher spatial resolution or shorter temporal footprint in the future.

3527	Computer 95	Minimum-variance weighted image reconstruction and the application to MRI
		Jyh-Miin Lin[1] and Philippe Ciuciu[2]
		[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]Neurospin, CEA Saclay, Paris, France
		Non-stationary MRI noise occurs in sparse and non-uniform k-space. Weighted least squares regression has been used to handle data with non-stationary noise. A minimum-variance weighting function may reduce the variance (image noise) of the image, and it may also relax the regularization needed for MRI reconstruction. To obtain the optimal weighting in non-uniform MRI reconstruction, this study uses the Monte Carlo method to determine the minimum-variance weighting function in Shepp-Logan phantom and breast MRI. The parameter $$$\alpha=-0.5$$$ provides a weighting function with the minimum-variance in the reconstructed images.

3528	Computer 96	Deep-SENSE: Learning Coil Sensitivity Functions for SENSE Reconstruction Using Deep Learning
		Xi Peng[1,2], Kevin Perkins[1,3], Bryan Clifford[1,3], Brad Sutton[1,4], and Zhi-Pei Liang[1,3]
		[1]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Shenzhen, China, [3]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [4]Department of Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States
		Parallel imaging is an essential tool for accelerating image acquisition by exploiting the spatial encoding effects of RF receiver coil sensitivity functions. In practice, the coil sensitivity functions are often estimated from low-resolution auto-calibration signals (ACS) which limits estimation accuracy and in turn results in aliasing artifacts in the final reconstructions. This paper presents a novel deep learning based method for coil sensitivity estimation which exploits empirical and physics-based prior information to produce high-accuracy estimates of coil sensitivity functions from low-resolution ACS. Results are given which demonstrate the proposed method provides a significant reduction in aliasing over standard methods.

Electronic Poster

Compressive MRI

Exhibition Hall	Monday 14:45 - 15:45

3529	Computer 97	Joint Reconstruction of Images with Different Temporal Basis in Carotid Vessel Wall Imaging Nan Wang[1,2], Anthony Christodoulou[1], Yibin Xie[1], Zixin Deng[1,2], Zhaoyang Fan[1,3], and Debiao Li[1,2] *[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Medicine, University of California, Los Angeles, Los Angeles, CA, United States* We recently proposed two techniques, qMATCH and DCE, based on Low Rank Tensor (LRT) framework. qMATCH is a single 8-min scan for carotid T1 T2 mapping and LRT DCE is a 10-min scan evaluating inflammatory status of carotid atherosclerosis. The LRT DCE has many advantages over conventional DCE protocols, but has a scan time longer than typical 5-6 minutes. In this work, we proposed a new protocol combining qMATCH and 5-min DCE. In vivo studies have demonstrated the feasibility of the joint reconstruction. Results of joint reconstruction showed improved image quality with shortened scan time.

3530	Computer 98	Accelerated Localized Correlated Spectroscopy with Compressed Sensing Reconstruction Using Joint Hankel Low Rank Regularization and Group Sparsity Andres Saucedo[1], Manoj K. Sarma[1], and M. Albert Thomas[1] *[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States* Compressed sensing (CS) combined with non-uniform undersampling, such as the low-rank Hankel matrix completion method, have accelerated the acquisition time of 2D magnetic resonance spectroscopy (MRS). This technique relies on reconstructing the vector of all t_1 points separately for each F_2 point. We introduce a CS-based method that implements joint Hankel low rank regularization, which enforces the low-rankness of all Hankel matrices formed from the entire F_2-t_1 data simultaneously. We compare this method with group sparsity CS reconstruction of retrospectively undersampled localized correlated spectroscopy (COSY) acquisitions in a brain phantom and calf muscle.

3531	Computer 99	Patch-Tensor Low-n-Rank Reconstruction for Oscillating Steady State fMRI Acceleration Shouchang Guo[1] and Douglas C. Noll[2]

		[1]*Electrical and Computer Engineering, University of Michigan, Ann Arbor, MI, United States,* [2]*Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States*
		Oscillating steady-state imaging is a new acquisition method for T2*-weighted functional MRI that offers very high SNR, but longer acquisition times. The oscillations are highly reproducible, which make low-rank models suitable. In this work, a sparse sampling scheme combined with a patch-based low-rank tensor reconstruction is introduced to speed the image acquisitions. The low-n-rank algorithm was applied to oscillating steady state data to demonstrate the utility of this approach for functional MRI, demonstrating a 17-fold speed up with error levels less than 3%.

3532	Computer 100	Gini reweighted ℓ1 minimization for rapid MRI
		Carlos Castillo-Passi[1,2], Claudia Prieto[1,2,3], Gabriel Varela-Mattatall[1,2], Carlos Sing-Long[2,4,5], and Pablo Irarrazaval[1,2,5]
		[1]*Department of Electrical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile,* [2]*Biomedical Imaging Center, Pontificia Universidad Católica de Chile, Santiago, Chile,* [3]*Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom,* [4]*Institute for Computational and Mathematical Engineering, Stanford University, Stanford, CA, United States,* [5]*Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile*
		Under-sampling acquisition is oftenly used to reduce the scan time. Compressed Sensing allows the reconstruction of these data by solving a convex optimization problem. This is done to exploit the sparsity of the signals using the ℓ1-norm. We propose to use the Gini Index as a sparsity measure. In this work we demonstrate that this index allow to further increase the under-sampling factor. Interestingly this non-linear index can be computed by solving iteratively reweighted ℓ1 problems, without excessive computational load.

3533	Computer 101	Robust Autocalibrated LORAKS for Improved EPI Ghost Correction with Structured Low-Rank Matrix Models
		Rodrigo A Lobos[1], Ahsan Javed[1], Krishna S Nayak[1], W Scott Hoge[2,3], and Justin P Haldar[1]
		[1]*Electrical Engineering, University of Southern California, Los Angeles, CA, United States,* [2]*Radiology, Brigham and Women's Hospital, Boston, MA, United States,* [3]*Radiology, Harvard Medical School, Boston, MA, United States*

		The presence of ghost artifacts is a recurrent problem in EPI images, which has been recently addressed using structured low-rank matrix (SLM) methods. In this work we propose a new SLM ghost correction method called Robust Autocalibrated LORAKS (RAC-LORAKS). RAC-LORAKS considers autocalibrated k-space constraints (similar to GRAPPA) to deal with the ill-posedness of existing SLM EPI ghost correction methods. RAC-LORAKS additionally adapts these constraints to enable robustness to possible imperfections in the autocalibration data. We illustrate the capabilities of RAC-LORAKS in two challenging scenarios: highly accelerated EPI of the brain, and cardiac EPI with double-oblique slice orientation.

3534	Computer 102	Compressive Sensing Reconstruction for Multi-Contrast Data with Unequal Acceleration Rates
		Emre Kopanoglu[1,2], Alper Güngör[1], Toygan Kilic[3,4], Emine Ulku Saritas[3,4,5], Tolga Çukur[3], and H. Emre Guven[1]
		[1]Department of Advanced Sensing Research Programs, ASELSAN Research Center, Ankara, Turkey, [2]School of Psychology / CUBRIC, Cardiff University, Cardiff, United Kingdom, [3]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey, [4]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey, [5]Neuroscience Program, Bilkent University, Ankara, Turkey
		In multi-contrast acquisitions, a critical concern is whether to distribute undersampling uniformly or unequally across contrasts, as scan times and SNR typically vary among sequences. This study investigates a compressive sensing framework in jointly reconstructing multi-contrast data with unequal acceleration rates. Using in-vivo and numerical datasets, the total scan time was fixed and acceleration factors were varied between protocols. The results suggest using lower acceleration rates for protocols with higher-SNR and shorter duration, and higher rates for protocols with lower-SNR and longer duration improves image quality, even in the highly accelerated contrast. The method was also compared to seven state-of-the-art methods from the literature.

3535	Computer 103	Joint Sparse Reconstruction of Multi-contrast MRI Images with Graph Wavelets
		Zongying Lai[1], Xinlin Zhang[1], Di Guo[2], Xiaofeng Du[2], Zhong Chen[1], and Xiaobo Qu[1]
		[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]School of Computer and Information Engineering, Xiamen University of Technology, Xiamen, China

		Multi-contrast images in magnetic resonance imaging (MRI) are widely applied in clinical applications, since an abundant contrast information reflects the characteristics of the internal tissue of human body, providing an effective reference for clinical diagnosis. However, long acquisition time limits the application of magnetic resonance multi contrast imaging. Under-sampling the k-space data and reconstructing images with sparsity constraint is one efficient way to accelerate magnetic resonance imaging sampling. In this work, multi-contrast undersampled MRI images are jointly reconstructed under the sparse representation using graph wavelets. Experiment results demonstrate that the proposed method outperforms the compared state-of-the-art methods.

3536	Computer 104	Feasibility of High Spatial and Temporal Resolution Breast DCE-MRI using Radial Acquisition with Data-Driven Model Consistency Condition Reconstruction
		Pingni Wang[1], Roberta M Strigel[1,2,3], Julia V Velikina[1], Alexey A Samsonov[2], Leah C Henze Bancroft[2], Kang Wang[4], Ty A Cashen[4], Kevin M Johnson[1], and James H Holmes[2]
		[1]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [3]Carbone Cancer Center, University of Wisconsin-Madison, Madison, WI, United States, [4]Global MR Applications & Workflow, GE Healthcare, Madison, WI, United States
		Dynamic contrast-enhanced (DCE) MRI using conventional Cartesian sampling is used in routine clinical practice due to its high sensitivity for breast cancer. However, ghosting artifacts caused by cardiac motion can obscure the axilla, making interpretation of this area more difficult and potentially obscuring findings. Radial acquisitions are less motion sensitive due to more frequent sampling of the center of k-space and prior work has suggested these methods for breast MRI. In this study, we report results from a reader study to assess image quality of a 3D stack-of-stars radial acquisition compared with Cartesian imaging for breast MRI.

3537	Computer 105	The influence of Sampling on Compressed Sensing accelerated high resolution Vessel Wall Imaging
		Sen Jia[1,2], Jing Cheng[1,2], Lei Zhang[2], Xin Liu[2], and Dong Liang[2]
		[1]University of Chinese Academy of Sciences, Shenzhen, China, [2]Shenzhen Institutes of Advanced Technology, Shenzhen, China
		This study aims to accelerate high resolution whole brain and neck vessel wall imaging using combined Compressed Sensing and Parallel Imaging. The influence of sampling choices with different control of sampling density and randomness on CSPI reconstruction were investigated on retrospectively and prospectively accelerated in vivo datasets, with emphasis on the sharpness of vessel wall borders which was critically demanded by detecting potential vessel wall thickening and atherosclerotic plaques for ischemic stroke patients.

3538	Computer 106	Evaluation of Sparse Sampling for Improved Image Quality of 19F Fluorinated Gas Lung Ventilation MRI Adam Maunder[1], Guilhem Collier[1], Fraser Robb[1,2], Madhwesha Rao[1], and Jim Wild[1] *[1]POLARIS, Academic Radiology, University of Sheffield, Sheffield, United Kingdom, [2]GE Healthcare Inc., Aurora, OH, United States* In an effort to improve image SNR per unit time and effective resolution in ^{19}F-fluorinated gas ventilation imaging the application of compressed sensing was investigated. Simulations of sparse sampling were performed using a 3D ^{3}He ventilation imaging dataset as a gold standard. Sparse and fully sampled image fidelity was quantified by the mean-square error and coefficient of variation of signal intensity. Simulations of low resolution and sparsely sampled images with equivalent acceleration factor were also compared. Based on the simulations prospective lung images using sparse sampling with C^3F^8 gas were then acquired in a healthy volunteer with acceleration factor of 4.

3539	Computer 107	On the importance of adapting compressed sensing for images with significant spatial phase variations Jérémie P. Fouquet[1], Michael Paquette[2], Réjean Lebel[1], Maxime Descoteaux[2], and Martin Lepage[1] *[1]Centre d'imagerie moléculaire de Sherbrooke, department of Médecine nucléaire et radiobiologie, Université de Sherbrooke, Sherbrooke, QC, Canada, [2]Sherbrooke Connectivity Imaging Lab (SCIL), Computer Science Department, Université de Sherbrooke, Sherbrooke, QC, Canada* We explore the limits of compressed sensing (CS) in the practical setting of T2*-weighted imaging of the brain. Surprisingly, those limits are rapidly reached due in part to the presence of spatial phase variations. While conventional CS performs well for synthetic phase-free images, it is equally performant to or even outperformed by a simple zero-padding of the k-space center for acquired complex-valued images. Clearly, CS must be adapted to images including spatial phase variations, and our results point toward new solutions to achieve this adaptation.

3540	Computer 108	Evaluating the Normalised Iterative Hard Thresholding Algorithm for Compressed Sensing Reconstruction on 7T Cardiac cine MRI. Sofia Dimoudi[1], Matthew D Robson[1], Jared Tanner[2], and Aaron T Hess[1] *[1]Oxford Centre for Clinical Magnetic Resonance Research, Division of Cardiovascular Medicine, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [2]Mathematical Institute, University of Oxford, Oxford, United Kingdom*

		We present our updated results in the evaluation of the Normalised Iterative Hard Thresholding Algorithm (NIHT) for parallel imaging and compressed sensing reconstructions of highly accelerated Cardiac cine MRI at 7 Tesla. We compare imaging performance with three other parallel imaging and compressed sensing methods, including regularisation in the temporal dimension.

3541	Computer 109	3D Real-Time MRI of Vocal Tract Shaping
		Yongwan Lim[1], Yinghua Zhu[1], Sajan Goud Lingala[1], Dani Byrd[1], Shrikanth S Narayanan[1], and Krishna S Nayak[1]
		[1]University of Southern California, Los Angeles, CA, United States
		We demonstrate a new three-dimensional (3D) real-time MRI technique for the study of dynamic vocal tract shaping during human speech production. This, for the first time, enables a comprehensive assessment of vocal tract area function dynamics. We used a minimum-phase 3D slab excitation, stack-of-spirals gradient echo sequence, pseudo golden-angle view order in kx-ky, linear Cartesian order along kz, and sparse SENSE image reconstruction with spatiotemporal finite difference constraints. This provides 2.4 x 2.4 x 5.8 mm^3 spatial resolution, 72 ms temporal resolution, and a 200 x 200 x 70 mm^3 field-of-view, which covers the entire adult human vocal tract.

3542	Computer 110	Accelerated volumetric renal perfusion using pseudo-continuous ASL and a 3D Fast-Spin-Echo readout with Compressed Sensing
		Manuel Taso[1], Li Zhao[1], Arnaud Guidon[2], Daniel V. Litwiller[3], and David C. Alsop[1]
		[1]Division of MRI Research, department of Radiology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States, [2]Global MR Applications and Workflow, GE Healthcare, Boston, MA, United States, [3]Global MR Applications and Workflow, GE Healthcare, New York, NY, United States
		While ASL is a promising technique to measure renal perfusion in multiple applications, its translation into clinical practice is still challenged by its motion-sensitivity and limited spatial coverage. In the current work, we propose an implementation of an undersampled Cartesian 3D-FSE readout with pseudo-continuous ASL labeling and Compressed-sensing reconstruction for fast whole kidney perfusion measurement. Results show that even at high acceleration factors (≈15), acceptable quality whole kidney ASL images could be obtained in less than a minute with increased motion-robustness. Furthermore, the CS acceleration enables acquiring multiple averages, providing increased coverage with similar SNR than mostly used 2D readouts.

3543	Computer 111	Rapid Parallel MRI Reconstruction Utilizing the Wavelet Filter Bank

		Efrat Shimron[1], Andrew G. Webb[2], and Haim Azhari[1]
		[1]Department of Biomedical Engineering, Technion - Israel Institute of Technology, Haifa, Israel, [2]Department of Radiology, Leiden University, Leiden, Netherlands
		A novel method for reconstruction from highly undersampled parallel MRI data is proposed. The method computes the Stationary Wavelet Transform (SWT) of the unknown MR image directly from sub-sampled k-space measurements, and then recovers the image using the Inverse SWT filter bank. Experiments with in-vivo data show that this method produces high quality reconstructions, comparable to Compressed Sensing (CS) reconstructions. However, unlike CS, the proposed method is non-iterative. Moreover, it is simple, fast, and allows flexible (random or ordered) k-space undersampling schemes.

3544	Computer 112	Accelerating Compressed Sensing in Cartesian Parallel Imaging Reconstructions using an Efficient and Effective Circulant Preconditioner
		Jeroen van Gemert[1], Kirsten Koolstra[2], Peter Börnert[3], Andrew Webb[2], and Rob Remis[1]
		[1]Circuits and Systems Group, Delft University of Technology, Delft, Netherlands, [2]C.J. Gorter Center for High-Field MRI, Leiden University Medical Center, Leiden, Netherlands, [3]Philips Research Hamburg, Hamburg, Germany
		Reconstruction methods in parallel imaging and compressed sensing problems are generally very time consuming, especially for a large number of coil elements. In this work, the image is reconstructed using the Split Bregman algorithm (SB). We present an efficient and effective preconditioner that reduces the number of iterations in the linear least squares step of SB by almost a factor of 5 as alternative to extra variable splitting. The designed preconditioner works for Cartesian sampling schemes and for different coil configurations. It has negligible initialization time and leads to an overall speedup factor of 2.5.

3545	Computer 113	Synergistic reconstruction of undersampled multi-contrast MRI using weighted quadratic priors
		ABOLFAZL MEHRANIAN[1], Claudia Prieto[1], Radhouene Neji[1,2], Colm J. McGinnity[3], Alexander J. Hammers[3], and Andrew J. Reader[1]
		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Frimley, United Kingdom, [3]School of Biomedical Engineering and Imaging Sciences, King's College London & Guy's and St Thomas' PET Centre, London, United Kingdom

		We propose a simple and robust methodology for synergistic multi-contrast MR image reconstruction to improve image quality of undersampled MR data beyond what is achieved from conventional independent reconstruction methods. The advantages of the proposed methodology are threefold: i) it exploits quadratic priors that are mutually weighted using all available MR images, leading to preservation of unique features, ii) the weighting coefficients are independent of the relative signal intensity and contrast of different MR images and iii) the algorithm is based on a well-established parallel imaging iterative reconstruction, which makes the synergistic reconstruction of undersampled MR data clinically feasible

3546	Computer 114	Parallel imaging compressed sensing for MRI-only radiation dosimetry of post-implant prostate cancer brachytherapy
		Jeremiah Sanders[1], Steven Frank[2], Hao Song[1], Paula Berner[2], Aradhana Venkatesan[3], and Jingfei Ma[1]
		[1]Imaging Physics, MD Anderson Cancer Center, Houston, TX, United States, [2]Radiation Oncology, MD Anderson Cancer Center, Houston, TX, United States, [3]Diagnostic Radiology, MD Anderson Cancer Center, Houston, TX, United States
		Researchers recently demonstrated that both anatomical structures and implanted radioactive seeds can be visualized with high-resolution balanced steady-state free precession (bSSFP) imaging using positive-MRI-signal seed markers and an endorectal coil (ERC). However, ERC use is limited by cost, patient intolerance, and low clinical throughput. A previous preliminary study demonstrated that imaging without an ERC resulted in reduced image signal-to-noise ratio and reduced seed detection. In the current study, we investigated the feasibility of using parallel imaging compressed sensing to substantially accelerate the bSSFP acquisition and potentially enable MRI-only dosimetry of post-implant prostate cancer brachytherapy without an ERC.

3547	Computer 115	Self-calibrating nonlinear MR image reconstruction algorithms for variable density sampling and parallel imaging
		Loubna EL GUEDDARI[1], Carole LAZARUS[1], Hanaé CARRIE[1], Alexandre VIGNAUD[2], and Philippe CIUCIU[1]
		[1]CEA/NeuroSpin & INRIA Parietal, Gif-sur-Yvette, France, [2]CEA/NeuroSpin, Gif-sur-Yvette, France

		Compressed Sensing has allowed a significant reduction of acquisition times in MRI. However, to maintain high signal-to-noise ratio during acquisition, CS is usually combined with parallel imaging (PI). Here, we propose a new self-calibrating MRI reconstruction framework that handles non-Cartesian CS and PI. Sensitivity maps are estimated from the data in the center of k-space while MR images are iteratively reconstructed by minimizing a nonsmooth criterion using the proximal optimized gradient method, which converges faster than FISTA. Comparison with L1-ESPIRiT suggests that our approach performs better both visually and numerically on 8-fold accelerated Human brain data collected at 7 Tesla.

3548	Computer 116	Locally Low Rank Regularization for Magnetic Resonance Fingerprinting
		Gastao Cruz[1], Aurelien Bustin[1], Olivier Jaubert[1], Torben Schneider[2], René M Botnar[1], and Claudia Prieto[1]
		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Philips Healthcare, Guildford, United Kingdom
		Magnetic Resonance Fingerprinting (MRF) estimates simultaneous, multi-parametric maps from a dynamic series of highly undersampled time-point images. At very high undersampling factors, some of these artefacts may propagate into the parametric maps leading to errors. Here we propose the use of locally low rank regularization for a low rank approximation reconstruction to enable highly accelerated MRF. The proposed approach was evaluated in simulations and in-vivo brain acquisitions. Results show that the proposed approach enables accurate MRF reconstructions from ~600 time-point images with one radial spoke per time-point.

3549	Computer 117	Accelerating T2 Mapping Using a Self-trained Kernel PCA Model
		Chaoyi Zhang[1], Ukash Nakarmi[1], Hongyu Li[1], Yihang Zhou[2], Dong Liang[3], and Leslie Ying[1,4]
		[1]Electrical Engineering, University at Buffalo, SUNY, Buffalo, NY, United States, [2]Medical Physics and Research department, Hong Kong Sanatorium & Hospital, Happy Valley, Hong Kong, [3]Biomedical and Health Engineering, Shenzhen Institutes of Advanced Technology, Shenzhen, China, [4]Biomedical Engineering, University at Buffalo, SUNY, Buffalo, NY, United States
		Kernel Principal component analysis(KPCA) model has recently been proposed to accelerate dynamic cardiac imaging. In this abstract, we study the effectiveness of KPCA for MR T2 mapping from highly under-sampled data acquired at different echo time. Different from dynamic cardiac imaging where only morphological information is needed, the quantitative values are highly important in parameter mapping. Here we use a self-trained KPCA model to guarantee the accuracy of the reconstructed T2 maps. The experimental results show that the proposed method can recover the T2 map with high fidelity at high acceleration factors.

3550	Computer 118	Accelerated real-time spiral MRI for high-resolution velum imaging using low rank and sparse decomposition and Chebyshev based off-resonance correction Xue Feng[1], Catherine M Pelland[1], Silvia S Blemker[1], and Craig H Meyer[1] *[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States* In this study, an accelerated real-time spoiled spiral GRE sequence was developed for high-resolution velum imaging during speech to evaluate VPI. The low rank plus sparse decomposition was used to reconstruction highly undersampled (6x) dynamic image series. Chebysheve based off-resonance correction was used to reduce local blurring around velum after L+S reconstruction. The developed method generated high quality dynamic images with minimal temporal blurring and reduced blurring at 1.5 T, which can then be used to track velum movements for further analysis.

3551	Computer 119	Highly Accelerated 3D Chemical-Shift Magnetic Resonance Imaging Using 4D Compressed Sensing Jian-xiong Wang[1], Xiaodong Wen[1], Crystal Harrison[1], A Dean Sherry[1], and Craig R Malloy[1] *[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States* Compressed Sensing method using 4D operators and functions to treat the entire 4D data as unity can perform high reduction rate of acceleration and preserve excellent data fidelity. This work demonstrated its effectiveness on 3D chemical-shift-imaging with reduction rate R=16 or 6.25% sampling ratio and up to R=32 or 3.125% sampling ratio. The method has been implemented onto MRI scanner for real-time sparse 3D CSI acquisition. The excellent data fidelity are demonstrated with 3D CSI images of phantom and in-vivo hyperpolarized [1-^{13}C]pyruvate and its production metabolites.

3552	Computer 120	MR image reconstruction using the Chambolle-Pock algorithm Jing Cheng[1], Sen Jia[1], Haifeng Wang[1], and Dong Liang[1] *[1]Shenzhen Institutes of Advanced Technology,Chinese Academy of Sciences, Shenzhen, China* The combination of Parallel imaging (PI) and compressed sensing (CS) allow high quality MR image reconstruction from partial k-space data. However, most CS-PI MRI methods suffer from detail loss with large acceleration and complicated parameter selection. In this work, we describe and evaluate an efficient and robust algorithm to overcome these limitations. The experimental results on in vivo data show that, the proposed method using a first-order primal-dual algorithm can successfully remove undersampling artifacts while keeping the details with little parameter tuning compared with the existing advanced method.

Electronic Poster

Hyperpolarisation: Technical Developments

Exhibition Hall	Monday 16:15 - 17:15

3553	Computer 1	A Late-Stage Deuteration Method for T1 Prolongation and Enhanced In Vivo Signal to Noise Ratio of Hyperpolarized 13C Substrates
		Céline Taglang[1], David E. Korenchan[1], Cornelius von Morze[1], Chloé Najac[1], Joseph E. Blecha[1], Justin Yu[1], Sukumar Subramaniam[1], Robert Bok[1], Henry VanBrocklin[1], Renuka Sriram[1], John Kurhanewicz[1], David M. Wilson[1], and Robert R. Flavell[1]
		[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States
		One of the fundamental limitations of hyperpolarized ^{13}C technology is the effective lifetime of the signal, which decays in keeping with the spin-lattice relaxation constant T_1. We have developed a robust late stage deuteration methodology which is broadly applicable to amino and alpha hydroxyl acids, including commonly used probes such as alanine and lactate. This methodology enables significant T_1 prolongation, yielding an effective doubling of *in vivo* signal to noise ratio at relevant imaging time-points. We tested [1-^{13}C, 2-^{2}H]alanine prepared via this method both *in vitro* and *in vivo*. This broadly applicable methodology may facilitate implementation and translation of hyperpolarized ^{13}C MRI probes.

3554	Computer 2	Spiral-In/Out Multi Spin-Echo Acquisitions for Increased SNR in Dynamic Hyperpolarized ^{13}C MRI
		Shuyu Tang[1], Robert Bok[1], Eugene Milshteyn[1], Daniel Vigneron[1], and Peder Larson[1]
		[1]University of California at San Francisco, San Francisco, CA, United States
		The long T2 relaxation time of hyperpolarized ^{13}C-labeled metabolites at 3T allows efficient use of hyperpolarized signal by multi spin-echo readouts. This work presents a novel ^{13}C sequence that uses spiral in/out acquisitions at multiple spin echoes, each formed by a single adiabatic pulse to improve signal-to-noise ratio(SNR) in dynamic hyperpolarized ^{13}C MRI. The proposed sequence was tested in vivo on a normal rat on a clinical 3T scanner. Results show that the proposed method has improved SNR for 15 dynamic acquisitions over 30s.

3555	Computer 3	Developing a Regional Bolus Tracking and Real-time B_1 Calibration Method for Hyperpolarized ^{13}C MRI
		Shuyu Tang[1], Eugene Milshteyn[1], Galen Reed[2], Jeremy Gordon[1], Robert Bok[1], Daniel B. Vigneron[1], and Peder Larson[1]

		[1]University of California at San Francisco, San Francisco, CA, United States, [2]HeartVista, Los Altos, CA, United States
		Acquisition timing and B_1 calibration are two key factors that affect the quality and accuracy of hyperpolarized ^{13}C MRI. This project developed a new approach using regional bolus tracking to trigger Bloch-Siegert B_1 mapping and real-time regional RF power compensation, followed by dynamic imaging of hyperpolarized ^{13}C metabolites. The feasibility of applying the proposed framework for in vivo hyperpolarized ^{13}C imaging was demonstrated on healthy rats and tumor-bearing mice on a clinical 3T scanner. This proposed method was designed to improve efficient use of hyperpolarized magnetization as well as the accuracy and robustness of hyperpolarized ^{13}C MRI.

3556	Computer 4	A perfused heart system to simulate first pass observation of rat cardiac metabolism with hyperpolarized [1-^{13}C]pyruvate and determination of LDH flux using selective excitation
		Gal Sapir[1], Talia Harris[1], Assad Azar[1], Atara Nardi-Schreiber[1], Ayelet Gamliel[1], Jacob Sosna[1], Moshe J. Gomori[1], and Rachel Katz-Brull[1]
		[1]Radiology, Hadassah-Hebrew University Medical Center, Jerusalem, Israel
		Aberrant cardiac metabolism is linked to major health issues in the Western world including diabetes and heart failure. New tools are needed to investigate these conditions and to allow better diagnosis. In this work we used dissolution dynamic nuclear polarization NMR spectroscopy (dDNP-NMR) to investigate [1-^{13}C]pyruvate metabolism in the isolated rat heart. A perfusion system simulating *in vivo* first-pass hemodynamics was used to measure the enzymatic flux through lactate dehydrogenase (LDH) using product selective excitation. LDH flux was found to be 52 ± 8 nmol lactate/s/g wet weight (n=3).

3557	Computer 5	The effect of ^{1}H-decoupling on hyperpolarized ^{13}C signal decay – a study on choline chloride analogs and comparison to the effect of deuterium substitution of directly bonded protons
		Sivaranjan Uppala[1], Gamliel Ayelet[1], Atara Nardi Schreiber[1], Talia Harris[1], Jacob Sosna[1], J. Moshe Gomori[1], and Rachel Katz-Brull[1]
		[1]Hadassah-Hebrew University Medical Center, Jerusalem, Israel
		The spin-lattice relaxation time (T_1) of a DNP molecular probe is a key parameter in acquiring NMR signals in dissolution-DNP (d-DNP) experiments. Using molecular probes with long T_1, NMR spin signals can survive for a duration sufficient for the study of metabolism (1-3 min). Deuteration of directly bonded ^{13}C protonated positions has been useful in prolonging the visibility of hyperpolarized labeled ^{13}C sites that are otherwise protonated. Here, we sought to investigate whether proton irradiation could affect the T_1 of such ^{13}C nuclei when such positions are in their naturally abundant form, i.e. directly bonded to protons.

3558	Computer 6	Optimizing signal-to-noise ratio for hyperpolarized carbon-13 magnetic resonance imaging using a hybrid flip angle scheme Lauren Smith[1], Trevor Wade[1,2], Alireza Akbari[1,2], Conrad Rockel[1], Lanette Friesen-Waldner[1], and Charles McKenzie[1,2,3] *[1]Medical Biophysics, Western University, London, ON, Canada, [2]Robarts Research Institute, London, ON, Canada, [3]Maternal, Fetal & Newborn Health, Children's Health Research Institute, London, ON, Canada* Hyperpolarized 13C imaging can provide useful metabolic information; however, rapid decay of hyperpolarized signal leads to reduced signal-to-noise ratio (SNR) images. We demonstrate an RF excitation scheme that dynamically changes the RF spectral profile and amplitude to achieve flip angles that vary throughout the acquisition independently for each metabolite. This preserves signal during a dynamic imaging experiment maintaining more signal for later time-points than using a constant RF pulse. Increased *in vivo* SNR at later time points of [1-13C]pyruvate and its metabolites was shown by dynamic imaging experiments in guinea pigs with both constant and variable flip angle schemes.

3559	Computer 7	Optimized Single Shot 3D Sequence for High Resolution Hyperpolarized 13C Imaging Jiazheng Wang[1], Richard L Hesketh[1], Alan J Wright[1], and Kevin M Brindle[1,2] *[1]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [2]Department of Biochemistry, University of Cambridge, Cambridge, United Kingdom* We have developed a single-shot 3D sequence for hyperpolarized ^{13}C MRI, which uses a spatial-spectral (SpSp) pulse for excitation, a train of adiabatic pulses for refocusing, and a stack-of-spirals acquired through a fast-spin-echo train. The sequence achieved an isotropic image resolution of 1.25x1.25x1.25 mm^3 in vivo on a 7 T animal system, where hyperpolarized [1-^{13}C]pyruvate and [1-^{13}C]lactate were imaged alternately at a frame rate of 2 s per metabolite. Signals from extra spirals acquired from later spin echoes were averaged with those from the early echoes to give a high signal-to-noise ratio (SNR) as well as high spatial resolution.

3560	Computer 8	Multichannel Hyperpolarized 13C MRI in a Patient with Liver Metastases using Multi-slice EPI and an Alternating Projection Method for Denoising Rie B Hansen[1], Jeremy W Gordon[2], Peter J Shin[2], Zihan Zhu[2,3], Daniele Mammoli[2], Pamela N Munster[4], Rahul Aggarwal[4], Michael A Ohliger[2], Peder EZ Larson[2], Lars G Hanson[1], Jan H Ardenkjær-Larsen[1], and Daniel B Vigneron[2] *[1]Department of Electrical Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark, [2]Department of Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States, [3]UC Berkeley-UCSF Graduate Program in Bioengineering, UC Berkeley and UCSF, San Francisco, CA, United States, [4]Department of Medicine, UCSF, San Francisco, CA, United States*

		Hyperpolarized ^{13}C-pyruvate for monitoring metabolism of liver metastases in vivo is being investigated for clinical trials of new therapeutics. This study applied advances in multichannel receive arrays and sequence design for human ^{13}C liver imaging and investigated a new denoising method. The method is based on an alternating projection method to enforce structuredness and low-rankness, and is applied with automatic threshold estimation. In vivo data demonstrate improved quality of kinetic modeling after denoising. However, simulations revealed certain unresolved pitfalls.

3561	Computer 9	Slice Profile Induced Errors in Metabolic Quantification of Hyperpolarized Pyruvate.
		Christopher M Walker[1] and James A Bankson[1]
		[1]Imaging Physics, MD Anderson Cancer Center, Houston, TX, United States
		Hyperpolarized pyruvate is being explored as a quantitative imaging biomarker of metabolism. Non-ideal slice excitation of hyperpolarized magnetization can result in temporally evolving slice profiles. This work evaluates the impact of slice profile on quantitative analysis of hyperpolarized pyruvate using a perfused Bloch-McConnell simulator. Results indicate that the slice profile can cause significant bias in the measured apparent metabolic exchange constant. Primary sources of bias are excess signal from the slice penumbra and the offset between metabolite slices. Therefore, it will be critical to properly account for the slice profile when attempting to quantify hyperpolarized signal using slice selective excitations.

3562	Computer 10	Improving robustness of hyperpolarized ^{13}C MRSI using k-t spiral acquisitions
		Erin Adamson[1], Benjamin Cox[1,2,3], and Sean Fain[1,4,5]
		[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Morgridge Institute for Research, Madison, WI, United States, [3]Laboratory for Optical and Computational Instrumentation, University of Wisconsin-Madison, Madison, WI, United States, [4]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [5]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States
		Hyperpolarized ^{13}C MRSI with chemical shift encoding relies on *a priori* knowledge of the N ^{13}C-labeled metabolite resonances and N+1 echoes to fully determine the reconstruction. However, the *a priori* frequencies may shift due to B_0 inhomogeneity, local susceptibilities, or motion, causing spectral leakage, blurring, and biased quantitative measures. To address these uncertainties, we apply IDEAL-based k-t spiral imaging with field-of-view oversampling to further constrain the signal model-based reconstruction in situations where the echo-spacing may be suboptimal, and we test the results in digital simulations, phantom experiments, and *in vivo* studies of murine renal metabolism. Results support improved metabolic quantification.

3563	Computer 11	Mitigating Chemical Exchange Effects in Advanced Pulse Sequences for pH Imaging with Hyperpolarized [13C]bicarbonate David E Korenchan[1], Jeremy W Gordon[1], Sukumar Subramaniam[1], Renuka Sriram[1], Peder E Z Larson[1,2], Robert R Flavell[1], and John Kurhanewicz[1,2] *[1]Radiology and Biomedical Imaging, UC San Francisco, San Francisco, CA, United States, [2]Bioengineering, UC San Francisco, San Francisco, CA, United States* Imaging extracellular acidification in tumors will likely lead to better characterization of tumor aggressiveness and treatment efficacy. Hyperpolarized (HP) [^{13}C]bicarbonate magnetic resonance spectroscopic imaging (MRSI) can map pH in murine tumors, but images generally suffer from low signal-to-noise ratio (SNR) and coarse spatial resolution. Although sophisticated pulse sequences can boost SNR, pH accuracy can be compromised due to bidirectional [^{13}C]bicarbonate <-> $^{13}CO_2$ chemical exchange during imaging. We investigated several pulse sequences and excitation/refocusing schemes, and a modified 2D echo-planar imaging sequence with spectral-spatial excitation demonstrated the best combination of spatial resolution, pH accuracy, and potential for future clinical implementation.

3564	Computer 12	Modeling In Vivo Metabolism of Hyperpolarized Pyruvate in Human Brain Tumor Patients. Daniele Mammoli[1], Jeremy Gordon[1], Adam Autry[1], Peder EZ Larson[1], Hsin-Yu Chen[1], Mark Van Criekinge[1], Lucas Carvajal[1], Ilwoo Park[2], James B Slater[1], Robert Bok[1], Jason Crane[1], Markus Ferrone[3], John Kurhanewicz[1], Susan Chang[4], and Daniel B Vigneron[1] *[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Chonam National University Medical School and Hospital, Chonam, Korea, Democratic People's Republic of, [3]Clinical Pharmacy, University of California San Francisco, San Francisco, CA, United States, [4]Neurological Surgery, University of California San Francisco, San Francisco, CA, United States* We show preliminary results of hyperpolarized [1-^{13}C]pyruvate injected in 9 patients affected with glioma. Raw data showed excellent SNR. Variable bolus delivery and magnitude images introduced errors in modeling the conversion of pyruvate into lactate: kinetic models were presented and compared quantitatively to address these issues. Finally, reliable and spatially-resolved maps of k_{PL} rates were obtained, which can be useful in future to assess the clinical relevance of the method for both diagnosis and response to therapy.

3565	Computer 13	Comparison between 8- and 32-channel phased-array receive coils for in vivo hyperpolarized C-13 brain imaging Adam Autry[1], Jeremy W Gordon[1], Lucas Carvajal[1], Ilwoo Park[2], Daniele Mammoli[1], Hsin-Yu Chen[1], Susan Chang[3], Yan Li[1], Duan Xu[1], Daniel Vigneron[1], and Sarah J Nelson[1,4]

		[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Department of Radiology, Chonam National University Medical School and Hospital, Chonam, Republic of Korea, [3]Department of Neurosurgery, University of California, San Francisco, San Francisco, CA, United States, [4]Bioengineering and Therapeutic Sciences, University of California, San Francisco, San Francisco, CA, United States
		This study sought to evaluate the performance of the first 32-channel head coil for *in vivo* hyperpolarized ^{13}C brain imaging by comparison against a conventional 8-channel receiver array. Initial phantom experiments characterized the B_1+ homogeneity and SNR profiles associated with each hardware configuration via EPI-based imaging techniques. As part of a clinical trial, *in vivo* dynamic EPI data were also acquired from patients with brain tumors. Phantom and patient data revealed improved uniformity, coverage, and SNR with the 32-channel array that will promote higher resolution and acceleration. *In vivo* data also demonstrated unprecedented detection of bicarbonate using both hardware platforms.

3566	Computer 14	Probing renal pH and aminopeptidase N activity with hyperpolarized [1-13C]alaninamide
		Alice Radaelli[1], Hikari Ananda Infinity Yoshihara[1], Ryunosuke Hata[2], Shinsuke Sando[3], and Rolf Gruetter[1,4]
		[1]Laboratory for Functional and Metabolic Imaging (LIFMET), EPFL, Lausanne, Switzerland, [2]Department of Chemistry and Biochemistry, Kyushu University, Fukuoka, Japan, [3]Department of Chemistry and Biotechnology, The University of Tokyo, Tokyo, Japan, [4]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland
		The detection of aminopeptidase N (APN) activity can give information on tumor development. Hyperpolarized L-[1-^{13}C]alaninamide is a specific, sensitive probe of APN activity in kidney homogenate. Here, we characterized its *in vivo* metabolic response in the rat kidney. In addition to being an APN substrate, L-[1-^{13}C]alaninamide is sensitive to pH and also reacts with dissolved carbon dioxide. To avoid spectral overlap, alaninamide is best suited as an APN probe in acidic environments, and it may have additional applications as a multifunctional sensor of pH and CO_2.

3567	Computer 15	Susceptibility-Induced Distortion Correction in Hyperpolarized Echo Planar Imaging
		Jack J J J Miller[1,2,3], Angus Z Lau[1,4], and Damian J Tyler[1,3]
		[1]Oxford Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom, [2]Department of Physics, University of Oxford, Oxford, United Kingdom, [3]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, United Kingdom, [4]Sunnybrook Research Institute, Toronto, ON, Canada

		Echo Planar Imaging is an attractive rapid imaging readout that can image hyperpolarized compounds in vivo. By alternating the sign of the phase encoding gradient waveform, spatial offsets arising from uncertain frequency shifts can be determined. We show here that blip-reversed EPI can also be used to correct for susceptibility and $$$B_0$$$ inhomogeneity effects that would otherwise produce image-domain distortion in the heart, through the use of an estimated deformation field that is calculated from the acquired data.

3568	Computer 16	Extended Signal Modelling and Regularization for Multi-Echo Hyperpolarized Metabolic Image Reconstruction
		Julia Busch[1], Valeriy Vishnevskiy[1], Maximilian Fuetterer[1], Claudio Santelli[1], Constantin von Deuster[1], Sophie Marie Peereboom[1], Mareike Sauer[2], Thea Fleischmann[2], Nikola Cesarovic[2], Christian Torben Stoeck[1], and Sebastian Kozerke[1]
		[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland, [2]Division of Surgical Research, University Hospital Zurich, Zurich, Switzerland
		The IDEAL signal model for hyperpolarized metabolic imaging is extended and spatiotemporal regularization and b0-map recalibration is included. The approach is tested on simulated data and in-vivo metabolic imaging data of the heart. Allowing variable b0-fields and including sparsity regularization signal leakage and ghosting can be significantly reduced (average reduction of root-mean-square error (RMSE) by 16% and 30%). Spatial and temporal regularization of the metabolite intensities considerably improved accuracy of the estimate in terms of RMSE with additional reductions by 68% and 20%, respectively. Thus, the metabolic conversion of [1-13C]pyruvate into [1-13C]lactate and 13C-bicarbonate can be measured with improved accuracy.

3569	Computer 17	Combined FDG-PET and hyperpolarized pyruvate-MRSI (hyperPET) for cancer metabolic phenotyping – a pilot study
		Sissel Bisgaard[1], Andreas Ettrup Clemmensen[1], Abubakr Eldirdiri[2], Helle Hjorth Johannesen[1], Jan Henrik Ardenkjær-Larsen[2], Adam Espe Hansen[1], and Andreas Kjær[1]
		[1]Department of Clinical Physiology, Nuclear Medicine & PET and Cluster for Molecular Imaging, Rigshospitalet and University of Copenhagen, Copenhagen, Denmark, [2]Center for Hyperpolarization in Magnetic Resonance, DTU Elektro, Technical University of Denmark, Kgs. Lyngby, Denmark
		Molecular imaging of cancer metabolism in vivo is increasingly employed in clinical settings. Both ^{18}F-FDG PET and hyperpolarized [1-^{13}C]pyruvate MRSI are sensitive to glucose metabolism but differ in which part of the glycolytic pathway is probed. We hypothesize that hyperPET may improve cancer specific metabolic phenotyping. Simultaneous ^{18}F-FDG PET and hyperpolarized [1-^{13}C]pyruvate MRSI (hyperPET) was used in a pilot study, examining the metabolic characteristics exhibited by four different cancer cell lines in nude mice. The results indicated that the combined modalities may distinguish between cancer types.

3570	Computer 18	Improved Hyperpolarized Cerebral Perfusion Imaging Using a Sucrose/Water Glassing Matrix for tert-Butanol Gopal Varma[1], Patricia Coutinho de Souza[1], Cody Callahan[1], David C Alsop[1], and Aaron K Grant[1] *[1]Division of MR Research, Radiology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States* Perfusion imaging is a promising application for hyperpolarized tracers, as they provide high signal with no endogenous background. Hyperpolarized 13C labeled tert-butanol is a freely diffusible perfusion agent with long T1 and T2 relaxation times in vivo. Prior work has shown that tert-butanol can be polarized to 5-10% using dynamic nuclear polarization through addition of glycerol as a glassing agent. Here we investigate a formulation based on a water/sucrose/tert-butanol mixture that yields a 1.6-fold improvement in polarization, and illustrate its use in 3D cerebral perfusion imaging in rats.

3571	Computer 19	A robust approach to generate high polarization levels of metabolites within seconds with para-hydrogen Sergey Korchak[1], Shengjun Yang[1], Salvatore Mamone[1], and Stefan Glöggler[1] *[1]NMR Signal Enhancement, Max-Planck-Institute for Biophysical Chemistry, Göttingen, Germany* Hyperpolarization of metabolites is a promising approach for in vivo disease detection and observation of treatment responses.1-4 Among hyperpolarization techniques, para-hydrogen induced polarization (PHIP) represents an inexpensive approach to generate polarization within a few seconds.5-11 Here, we are introducing a pulsed magnetic resonance method to polarize metabolites that enables us to efficiently transfer proton polarization to a 13C nucleus of interest. This becomes especially possible by attaching an optimized molecular sidearm to a metabolite of choice (here: acetate, glycine and pyruvate) which is para-hydrogenated and the polarization subsequently transferred. We have achieved high levels of metabolite precursor polarization (P >10%) with para-hydrogen within 15 seconds. Cleavage of the sidearm yields hyperpolarized metabolites.

3572	Computer 20	Hyperpolarization without a polarizer: in vivo 13C-MRI using SAMBADENA Andreas B. Schmidt[1,2], Stephan Berner[1,3,4], Moritz Braig[1], Mirko Zimmermann[1], Jürgen Hennig[1], Dominik von Elverfeldt[1], and Jan-Bernd Hövener[2,4] *[1]Radiology - Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]Radiology and Neuroradiology, University Medical Center Schleswig-Holstein, Kiel, Germany, [3]German Consortium for Cancer Research (DKTK), Heidelberg, Germany, [4]German Cancer Research Center (DKFZ), Heidelberg, Germany*

		Hyperpolarization (HP) enhances the sensitivity of MR by several orders of magnitude and allows the detection of metabolism non-invasively and *in vivo*. However, well-established methods are costly, complex and require a dedicated "polarizer" next to the MRI system. SAMBADENA is, to date, the simplest and most cost-effective method to generate ^{13}C-HP > 20 % for MRI. Within seconds HP is achieved within the MRI and little additional hardware is required. Here, the first *in-vivo* applications of SAMBADENA are reported, demonstrating its potential to be a fast, simple, low-cost alternative method for HP-MRI.

3573	Computer 21	Considerations for Spin Order Transfer to 13C-labeled pyruvate precursors by Parahydrogen-induced Polarization for in vivo applications
		Neil James Stewart[1], Mitsushi Tomohiro[1], Yoshiki Uchio[1], Kensuke Takoshima[1], and Shingo Matsumoto[1]
		[1]*Graduate School of Information Science & Technology, Hokkaido University, Sapporo, Japan*
		The recent achievement of ^{13}C-pyruvate polarization by side-arm para-hydrogen induced polarization (SA-PHIP) in-vitro has renewed interest in PHIP, which has been limited by a lack of biologically-relevant directly-polarizable compounds. To investigate the achievable polarization of ^{13}C-pyruvate by SA-PHIP for in-vivo metabolic MRI, density matrix simulations of polarization transfer by magnetic field cycling (MFC) and spin-order transfer (SOT) pulse sequences were performed for target precursors. MFC-based approaches were confirmed to be suitable for polarization transfer over the long-range J-couplings present in SA-PHIP precursors. Additionally, simulated polarization levels with SOT approaches were reasonable for representative ^{13}C-pyruvate precursors, promising for metabolic MRI.

3574	Computer 22	Feasibility of Imaging Lung Cancer Using Hyperpolarized MRI Technology
		Mehrdad Pourfathi[1], Luis Loza[1], Stephen Kadlecek[1], Ian Duncan[1], Diane Lim[2], Shampa Chatterjee[3], Kai Ruppert[1], Sarmad Siddiqui[1], Harrilla Profka[1], Yan Liu[2], Jessica Kim[2], Hooman Hamedani[1], Yi Xin[1], Faraz Amzajerdian[1], Maurizio Cereda[4], Ryan Baron[1], Mary Spencer[1], Tahmina Achekzai[1], Jose Conejo-Garcia[5], and Rahim R. Rizi[1]
		[1]*Radiology, University of Pennsylvania, Philadelphia, PA, United States,* [2]*Sleep Medicine, University of Pennsylvania, Philadelphia, PA, United States,* [3]*Physiology, University of Pennsylvania, Philadelphia, PA, United States,* [4]*Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA, United States,* [5]*Moffitt Cancer Center, Tampa, FL, United States*
		We demonstrate the feasibility of hyperpolarized MRI technology to image lung cancer in mice. We demonstrated the use of ^{13}C MRSI to detect elevated pyruvate to lactate conversion in the tumor relative to the adjacent non-cancerous lung tissue. We also showed the feasibility of ^{129}Xe imaging to detect non-aerated regions in the lung tissue co-localized with the tumor. The utility of these modalities combined may provide a multi-faceted tool to assess tumor's stage and its response to therapy in lung cancer.

3575	Computer 23	Improved Hyperpolarization of Solid and Mesoporous Nanoscale Silicon Particles Using TEMPO Radicals Allows In Vivo 29Si MRI
		Nicholas Whiting[1,2], Jingzhe Hu[1,3], Shivanand Pudakalakatti[1], Caitlin McCowan[1,3], Hyeonglim Seo[4], Youngbok Lee[4], and Pratip Bhattacharya[1]
		[1]The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Rowan University, Glassboro, NJ, United States, [3]Rice University, Houston, TX, United States, [4]Hanyang University, Ansan, Republic of Korea
		Hyperpolarized silicon microparticles have been previously demonstrated as *in vivo* MRI contrast agents; unfortunately, their large size and decreased mobility present limitations for targeted molecular imaging. While nanoscale silicon particles can also be hyperpolarized, their signal enhancement is typically limited by a low concentration of endogenous electrons. As such, no studies to date have demonstrated *in vivo* ^{29}Si MRI of hyperpolarized nano-scale silicon. We demonstrate improved ^{29}Si hyperpolarization with the addition of an exogenous radical species to both solid and mesoporous nanoparticle samples (30-300 nm diameter), which increases ^{29}Si hyperpolarization and allows *in vivo* imaging of silicon nanoparticles.

3576	Computer 24	Macrocyclic Xenon hosts: potential inhibitors and reporters for protein aggregation in Hyper-CEST MRI
		Jan Oliver Jost[1], Christopher Witte[1], and Leif Schröder[1]
		[1]Molecular Imaging, Leibniz Forschungsinstitut für Molekulare Pharmakologie, Berlin, Germany
		Contrast agents for neurodegenerative diseases such as amyloidosis are challenging for MRI due to sensitivity limitations. Using hyperpolarized Xenon with special Xe hosts in combination with chemical excitation saturation transfer (CEST) has the potential to overcome this issue. It has been demonstrated that Cucurbit[7]uril (CB7) is inhibiting the fibrillation of Aβ40/ Aβ42 by interaction with its Phe residues. In parallel, we have demonstrated that CB7 can be used as a Xe-host. Here we present first results for a concept that uses CB7 as a drug and Xe biosensor simultaneously where binding of CB7 to Aβ40 can be detected by changing the Xe-HyperCEST signal.

Electronic Poster

Molecular Imaging

Exhibition Hall	Monday 16:15 - 17:15

3577	Computer 25	First-pass Perfusion MRI of Myocardial Infarction Using a Novel Manganese Chelate Contrast Agent in a Rabbit Model
		Lingyi Wen[1], Zhigang Yang[2], Hang Fu[1], Kun Zhang[2], Ran Sun[1], and Yingkun Guo[1]

[1]Department of Radiology, West China Second University Hospital, Sichuan University, Chengdu, China, [2]Department of Radiology, West China Hospital, Sichuan University, Chengdu, China

First-pass perfusion MRI allows evaluation of myocardial perfusion in myocardial infarction (MI). While Gd^{3+}-based contrast agents are incompatible with renal compromise, we designed and synthesized a novel manganese (Mn^{2+}) based contrast agents. MI was induced in 4 rabbits, Mn^{2+} based and Gd^{3+}-based first-pass perfusion MRI were performed on a 3.0T MRI scanner. All rabbits survived without significant differences in heart rate and left ventricular function. All the perfusion parameters of infarcted and normal myocardial segments correlated well between Gd-based and Mn-based perfusion imaging. Our novel Mn^{2+} contrast agents is safe and reliable to visualize myocardial perfusion in MI.

3578 Computer 26

Intracellular Assembly of Olsalazine Nanoparticles for CEST MR Imaging and Cancer Therapy

Yue Yuan[1], Xiaoliang Qi[1], Jia Zhang[1], Xiaolei Song[1], Michael T. McMahon[2], and Jeff W.M. Bulte[1]

[1]The Russell H. Morgan Department of Radiology and Radiological Science; Cellular Imaging Section, Institute for Cell Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F.M. Kirby Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States

Based on a biocompatible condensation reaction caused by tumor-related proprotein convertase furin, we developed a novel probe **RRVR-Olsa** for tumor-targeted CEST MR imaging and chemotherapy to accomplish theranostics. Our preliminary studies indicated that, **RRVR-Olsa** elicited an obvious increase in CEST signal and higher cytotoxicity on furin-overexpressing HCT116 cancer cells than on furin-deficient LoVo cells and on furin inhibitor-treated HCT116 cancer cells. *In vivo* CEST MRI with the use of **RRVR-Olsa** could readily distinguish the difference of furin expression in HCT116 tumor and LoVo tumor, which we attributed to the furin-directed intracellular self-assembly of **RRVR-Olsa** to olsalazine nanoparticles with enhanced accumulation.

3579 Computer 27

In Vivo iCEST MRI Detection of Zinc Depletion in an Orthotopic Prostate Cancer Mouse Model

Yue Yuan[1,2], Chengyan Chu[1], Zhiliang Wei[1,2], Xiaolei Song[1,2], and Jeff W.M. Bulte[1,2]

[1]The Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States

		Prostate cancer is the only known disease of the prostate that displays such a substantial decrease in tissue zinc content and neither prostatitis nor benign prostatic hyperplasia are associated with this phenotype. ^{19}F-based iCEST MRI probe TF-BAPTA was used to show clearly a detectable difference in zinc concentration between normal and malignant prostate cell lines, and normal prostate cells with a downregulated ZIP1 transporter. *Via* an orthotopic prostate cancer mouse model, the feasibility of iCEST MRI to distinguish normal mouse prostate and cancerous prostate has been verified. Hence, iCEST MRI may have potential to non-invasively monitor the early malignant transformation in prostate cancer.

3580	Computer 28	Imaging and discrimination of extracellular lactate in vivo using CEST and a paramagnetic shift reagent
		Andre Martins[1,2], Lei Zhang[2], Veronica Clavijo-Jordan[1], Alexander Funk[1], Carlos Platas-Iglesias[3], and A. Dean Sherry[1,2]
		[1]Advanced Imaging Research Center, UTSW Medical Center, Dallas, TX, United States, [2]UT Dallas, Richardson, TX, United States, [3]Universidade da Coruña, Coruña, Spain
		Glucose taken up by cancer cells is thought to be converted largely to lactate even in the presence of abundant oxygen although the amount of pyruvate diverted into the mitochondria is largely unknown. Hence, a method for imaging actual lactate production by tumors could be highly informative. We report in this work the design of several lanthanide-based shift reagents (SR) that form complexes with lactate and shift the lactate –OH CEST signal to a different frequency far away from water. Given that these SR's are confined to extracellular space, the resulting lactate –OH CEST signal becomes a specific biomarker of lactate exported from cancer cells. This method offers great promise for imaging lactate production by tumors.

3581	Computer 29	Low affinity zinc sensors for improved MRI detection of glucose-stimulated zinc(II) secretion from pancreatic beta-cells in vivo
		Andre F Martins[1,2], Veronica Clavijo-Jordan[1], Sara Chirayil[1], Shanrong Zhang[1], Namini Paranawithana[2], and A. Dean Sherry[1,2]
		[1]Advanced Imaging Research Center, UTSW Medical Center, Dallas, TX, United States, [2]UT Dallas, Richardson, TX, United States
		We report here the design of several gadolinium-based MR contrast agents with different zinc affinities. The zinc sensors increased r_1 in the presence of Zn^{2+} ions and more in the presence of serum albumin, only when zinc was present. The sensors with a lower affinity for Zn^{2+} enhanced better the MR contrast produced by zinc release in mouse pancreas due to reduced background signal. These lower affinity Zn^{2+} agents show great promise for detecting and monitoring the pharmacological effect of drugs in diabetes.

3582	Computer 30	An Elastase Activity Reporter for EPR and OMRI as a Line-Shifting Nitroxide. Natacha Jugniot[1], Indranil Duttagupta[2], Angélique Rivot[1], Philippe Massot[1], Colleen Cardiet[1], Jean-Michel Franconi[1], Pierre Voisin[1], Elodie Parzy[1], Eric Thiaudière[1], Sylvain R.A Marque[2], Abderrazzak Bentaher[3], Gérard Audran[2], and Philippe Mellet[1] *[1]UMR CNRS 5536, bordeaux, France, [2]UMR CNRS 7273, marseille, France, [3]EA7426, Faculté de Médecine Lyon Sud, Pierre Bénite, France* Neutrophils secrete proteases at inflammation sites leading to protease/inhibitor imbalance. Among them, neutrophil elastase (NE) is responsible for lung degradation via elastin fragmentation. Monitoring protease/inhibitor status non-invasively would be an important diagnostic tool. We present Meo-Suc-(Ala)2-Pro-Val-nitroxide, a line-shifting elastase activity probe for Electronic Paramagnetic Resonance (EPR) spectroscopy and Overhauser-enhanced Magnetic Resonance Imaging (OMRI). Fast and sensitive with Km= 15 ± 2.9 µM, kcat/Km= 930000 s-1.M-1, this substrate was assessed with bronchoalveolar lavage samples from Pseudomonas pneumonia mouse model. We observed a clear difference between wild type and NE deficient animals. These results can lead to new in vivo diagnostic methods and lung protection.

3583	Computer 31	Using single 19F-probe for multiplexed imaging with 19F-CEST MRI Ronit Shusterman-Krush[1], Liat Avram[2], Bruce C. Gibb[3], and Amnon Bar-Shir[1] *[1]Organic chemistry, Weizmann Institute of science, Rehovot, Israel, [2]chemical services, Weizmann Institute of science, Rehovot, Israel, [3]Chemistry, Tulane University, New Orleans, LA, United States* Heteronuclear-CEST imaging presents several unique properties when compared to ^{1}H-CEST, which is based on water, including background-free signals, quantifyability and ability to monitor low concentrations of targets. Here we present the performance of the CEST approach in ^{19}F-MRI framework for mapping multiple targets in a “multicolor” fashion. Specifically, the difference in binding kinetics between a ^{19}F-agent and a molecular target (i.e., macrocyclic molecular host) and the different Δw values obtained in ^{19}F-NMR lead to a clear ^{19}F-CEST characteristics. The large ^{19}F-CEST effect obtained and its Δw dependency allow the mapping of two molecular targets simultaneously using single ^{19}F-probe.

3584	Computer 32	Calcium-dependent molecular fMRI using a magnetic nanosensor Benjamin B Bartelle[1], Satoshi Okada[1], Nan Li[1], Vincent Breton-Provencher[2], Mriganka Sur[2], and Alan P Jasanoff[1,2] *[1]Bioengineering, MIT, Cambridge, MA, United States, [2]Brain & Cognitive Sciences, MIT, Cambridge, MA, United States*

		Superparamagnetic iron oxide nanoparticles are a modular platform technology for sensors with sub nM sensitivity and robust biomedical applications. In this work we engineer nanoparticle sensors that display Ca^{2+} dependent aggregation and demonstrate the first functional MRI study of Ca^{2+} dynamics as well as the first *in vivo* demonstration of a dynamic nanosensor.

3585	Computer 33	Sensing intracellular calcium ions using a manganese-based MRI contrast agent
		Benjamin B Bartelle[1], Barandov Ali[1], Catherine G Williamson[1], Emily S Loucks[1], and Alan P Jasanoff[1]
		[1]Bioengineering, Massachusetts Institute of Technology, Cambridge, MA, United States
		Inspired by the classical work of R. Tsien on cell-permeable calcium specific chelators using readily cleavable acetomethoxy esters (AM) of BAPTA and taking advantage of our own, novel, cell permeable manganese-based contrast agent, we developed a new MRI contrast that displays membrane permeability, cellular accumulation via cleavable ester groups, and physiological sensitivity to calcium. With this breakthrough innovation, we present a series of firsts for functional molecular imaging, reporting chemically and optogenetically induced calcium transients with MRI in living cells.

3586	Computer 34	Labelling of collagen type I templates with a novel naturally derived contrast agent for magnetic resonance imaging in soft tissue engineering
		Heinz Peter Janke[1], Nihan Güvener[2], Weiqiang Dou[3], Jozef Cremers[4], Paul Borm[4], Wout Feitz[5], Arend Heerschap[3], Fabian Kiessling[2], and Egbert Oosterwijk[1]
		[1]Urology, Radboud University Medical Center; Radboud Institute for Molecular Life Sciences, Nijmegen, Netherlands, [2]Experimental Molecular Imaging, Uniklinik RWTH and Helmholtz Institute for Biomedical Engineering, RWTH Aachen University, Aachen, Germany, [3]Department of Radiology and Nuclear Medicine, Radboud University Medical Center, Nijmegen, Netherlands, [4]Nano4Imaging, Aachen, Germany, [5]Urology, Radboud University Medical Center; Radboud Institute for Molecular Life Sciences; Radboudumc Amalia Children's Hospital, Nijmegen, Netherlands
		Contrast agents (CA) need to be applied for monitoring tissue-engineered implants by MR imaging. However, currently used CAs have limitations (i.e. negative contrast, label instability). In this study, Hemin-Lysine complex (HL) -as a naturally derived alternative CA- is used for active labeling of hybrid collagen-based templates. HL-labeled templates are clearly identified because of their bright signal in T1-weighted MR images. The signal of labeled templates and thus their integrity could be followed over time when subcutaneously implanted in a mouse model. Thus, loading collagen-based templates with HL appears to be a promising strategy to localize and monitor its fate upon implantation.

3587	Computer 35	The effect of liposomal encapsulation on the chemical exchange properties of diamagnetic CEST agents.

		Eleni Demetriou[1], Harriet Story[2], Robin Bofinger[2], Helen Hailes[2], Alethea Tabor[2], and Xavier Golay[3]
		[1]Brain repair and rehabilitation, University College of London, London, United Kingdom, [2]Department of Chemistry, University College of London, London, United Kingdom, [3]Brain Repair and Rehabilitation, University College of London, London, United Kingdom
		Liposome encapsulation of glucose or 2-deoxy-D-glucose (2-DG) may be exploited to enhance the CEST signal by reducing the overall apparent exchange rate. Here we aim to construct a complete theoretical model to measure the exchange properties of diamagnetic CEST agents. Experimentally measured exchange rates of glucose and 2-DG in the liposomal system were found to be reduced by one or two orders of magnitude due to the intermembrane exchange between the intra- and extra-liposomal compartment because of restrictions in water transfer imposed by the lipid membrane. These new theoretical and experimental findings are expected to benefit applications of diamagnetic liposomes to image biological processes.

3588	Computer 36	A mannan-based probe for multimodal imaging of cancer and immune cells
		Daniel Jirak[1], Andrea Galisova[1], Marketa Jiratova[1], Mariia Rabyk[2], Martin Hruby[2], and Milan Hajek[1]
		[1]IKEM, Prague, Czech Republic, [2]UMCH, Prague, Czech Republic
		Presented mannan-based polymers have promising properties for tumor and metastasis imaging due to their biocompatibility, nanosize and specificity for the immune cells. In this study, two mannan-based polymers were tested by multimodal imaging (MRI and fluorescence). The polymers showed superior imaging properties compared to a commercially available contrast agent. FLI signal at the liver and higher signal at the injection site in the mouse with MN-Ox suggested slower elimination process due to addition of polyoxazoline chains in its structure. Both probes were visualized by MR and optical imaging modality at the injection sites and in the lymph nodes of the experimental mice suggesting their promising properties for cancer diagnosis.

3589	Computer 37	High Temporal Resolution Dynamic BOLD MRI in Tracking Kidney Response to Hypoxia and Hyperoxia in a Rat AKI model at 7T
		Kaixuan Zhao[1], Yingjie Mei[1,2], Guixiang Yang[1], and Yanqiu Feng[1]
		[1]School of Biomedical Engineering, Guangdong Provincial Key Laboratory of Medical Image Processing, Southern Medical University, Guang Zhou, China, [2]Philips Healthcare, Guang Zhou, China
		Blood oxygenation level-dependent magnetic resonance imaging has shown potential to monitoring the tissue oxygenation. However, the absolute T2* value has shown limited usefulness to surrogate the renal microcirculation. This work we monitor the AKI rat renal response to hypoxia and hyperoxia to tracking the hemodynamic changes in the progress of acute kidney injury.

3590	Computer 38	A new class of pH-responsive paraCEST agents for MRI James S Ratnakar[1], Sara Chirayil[1], Alexander M Funk[1], Zoltan Kovacs[1], and A Dean Sherry[1,2] *[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [2]Department of Chemistry, University of Texas at Dallas, Richardson, TX, United States* Many paraCEST agents have reduced sensitivity in vivo due to the reduction of the T_2 relaxation of bulk water by T_{2ex} exchange. Phosphonate coordinating side-chains in cyclen-based complexes exclude inner sphere water and this should reduce the interfering T_{2ex} effects. In the new complexes reported here, a combination of phosphonate and hydroxypropyl pendant arms were incorporated to take advantage of the CEST signal from the Ln-bound OH. Protonation of the coordinating phosphonates results in a shift in the resonance frequency of Ln-bound OH CEST. These agents display several attractive features for imaging tissue pH in vivo by CEST MRI.

3591	Computer 39	Relaxation-compensated multi-pool CEST signal at 7T MRI of WHO IV gliomas is dependent on the anatomic localization Constantin Dreher[1], Johanna Oberhollenzer[1], Johannes Windschuh[2], Jan-Eric Meißner[2], Felix Sahm[3], Martin Bendszus[4], Andreas Unterberg[5], Wolfgang Wick[6], Peter Bachert[2], Mark E. Ladd[2], Heinz-Peter Schlemmer[1], Moritz Zaiss[7], Alexander Radbruch[1], and Daniel Paech[1] *[1]Radiology, DKFZ, Heidelberg, Germany, [2]Medical Physics in Radiology, DKFZ, Heidelberg, Germany, [3]Neuropathology, University Hospital Heidelberg, Heidelberg, Germany, [4]Neuroradiology, University Hospital Heidelberg, Heidelberg, Germany, [5]Neurosurgery, University Hospital Heidelberg, Heidelberg, Germany, [6]Neurology, University Hospital Heidelberg, Heidelberg, Germany, [7]Max-Planck-Institut, Tübingen, Germany* As patients with WHO IV° gliomas are still having a dismal prognosis, further tumor characterization is needed. With prognosis and histopathological parameters being dependent on tumor localization, and Chemical-Exchange-Saturation-Transfer(CEST) MRI at 7T being one of the latest advances in tumor imaging, we have prospectively evaluated CEST signals in 21 patients. Amide CEST and ADC parameters are significantly different with regard to brain hemispheres and correlating. CEST NOE(Nuclear Overhauser-Effect) is not different with regard to brain hemispheres, but in case of contact to the subventricular zone, which is accompanied by worse prognosis. NOE is possibly showing complementary information to Amide CEST.

3592	Computer 40	Detecting prostatic zinc (II) loss in a TRAMP prostate cancer model by glucose-stimulated zinc (II) secretion in vivo with MRI Veronica Clavijo Jordan[1], Alia Al-Ebraheem[2], Su-Tang Lo[1], Tina Geraki[3], Andre F. Martins[1,4], Sara Chirayil[1], Neil M. Rofsky[1], Michael Farquharson[2], and A. Dean Sherry[1,4]

		[1]University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]McMaster University, Hamilton, Canada, [3]Diamond Light Source, Harwell, United Kingdom, [4]University of Texas at Dallas, Richardson, TX, United States
		We have previously found that glucose stimulates the secretion of zinc stores from epithelial cells in the prostate gland, and that this glucose-stimulated zinc secretion (GSZS) can be detected in vivo by a Gd-based zinc sensor with T_1-weighted MRI. Here we elucidate the mechanisms of enhancement in the healthy prostate and loss of enhancement in the malignant prostate by GSZS MRI and Synchrotron-Radiation X-Ray Fluorescence (SR-XRF). GSZS MRI detects the unique loss of zinc content in the lateral lobe of the malignant prostate as observed by SR-XRF with a Gd-based high affinity Zn^{2+} sensor.

3593	Computer 41	MR and optical imaging study to evaluate effects on bioorthogonal click therapy in prostate cancer mouse models
		Sudath Hapuarachchige[1], Colin Huang[1], Jorge S Flores[1], Cyril Bařinka[2], and Dmitri Artemov[1,3]
		[1]Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Laboratory of Structural Biology, Institute of Biotechnology CAS, Vestec, Czech Republic, [3]Department of Oncology, The Sidney Kimmel Comprehensive Cancer Center, The Johns Hopkins University School of Medicine, Baltimore, MD, United States
		Click therapy is a new therapeutic strategy for cancers minimizing systemic toxicity and enhancing therapeutic efficacy. For this strategy, slow internalization of pretargeted cell surface receptors gives a sufficient window for clearance of the unbound pretargeting component before administration of delivery components. Here, we tested click therapy in PSMA(+) PC3-PIP and PSMA(-) PC3-Flu (control) tumors to evaluate delivery and internalization of components. We observed that internalization of 5D3 antibody is fast, which may interfere with the delivery of therapeutic components. In large tumors with leaky vasculature, 5D3 antibody can effectively extravasate leading to the cluster formation with delivery component in tumor microenvironment.

3594	Computer 42	Imaging glucose-stimulated zinc secretion from the prostate and pancreas using a Mn(II)-based zinc sensor
		Veronica Clavijo Jordan [1], Sara Chirayil[1], Andre F Martins[1,2], Namini Paranawithana[2], James S Ratnakar[1], and A. Dean Sherry [1,2]
		[1]University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]University of Texas at Dallas, Richardson, TX, United States

		Imaging glucose-stimulated zinc secretion (GSZS) from secretory tissues has proven useful at assessing organ function and health; current probes to detect zinc secretion by MRI have so far been limited to gadolinium-based sensors. In this work we introduce a manganese-based zinc sensor and show that pancreatic and prostatic zinc detection is not compromised when using Mn instead of Gd for imaging GSZS in vivo. Biodistribution studies indicate that the Mn-based sensor is cleared intact after renal filtration but degraded during hepatobiliary clearance.

3595	Computer 43	In Vivo Murine Cardiac 19F MRI and Tracking of PFCE- and FuGENE-labeled Progenitor Stem Cells in the C57BL/6 Mouse
		Chris Constantinides[1], Ricardo Carnicer Hijazo[1], Andrew Shaw[1], Jyoti Patel[1], Edyta Swider[2], Mangala Srinivas[2], and Carolyn Carr[1]
		[1]U. Oxford, Oxford, United Kingdom, [2]Radboud University Medical Center, Nijmegen, Netherlands
		Despite advances in the visualization of pre-labeled SCs with perfluorocarbon-ether-nanoparticles (PFCE-NPs) or other MRI contrast agents using 19F MRI, there have been no prior reports on murine cardiac 19F imaging of exogenously administered cardiac SCs following direct, intra-cardiac injections. To-this-date, human or murine in vivo cardiac studies have been limited, while prior reported imaging attempts in rats have been prohibitively lengthy, costly (use of multiple millions of cells/animal), and practically complex to reproduce in mice. We report herein significant enhancements of PFCE-NP label following labeling with the highly efficient agent FuGENE, thereby allowing in vivo murine cardiac 19F MRI visualization with minimal cellular toxicity.

3596	Computer 44	A Triple Modality Contrast Agent for Acoustic and Magnetic Particle Imaging (MPI) of Stem Cells
		Jeanne Lemaster[1], Fang Chen[1], Taeho Kim[1], and Jesse Jokerst[1]
		[1]NanoEngineering, University of California, San Diego, La Jolla, CA, United States
		Magnetic particle imaging is a novel and background-free imaging technique that offers good depth of penetration and high contrast of iron oxide nanoparticle tracers. Here, we combined MPI with acoustic imaging through multimodal polymeric nanoparticles. We used these nanoparticles for in vivo stem cell tracking.

3597	Computer 45	Translating 19F-based cellular MRI from 9.4T to 3T: Feasibility of future clinical applications
		Ashley V Makela[1,2] and Paula J Foster[1,2]

		[1]Medical Biophysics, Western University, London, ON, Canada, [2]Robarts Research Institute, London, ON, Canada
		A limitation of ^{19}F-based MRI is low sensitivity; consequently, many studies have been performed at high field strengths with relatively long scan times (ie. 30 minutes). Because of this, human applications have seemed unreasonable. Here, we investigate the feasibility of translating ^{19}F MRI from 9.4T to a 3T clinical scanner. Upon optimization of 3T scan parameters, ^{19}F image quality was similar and ^{19}F spin quantification was not different to a scan performed at 9.4T. Additionally, a 30 second scan produced the same ^{19}F spin quantification as a 30 minute scan at 3T. These findings show promise for future clinical applications.

3598	Computer 46	Magnetic Particle Imaging as a tool for cell tracking: filling the voids left by MRI
		Ashley V Makela[1,2], Jeffrey M Gaudet[3], and Paula J Foster[1,2]
		[1]Medical Biophysics, Western University, London, ON, Canada, [2]Robarts Research Institute, London, ON, Canada, [3]Magnetic Insight Inc, Alameda, CA, United States
		Magnetic Particle Imaging (MPI) is emerging as a specific, quantitative and sensitive cellular imaging technique. MPI directly detects a SPIO tracer as positive contrast, and this signal is linearly quantifiable with zero tissue attenuation. Because of this, MPI is well suited for *in vivo* cell tracking to image tumor associated macrophages (TAMs). TAM content can be used as a biomarker to predict tumor growth and metastatic potential. Mice bearing 4T1 and 168FARN tumors were imaged post intravenous SPIO injection to investigate for the first time, the application of MRI and MPI to differentiate between murine cancer models with varying metastatic potentials.

3599	Computer 47	Novel tracking method for cellular patterns obtained by Laser-Assisted Bioprinting using Magnetic Resonance Imaging
		Olivia Kérourédan[1], Sylvain Miraux[2], Raphael Devillard[1], and Emeline J Ribot[2]
		[1]Biotis, INSERM-Univ.Bordeaux, Bordeaux, France, [2]CRMSB UMR5536, CNRS-Univ.Bordeaux, Bordeaux, France
		One major issue of in situ bioprinting is related to cell pattern imaging in vivo. Magnetic Resonance Imaging (MRI) associated with Micron-sized superparamagnetic Iron Oxide (MPIO) particles constitutes a non-invasive method for tracking cells in vivo. In this study, optimal MPIO concentrations for tracking bioprinted cells were determined. Cell densities of patterns and MRI signals were correlated. MRI was used to track cell patterns in vitro and post-mortem, after in situ bioprinting onto a mouse calvaria defect. Results indicate that MRI combined with MPIO cell labeling is a valuable technique to track bioprinted cells with sufficient precision.

3600	Computer 48	Cellular MRI reveals altered brain arrest of genetically-engineered reporter-expressing metastatic breast cancer cells
		Katie Parkins[1], Veronica Dubois[1], Suzy Wong[1], Amanda Hamilton[2], Paula Foster[1], and John Ronald[1]
		[1]Medical Biophysics, Western University, London, ON, Canada, [2]Western University, London, ON, Canada
		While BLI is very complementary to MRI in evaluating the fate of many different cell populations in vivo, including cancer cells, some considerations for the use of BLI have been reported including an increase in tumor growth variation as well as a change in metastatic pattern following luciferase tagging. The objective of this work was to use cellular and anatomical MRI to characterize the in vivo growth patterns of naive and lentiviral-engineered brain-seeking breast cancer cell lines co-expressing fluorescent and bioluminescent reporters in the mouse brain.

Electronic Poster

Neurodegeneration

Exhibition Hall	Monday 16:15 - 17:15

3601	Computer 49	Disrupted topological organization of brain structural network associated with prior overt hepatic encephalopathy in cirrhotic patients
		Hua-Jun Chen[1]
		[1]Fujian Medical University Union Hospital, Fuzhou, China
		Disrupted topological organization of brain structural network associated with prior overt hepatic encephalopathy

3602	Computer 50	Resting-State fMRI Low-Frequency Fluctuations in Temporal-Lobe Epilepsy Patients and The Relationship with Hemodynamic Correlates
		Chantelle Lim[1], Baxter P Rogers[2], and Victoria L Morgan[2]
		[1]University of Rochester, Rochester, NY, United States, [2]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States

		Amplitude of low-frequency fluctuations (ALFF) of blood oxygenation is a marker of resting-state functional magnetic resonance imaging (fMRI) used to measure local spontaneous activity of the brain. However, interpretation of ALFF results is still unclear. Comparing ALFF values in left and right temporal-lobe epilepsy (TLE) patients with controls showed an increase in seizure-related regions. Increases in cerebral blood flow (CBF) were also found to be partially responsible for the increase in ALFF in another cohort of controls. Therefore, the development of ALFF measures may potentially provide a non-invasive perfusion measure in the presurgical evaluation of TLE.

3603	Computer 51	Effect of repetitive head trauma on diffusion MRI derived measures of diffusivity and free water
		Virendra R Mishra[1], Zhengshi Yang[1], Karthik Sreenivasan[1], Xiaowei Zhuang[1], Sarah Banks[1], Dietmar Cordes[1], and Charles Bernick[1]
		[1]Imaging, Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States
		In this study, we utilized the diffusion MRI (dMRI) data of cognitively impaired and nonimpaired active professional fighters from the Professional Fighters Brain Health Study and studied the effect of repeated head trauma on conventional and advanced dMRI derived measures of diffusivity and free-water fraction (fiso). Our study revealed increased fiso and weighted FA in cognitively impaired active fighters, in addition to increased conventional radial and mean diffusivity, which was further associated with years of fighting in impaired fighters. Our study opens new avenues to explore advanced dMRI measures to understand the effect of repetitive head trauma on cognition.

3604	Computer 52	Exploratory Group Independent Components Analysis of resting state fMRI data reveals widespread brain function impairments in Gulf War Illness
		Kaundinya Gopinath[1], Unal Sakoglu[2], Bruce Crosson[3,4], and Robert Haley[5]
		[1]Department of Radiology, Emory University, Atlanta, GA, United States, [2]University of Houston Clear-Lake, Houston, TX, United States, [3]VA RR&D Center of Excellence, Atlanta VAMC, Decatur, GA, United States, [4]Department of Neurology, Emory University, Atlanta, GA, United States, [5]Department of Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States
		Around 200,000 veterans (up to 32% of those deployed) of the 1991 Gulf War (GW) suffer from GW illness (GWI), which is characterized by multiple deficits in cognitive, emotion, sensory and interoception domains. In this study we examined 23 GWI patients and 30 age-matched controls with resting state fMRI (rsFMRI) in order to map impairments in brain function networks in GWI with group independent components analysis. The results show that GWI veterans exhibit impaired, or abnormally increased functional connectivity in a lot of brain function networks consistent with their self-reported symptoms.

3605	Computer 53	Measuring the effect of soman, a seizure-inducing chemical warfare nerve agent, with simultaneous perfusion and brain oxygenation measurements Kevin Lee[1], Sara Bohnert[2], Matthew Bouchard[1], Ying Wu[1], Cory Vair[2], John Mikler[2], and Jeff F Dunn[1] *[1]Radiology, University of Calgary, Calgary, AB, Canada, [2]Casualty Management Section, Defence Research and Development Canada-Suffield Research Centre, Suffield, AB, Canada* Chemical warfare nerve agents induce neurological damage through seizures. It is widely accepted in the field of nerve agent research that excitotoxicity is the main contributor to the neuropathology. Growing evidence suggests the involvement of hypoxia in seizure-related neuropathology. However, it is difficult to detect hypoxia without directly measuring oxygenation. We applied a method we developed to simultaneously quantify tissue oxygenation and cerebral blood flow to detect hypoxia following soman-induced seizures.

3606	Computer 54	High Resolution 3D T1-weighted Black Blood MRI of Human Lenticulostriate Arteries as Biomarker for Small Vessel Diseases Samantha J Ma[1], Lirong Yan[1], Lei Cao[1], Giuseppe Barisano[1], Marlene Casey[1], John Ringman[2], Meng Law[1], Arthur Toga[1], and Danny JJ Wang[1] *[1]Stevens Neuroimaging and Informatics Institute, University of Southern California, Los Angeles, CA, United States, [2]Neurology, University of Southern California, Los Angeles, CA, United States* The early microvascular changes related to cerebral small vessel disease are still unclear. In this study, we applied a T1-weighted turbo spin echo sequence with variable flip angles for high resolution black-blood MRI to delineate the lenticulostriate arteries (LSA) at 3T. The vessel delineation was rated using a 4-point scale, and then correlated with clinical vascular risk factors as well as measures of executive function, cognitive flexibility and attention. LSA ratings were found to be reliable. Subjects with >4 visible LSA that were minimally tortuous exhibited positive trends with executive function, and male subjects tended to have poorer LSA delineation.

3607	Computer 55	Investigation of differences in the connectivity between the insular cortex and brain activity and metabolites between male smokers and non-smokers in their 20s Seung-Man Yu[1] *[1]Gimcheon University, Seoul Korea, Republic of Korea*

		The purpose of the experiment was to investigate differences in the connectivity between the insular cortex out of the brain areas and other brain areas and the concentration of neuro-metabolites between male adult smokers and non-smokers in their 20s so that the results can be utilized as basic data for smoking cessation programs. The Cr concentration in the right insular cortex area of non-smokers is higher than that of smokers. In addition, it could be seen that smokers had stronger connectivity between their right insular cortex area and Gyrus Right, Occipital Fusiform, and Gurus Right areas than non-smokers and that non-smokers had stronger connectivity between their left insular cortex area and the frontal role right than smokers.

3608	Computer 56	Iron accumulation in the striatonigral pathway of patients with Fabry Disease
		Camilla Russo[1], Giuseppe Pontillo[2], Antonio Pisani[2], Francesco Saccà[2], Eleonora Riccio[2], Antonio Macera[2], Giovanni Rusconi[2], Arnaldo Stanzione[2], Pasquale Borrelli[3], Vincenzo Brescia Morra[2], Enrico Tedeschi[2], Arturo Brunetti[2], Sirio Cocozza[2], and Giuseppe Palma[4]
		[1]Scienze Biomediche Avanzate, Università degli Studi di Napoli "Federico II", Napoli, Italy, [2]University "Federico II", Napoli, Italy, [3]IRCCS SDN, Napoli, Italy, [4]Institute of Biostructure and Bioimaging, National Research Council, Napoli, Italy
		In Fabry Disease (FD) patients, compared to healthy controls, a significant increase in magnetic susceptibility has been observed in the substantia nigra and in the striatum, associated to a significant volume loss limited to the single substantia nigra. These findings probably reflect neurodegenerative phenomena due to pathological iron deposition in these particular extrapyramidal relay stations. This evidence supports the current hypothesis of a permeative cerebral involvement in FD that goes further the pure cerebrovascular association, thus shedding new light on this condition.

3609	Computer 57	Pre-operative DTI of white matter tracts in patients with idiopathic normal pressure hydrocephalus (iNPH) correlates with changes in clinical findings after shunt surgery
		Johanna Mårtensson[1], Katarina Laurell[2], Johan Virhammar[3], and Elna-Marie Larsson[1]
		[1]Radiology, Clinical Sciences, Uppsala, Sweden, [2]Pharmacology and Clinical Neuroscience, Neurology, Östersund, Sweden, [3]Neuroscience, Neurology, Uppsala, Sweden
		Preoperative prediction of shunt surgery outcome is difficult. A test to predict outcome is missing. The use of diffusion tensor imaging (DTI) as a bioimaging marker was investigated. DTI parameters in white matter tracts were compared between patients and healthy controls, and also correlated with changes in clinical findings after shunt surgery. Significantly differences between healthy controls and patients were found. Correlations were found between preoperative DTI results and changes in clinical findings after shunt surgery, suggesting DTI to be a supportive tool for prediction of clinical outcomes from shunt surgery in patients with idiopathic normal pressure hydrocephalus (iNPH).

3610	Computer 58	Abnormal Gray Matter Structural networks in Idiopathic Normal Pressure Hydrocephalus
		Lekang Yin[1], Yanmei Yang[2], Jianding Ye[3], and Hong Yu[3]
		[1]Radiology Deparment, Shanghai Chest Hospital, Shanghai, China, [2]Radiology Department, Huashan Hospital of Fudan University, Shanghai, China, [3]Radiology Department, Shanghai Chest Hospital, Shanghai, China
		Idiopathic normal pressure hydrocephalus (iNPH) is a neurological disorder, the structural networks changes were never studied. We examined changes in gray matter structural network of patients with iNPH comparing with normal elderly people. Global network modularity was significantly larger in the iNPH network compared with the NC network (P<0.05). Eight nodes with significantly decreased betweenness were found in right frontal, temporal, insula lobe and right posterior cingulate region of iNPH network, while only one node was detected with significantly larger betweenness. Hubs of the iNPH network were mostly located in temporal areas and limbic lobe, while hubs of NC network were mainly located in frontal areas. We found some abnormalities in gray matter structural network that may relate to the occurrence of iNPH.

3611	Computer 59	Structural and functional assessments of eye, brain and visual field in glaucoma using optical coherence tomography, magnetic resonance imaging and perimetry
		Vivek Trivedi[1], Yue Chen[2], Carlos Parra[1], Ahmel Arshad[3], Ji Won Bang[1], Mengfei Wu[4], Ian Conner[5], and Kevin Chan[6]
		[1]Department of Ophthalmology, New York University, New York, NY, United States, [2]Department of Biomedical Engineering, Tsinghua University, Beijing, China, [3]Touro College of Osteopathic Medicine, Middletown, NY, United States, [4]Department of Population Health, New York University, New York, NY, United States, [5]Department of Ophthalmology, University of Pittsburgh, Pittsburgh, PA, United States, [6]Department of Ophthalmology, Department of Radiology, New York University, New York, NY, United States
		We used 3-Tesla anatomical MRI, DTI, optical coherence tomography, and perimetry to assess structural and functional changes in the eye and brain in glaucoma patients across disease stages. Both optic nerve and optic chiasm volumes were found to decrease from early to advanced staged glaucoma, and were associated with inner retinal thinning and visual field functional loss. Fractional anisotropy, mean diffusivity, and radial diffusivity in optic radiation were significantly different from early to advanced staged patients, but not when comparing control to early disease states. These results suggest anatomical MRI and DTI may be useful in monitoring glaucomatous brain damages non-invasively across stages.

3612	Computer 60	Dose-dependent effects of citicoline on the visuomotor response and white matter integrity in the visual pathway after chronic intraocular pressure elevation
		Yolandi van der Merwe[1,2], William J Kohler[3], Michael Krawchuk[3], Xiaoling Yang[2], Leon C Ho[4], Yu Yu[5], Ying Chau[6], Christopher K Leung[7], and Kevin C Chan[2,8,9]

		[1]*Department of Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States,* [2]*Department of Ophthalmology, University of Pittsburgh, Pittsburgh, PA, United States,* [3]*Neuroimaging Laboratory, University of Pittsburgh, Pittsburgh, PA, United States,* [4]*Department of Electrical Engineering, University of Hong Kong, Hong Kong, Hong Kong,* [5]*Division of Biomedical Engineering, Hong Kong University of Science and Technology, Hong Kong, Hong Kong,* [6]*Department of Chemical and Biological Engineering, Hong Kong University of Science and Technology, Hong Kong, Hong Kong,* [7]*Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, Hong Kong, Hong Kong,* [8]*Department of Radiology, New York University, New York, NY, United States,* [9]*Department of Ophthalmology, New York University, New York, NY, United States*
		Glaucoma is a neurodegenerative disease that can cause irreversible vision loss. Elevated intraocular pressure is a major risk factor for the glaucoma; however, the disease may still progress in some patients after lowering IOP. Citicoline has been suggested as a potential therapeutic to ameliorate damage caused by neurodegenerative diseases, including glaucoma, but its neuroprotective effects remain incompletely studied. In this study, we analyzed the dose-dependent effect of oral citicoline on visual behavior response and white matter integrity in a rodent model of glaucoma. The results show citicoline preserves visual behavior response and visual system integrity in a dose dependent manner.

3613	Computer 61	Microstructural and metabolism changes in the longitudinal progression of white matter hyperintensity
		Yeerfan Jiaerken[1], Xiao Luo[1], and Minming Zhang[1]
		[1]*Second Affiliated Hospital of Zhejiang University, School Of Medicine, Hangzhou, China*
		To evaluate the microstructural and metabolism property in the white matter that later become white matter hyperintensity (WMH), and the property of WMH that later disappeared. And we discovered that there is a dynamic change in microstructural and metabolism in WMH. Metabolism in NAWM will start to decline rapidly to a point where microstructure will then start to deteriorate.

3614	Computer 62	Neurological symptoms and pathology in patients with newly-diagnosed, “classical” coeliac disease
		Iain Croall[1], Marios Hadjivassiliou[1], Panagiotis Zis[1], David S Sanders[1], Pascale Aeschlimann[2], Richard A Grünewald[1], Paul Armitage[1], Dan Connolly[1], Daniel Aeschlimann[2], and Nigel Hoggard[1]
		[1]*University of Sheffield, Sheffield, United Kingdom,* [2]*Cardiff University, Cardiff, United Kingdom*

		Coeliac disease is known to cause neurological problems, although these are not well recognised by healthcare professionals. In this prospective study of 100 newly-diagnosed patients with classical coeliac disease, we show 67% to have neurological symptoms, and 46% to have abnormal NAA/Cr values by MR Spectroscopy investigation. Further, we demonstrate how participants with positivity to transglutaminase 6, an auto-antibody suggested to be involved in neuro-pathology of gluten-related disorders, are more likely to suffer these. Finally, we present a volumetric analysis showing subcortical atrophy in this sub-group. This study highlights the prevalence, and potential mechanisms, of neurological involvement in coeliac disease.

3615	Computer 63	Paravermal sign: new MR imaging features of cerebellum in neuronal intranuclear inclusion disease
		Noriko Sato[1], Atsuhiko Sugiyama[2], Yukio Kimura[1], Yuko Saito[3], and Hiroshi Matsuda[3]
		[1]Radiology, National Center of Neurology and Psychiatry, Tokyo, Japan, [2]Neurology, Ciba University, Chiba, Japan, [3]National Center of Neurology and Psychiatry, Tokyo, Japan
		Neuronal intranuclear inclusion disease (NIID) is a neurodegenerative disorder with characteristic high signals along the corticomedullary junction on MR DWI. However, cerebellar findings have not been fully evaluated on MRI and we reviewed them in a series of ten NIID patients. MRI results showed cerebellar atrophy (10/10), high intensity signal on FLAIR images in medial part of the cerebellar hemisphere immediately beside the vermis (paravermal area) (7/10), and in the middle cerebellar peduncle (6/10). The paravermal abnormal signals could be a clue for diagnosis of NIID even in the past MR studies in which DWI was not examined.

3616	Computer 64	Regional cortical folding morphometry in Friedreich ataxia using Laplace Beltrami based gyrification index
		Rosita Shishegar[1,2], Imis Dogan[3,4], Martin B. Delatycki[1,5,6,7], Gary F. Egan[1,2], Elsdon Storey[8], Louise A. Corben[1,5,7], and Nellie Georgiou-Karistianis[1]
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		Friedreich ataxia (FRDA) is an inherited neurodegenerative disorder mainly affecting the spinal cord and dentate nuclei of the cerebellum. Although there is growing evidence of cerebral atrophy and cortical thinning in FRDA, no research has investigated the pattern of cortical folding (gyrification) in the disorder. We have proposed a new MRI analysis technique, Laplace Beltrami based gyrification index (LB-GI), and validated its use in individuals with FRDA. Preliminary results reveal significantly increased regional gyrification in the motor cortex in individuals with FRDA, compared to healthy controls. Overall, our results demonstrate that LB-GI is a sensitive technique which requires further investigation as a potential neuroimaging marker of disease progression in FRDA.

3617	Computer 65	Multi-delay Simultaneous-Multi-Slice pCASL Imaging of Acute Treatment Effects of Ketamine in Major Depression
		Kai Wang[1], Xingfeng Shao[1], Katherine Narr[2], Amber Leaver[2], Randall Espinoza[2], and Danny Wang[1]
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		Sub-anesthetic dose of ketamine elicit acute and robust antidepressant effects, however the mechanism is still less understood. With a state-of-the-art Simultaneous Multislice EPI pCASL sequence, whole-brain rCBF and Arterial Transit Time (ATT) maps were acquired pre and post intravenous infusion of ketamine. Eight clusters were detected with significant CBF change, two of which (one in left inferior frontal gyrus, the other in right parietal lobe) were significantly correlated (r=-0.7, p=0.04; r=-0.74, p=0.03 respectively) with Hamilton Depression rating score. This study suggests that possible mechanism of the antidepressant effects of ketamine is to increase CBF of certain mood- and attention-related brain regions.

3618	Computer 66	Impaired microstructural integrity of the callosum forceps minor in type 2 diabetes mellitus affect bilateral frontal functional connectivity
		Xin Wang[1], Zhou Zhang[2], Jiaming Lu[1], Xin Zhang[1], Zhao Qin[1], Yan Bi[2], and Bing Zhang[1]
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		Type 2 diabetes mellitus (T2DM) is a risk factor for cognitive impairment. While its mechanism remains to be explored. In this study, using Automating Fiber-Tract Quantification (AFQ) analysis, we found that the fractional anisotropy (FA) in callosum forceps minor decreased in patients with T2DM, which indicated transverse white matter tracts connecting bilateral frontal cortex, was damaged. Meanwhile, functional connectivity between multiple brain regions within bilateral frontal cortex was decreased. The changes in the tract of callosum forceps minor might be the microstructural basis for functional changes of frontal cortex and help us understand the mechanism of T2DM related cognition decline.

3619	Computer 67	Quantitative Magnetic Resonance Imaging in diabetes: inflammation, oedema and neurodegeneration
		Ana-Maria Oros-Peusquens[1], Ricardo Loucao[1], Elene Iordanishvili[1], Melissa Schall[1], Markus Zimmermann[1], Svenja Caspers[2], and N. Jon Shah[1]
		[1]Institute of Neuroscience and Medicine 4, Medical Imaging Physics, Research Centre Juelich, Juelich, Germany, [2]Institute of Neuroscience and Medicine 1, Research Centre Juelich, Juelich, Germany
		Type II diabetes is one of the most important metabolic disorders for public health with around 8% prevalence in European population (11% in the US). We report here for the first time a generalized increase in brain water content of ~ 2% in type II diabetics compared to age- and gender-matched controls, supporting the presence of neuroinflammation in diabetes. Several other quantitative measures are investigated (T1, T2*, MT parameters, magnetic susceptibility and diffusion kurtosis) as well as region-based volume, area and cortical thickness. Regions with significant changes in a large number of quantitative parameters are identified.

3620	Computer 68	Perfusion Pattern Scores Associates with Disease Severity in Type 2 Diabetes
		Yuheng Chen[1], Wenna Duan[2], Parshant Sehrawat[1], Vaibhav Chauhan[1], Freddy J Alfaro[3], Anna Gavrieli [3], Vera Novak[3], and Weiying Dai[2]
		[1]Department of Computer Science, State University of New York at Binghamton, Vestal, NY, United States, [2]Computer Science, State University of New York at Binghamton, Vestal, NY, United States, [3]Department of Neurology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States
		Type 2 diabetes mellitus (T2DM) is associated with alterations in the blood brain barrier, neuronal damage, and arterial stiffness, thus affecting cerebral metabolism and brain perfusion. We develop a machine learning method to investigate T2DM-related covariance pattern and its association with cognitive performance/disease severity. Our pipeline is superior to the traditional method and the pattern-related individual scores are associated to diabetes severity variables, mobility and cognitive performance at baseline. Besides, the longitudinal score change is associated with change of HbA1c, and baseline cholesterol, indicating that this score is a promising biomarker for tracing the disease progression of individual T2DM patients.

3621	Computer 69	Distinct mechanism underlying patients who might benefit from edaravone or those may not - a combined quantitative susceptibility mapping and DTI study
		Qiuli Zhang[1], Haining Li[1], Ming Zhang[1], Dandan Zheng[2], and Lijun Bai[3]
		[1]Department of Medical Imaging, the First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China, [2]2GE Healthcare, MR Research China, Beijing, China, [3]School of Life Science and Technology, Xi'an Jiaontong University, the Key Laboratory of Biomedical Information Engeering, Ministry of Education, Xi'an', China
		The coexistence of multiple complicated pathological mechanisms, and lack of valid biomarker for treatment effects, remains to be main challenges that retarded ALS clinical trials. The approve of edaravone in treating ALS confirmed the importance of oxidative stress in ALS pathology. However, only a subgroup of patients would benefit with edaravone. We used QSM and DTI to explore the different mechanism that underlying those two cohorts. Our study revealed that neuroinflammation-prominent pathology and age-dependent oxidative stress might a feature for patients benefit with eradavone. While for patients not fulfill edaravone therapy, iron-mediated injury, like ferroptosis might accelerate disease progression.

3622	Computer 70	Structural analysis of m.3243A>G patients using 3D anatomical MRI brain scans
		Catherine Hossain[1,2], Julie Hall[1,3], Yi Ng[2,3], Alexandra Bright[2,3], Andrew Blamire[4,5], Douglass Turnbull[1,2,3], Robert McFarland[1,2,3], and Grainne Gorman[1,2,3]
		[1]Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom, [2]Wellcome Mitochondrial Research Centre, Newcastle upon Tyne, United Kingdom, [3]Newcastle upon Tyne Hospitals (NUTH), Newcastle upon Tyne, United Kingdom, [4]Magnetic Resonance Centre, Newcastle upon Tyne, United Kingdom, [5]Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, United Kingdom
		Symptoms associated with mitochondrial disease are heterogeneous and unpredictable. 17 m.3243A>G patients and 24 controls had 3D anatomical MRI brain scans, which were analysed to test the hypothesis that there are structural differences in patients that may potentially be used as biomarkers to predict symptoms. Results indicate head size is a possible surrogate biomarker for susceptibility to seizure-mediated strokes, but more detailed analysis did not provide any specific markers. Thinning of the cortex in the temporal poles appears to be directly related to the presence of the m.3243A>G point mutation and is an area to investigate further.

3623	Computer 71	CORRELATION OF IMMUNE ACTIVATION BIOMARKERS AND MRS MEASURES IN ACUTE HIV INFECTION

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Proton MRS was performed in 51 acute HIV participants. We observed Inverse correlations between sCD163 and markers of neuronal integrity (BG and PCG NAA) in select brain regions suggests regional variability to neuronal injury in AHI. Further, correlations between CSF sCD163 and BG Cho and mI reveal that membrane turnover activity and glia activation that occur early in infection remain susceptible to CNS neuroinflammation. Our observation suggests select brain injury linked to myeloid activation persists even early ART in AHI arguing for additional interventions to halt detrimental neuroinflammation.

3624 Computer 72

Whole-brain MRSI for Quantification of Metabolite Markers of Inflammation and Neuronal Integrity in HIV-1 Clade C Infection

Varan Govind[1], Sameer Vyas[2], Vivek Gupta[2], Aman Sharma[3], Sulaiman Sheriff[1], Mahendra Kumar[1], and Niranjan Khandelwal[2]

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HIV-1 enters the brain early in the course of infection and its replication continues despite use of combination anti-retrovirals (cART), causing chronic neuroinflammation, resulting in mild-to-moderate HIV-associated neurocognitive disorders in up to 50% of infected individuals. HIV-1 virus can be found throughout the brain of infected individuals, however, its maximum viral loads were found in the basal ganglia, frontal and medial temporal lobes, and hippocampus.[1] We evaluated the use of a whole-brain proton MR spectroscopic imaging (MRSI) method at 3Tesla to better characterize the metabolite changes within the whole brain as a result of HIV infection.

Electronic Poster

Parkinson's Disease

3625	Computer 73	Overlap of R2* map based SN and SNpc defined by neuromelanin-sensitive MRI in Parkinson's Disease: A promising diagnostic biomarker
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		There is an urgent need for developing diagnostic imaging biomarkers for Parkinson's Disease (PD). In this work, we applied a standardized substantia nigra pars compacta (SNpc) mask based on neuromelanin-sensitive MR images from healthy subjects to investigate the diagnostic performance of the SNpc overlap percentage and R2* in the SNpc overlap in PD. R2* in the SNpc overlap volume was increased in PD patients as compared to controls. Furthermore, it was significantly positively correlated with the disease duration in PD. We found an excellent diagnostic accuracy for the SNpc overlap percentage (AUC, 0.927) in PD.

3626	Computer 74	Visualization of Substantia Nigra Pars Compacta: MPRAGE vs. DANTE T1-SPACE
		Sonoko Oshima[1], Yasutaka Fushimi[1], Tomohisa Okada[2], Takuya Hinoda[1], Takayuki Yamamoto[1], Hikaru Fukutomi[1], Yusuke Yokota[1], Akira Yamamoto[1], Tsutomu Okada[1], John Grinstead[3], Sinyeob Ahn[4], and Kaori Togashi[1]
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		Neuromelanin-sensitive magnetic resonance techniques have been developed for depicting neuromelanin-rich structures such as substantia nigra pars compacta (SNpc). We compared visualization of SNpc between magnetization-prepared rapid gradient-echo imaging (MPRAGE) and delay alternating with nutation for tailored excitation-prepared T1-weighted variable flip angle turbo spin echo (DANTE T1-SPACE) in 21 healthy volunteers. DANTE T1-SPACE provided much better delineation of SNpc and showed higher signal intensity than MPRAGE. DANTE T1-SPACE can be used for evaluating SNpc.

3627	Computer 75	Automated White Matter Lesion Quantification Correlates With Gait and Cognitive Dysfunction In Parkinson's Disease
		Eric Fang*[1], Mário João Fartaria*[2,3,4], Chu-Ning Ann[5], Bénédicte Maréchal[2,3,4], Tobias Kober[2,3,4], Jie-Xin Lim[6], Celeste Chen[5], Soo-Lee Lim[1], Julian Gan[7], Eng-King Tan[5,8], and Ling-Ling Chan[1,8]
		[1]Singapore General Hospital, Singapore, Singapore, [2]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [3]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [5]National Neuroscience Institute, Singapore, Singapore, [6]Nanyang Technological University, Singapore, Singapore, [7]Siemens Healthcare, Singapore, Singapore, [8]Duke-NUS Medical School, Singapore, Singapore
		White matter lesions (WMLs) have an impact on neuronal connectivity; and consequently affect balance, mobility and cognition in both normal aging and disease states. Using a fully automated segmentation algorithm and multi-modal images, we estimated WMLs volumes to predict the clinical severity in a cohort of Parkinson's disease (PD) patients and healthy controls (HC). Increased WMLs volume is strongly associated with both motor/gait and cognitive dysfunctions in PD. Lobar WMLs are found to have differential impact on distinctive cognitive domains. Automated volumetric quantification of WMLs load, particularly within the frontal and prefrontal regions can predict severity of symptoms in PD.

3628	Computer 76	White Matter Alterations in Parkinson's Disease Analyzed with Combined Diffusion Magnetic Resonance Imaging and Magnetization Transfer Saturation Imaging: A Tract-Based Spatial Statistics Analysis
		Christina Andica[1], Koji Kamagata[1], Taku Hatano[2], Asami Saito[1], Yuki Takenaka[1,3], Akifumi Hagiwara[1,4], Masaaki Hori[1], Ryusuke Irie[1,4], Akihiko Wada[1], Kanako Kumamaru[1], Nobutaka Hattori[2], and Shigeki Aoki[1]
		[1]Department of Radiology, Juntendo University Graduate School of Medicine, Tokyo, Japan, [2]Department of Neurology, Juntendo University School of Medicine, Tokyo, Japan, [3]Department of Radiological Sciences, Graduate School of Human Health Sciences, Tokyo Metropolitan University, Tokyo, Japan, [4]Department of Radiology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan
		Our study combined three in-vivo imaging modalities (diffusion tensor imaging, neurite orientation dispersion and density imaging, and magnetization transfer saturation imaging) to provide a deeper understanding of white matter (WM) pathologies in Parkinson`s disease (PD). The tract-based spatial statistics analysis showed significantly decreased fractional anisotropy and intracellular volume fraction, and increased mean diffusivity, axial diffusivity, and radial diffusivity in an extensive area of WM in PD patients. Meanwhile, non-significantly increased myelin volume fraction was observed in limited areas of WM. The findings of this study might indicate that PD predominantly affects axons rather than myelin in WM.

3629	Computer 77	Brain Structural Differences in Healthy LRRK2 G2019S Mutation Carriers: An MR Radiomics Study Moran Artzi[1,2], Avner Thaler[2,3,4], Avi Orr Urterger[2,5], Talma Hendler[1,2,4,6], Nir Giladi[2,3,4], Anat Mirelman[2,3,4,7], and Dafna Ben Bashat[1,2,4] *[1]The Functional Brain Center, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [2]Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel, [3]Movement Disorders Unit, Neurological Institute, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [4]Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel, [5]Genetics Institute, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [6]Department of Psychology, Tel Aviv University, Tel Aviv, Israel, [7]Laboratory for Early Markers of Neurodegeneration, Neurology Institute, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel* Structural brain differences in healthy LRRK2-G2019s mutation carriers who are at risk of developing Parkinson's disease (PD) were studied using radiomics analysis of DTI and T1-weighted images. 83 subjects were included: 43 healthy-carriers (HC) and 40 healthy-non-carriers (HNC). 18 statistical parameters were extracted for each modality in 14 subcortical brain regions. Various machine-learning classifiers were tested. The best classification results were obtained using RUSBoosted classifier, with average accuracy 73%, sensitivity 68% and specificity 79%. Radiomics analysis revealed brain differences in HC in comparison to HNC. These results together with the preliminary results among converters support the hypothesis of utilization of structural compensatory mechanisms in this "at risk" cohort.

3630	Computer 78	Contribution of basal forebrain damage to cognitive deficits in Parkinson's disease Fatma Gargouri[1,2], Cécile Gallea[1,2,3], Marie Mongin[1,2,3], Nadya Pyatigorskaya[1,2,3,4], Romain Valabregue[1,2], Marie Sarazin[5], Lydia Yahia-Cherif[1,2], Marie Vidailhet[2,3,6], and Stéphane Lehéricy[1,2,3,4] *[1]Institut du Cerveau et de la Moelle épinière – ICM, Centre de NeuroImagerie de Recherche – CENIR, Paris, France, [2]Sorbonne Universités, UPMC Univ Paris 06, Inserm U1127, CNRS UMR 7225, Paris, France, [3]ICM Team Control of Normal and Abnormal Movement, Paris, France, [4]Service de neuroradiologie, Groupe Hospitalier Pitié-Salpêtrière, AP-HP, Paris, France, [5]Service de Neurologie, Hôpital Saint Anne, Paris, France, [6]Département de Neurologie, Groupe Hospitalier Pitié-Salpêtrière, AP-HP, Paris, France* We investigated the contribution of basal forebrain damage in the cognitive dysfunction of 52 non-demented patients with Parkinson's disease (PD) and 25 age-matched healthy controls using diffusion and resting state functional MRI. Patients showed diffusion changes in the basal forebrain and the fornix. They also showed reduced functional connectivity between the septal area and the temporal lobe including the hippocampi and parahippocampal gyri, and between the basal nucleus of Meynert and frontal areas and bilateral thalami. Structural and functional changes correlated with memory and executive functions.

3631	Computer 79	Automatic analysis of multi-echo GRE and DTI data of Parkinson's disease patients and control subjects using atlas-based subcortical regions

		Gerd Melkus[1,2,3], Santanu Chakraborty[1,2,3], Goncalo Santos[4], Donghoon Kim[2], David Grimes[3,4], and Tiago Mestre[3,4]
		[1]Medical Imaging, The Ottawa Hospital, Ottawa, ON, Canada, [2]Radiology, University of Ottawa, Ottawa, ON, Canada, [3]Ottawa Hospital Research Institute, Ottawa, ON, Canada, [4]Division of Neurology, University of Ottawa Brain and Mind Research Institute, Ottawa, ON, Canada
		Multi-parametric brain MRI longitudinal studies, which result in multiple quantitative parameter maps, can require intense post-processing work and time if several sub-cortical structures need to be analyzed individually on a region of interest (ROI) basis. In this study, we used a brain co-registration process together with a structural subcortical probability atlas for an automated analysis of quantitative MRI data. Patients with a recent diagnosis of Parkinson's disease (<1 year) and healthy controls underwent brain MRI in a longitudinal study design. Quantitative maps derived from multi-echo GRE and DTI acquisitions were analyzed using this automated post-processing procedure at 3 different time points.

3632	Computer 80	Clinical diagnosis based on speech mechanics with dynamic (real time) MRI, functional MRI and acoustics of speech (spectrogram)
		Sunita Gudwani[1], S. Senthil Kumaran[2], and Madhuri Behari[3]
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		In evidence based clinical practice, mapping speech production problems is a challenge, further with cognitive impairment in degenerative disease makes the examination and assessments difficult. Visualization of the flexible vocal tract (dynamic MRI), cognitive planning (BOLD activation) and automated acoustic analysis (spectrogram) of speech production in motor degenerative diseases (like Parkinson's Disease) might reframe the diagnostic evaluations. Empirically dynamic MRI is important technique for articulatory movements when adjunct with cognitive planning (fMRI) and spectrogram analysis may team as sensitive measures in clinical diagnosis. Thus this pilot study was planned to observe the significance.

3633	Computer 81	White Matter Differences in Parkinson's Disease: a 7Tesla Tract-Based Spatial Statistics Study
		Remi Patriat[1], Jacob Jacob Niederer[1], Sommer Amundsen Huffmaster[2], Matthew Petrucci[2], Noam Harel[1], Colum MacKinnon[2], and Christophe Lenglet[1]
		[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Neurology, University of Minnesota, Minneapolis, MN, United States

		We used tract-based spatial statistics (TBBS) of 7Tesla fractional anisotropy (FA) measures to find differences between a cohort of early PD patients (N=30) and healthy controls (N=28). We examined the evolution of these differences by adding a PD cohort with longer disease duration (N=21). TBSS analysis revealed increased FA in the early PD group in the portions of the superior longitudinal fasciculus and the corticospinal tracts near M1, pre-motor and SMA. Subsequent analyses revealed increased FA in both PD groups compared to the control group. Radial diffusivity was significantly lower in the early and late PD groups compared to controls.

3634	Computer 82	Investigating differences in laterality and novel diffusion-derived metrics between freezing of gait (FOG) and non-FOG early Parkinson's disease patients
		Virendra R Mishra[1], Zhengshi Yang[1], Karthik Sreenivasan[1], Xiaowei Zhuang[1], Dietmar Cordes[1], and Brent Bluett[1]
		[1]Imaging, Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States
		In this study, we utilized the diffusion MRI (dMRI) data of self-reported freezing of gait early Parkinson's disease (PD-FOG) patients and PD-nonFOG patients from the Parkinson's Progressive Markers Initiative (PPMI) database and investigated laterality along with the sensitivity of the conventional and advanced dMRI derived measures to classify the two groups. Our study revealed an asymmetric left laterality in early PD-FOG and a significant association of weighted fractional anisotropy with UPDRS scores in PD-FOG patients. Our study opens a window to understand disease severity using a potential new imaging biomarker for PD-FOG.

3635	Computer 83	Concurrent assessment of perfusion and functional connectivity in Parkinson's disease
		Maria Marcella Lagana[1], Laura Pelizzari[1,2], Niels Bergsland[1,3], Alice Pirastru[1], Giuseppe Baselli[2], Mario Clerici[1,4], Pietro Cecconi[5], Raffaello Nemni[1,4], and Francesca Baglio[1]
		[1]Fondazione Don Carlo Gnocchi ONLUS, Milan, Italy, [2]Department of Electronics, Information and Bioengineering, Politecnico di Milano, Milan, Italy, [3]Buffalo Neuroimaging Analysis Center, Department of Neurology, School of Medicine and Biomedical Sciences, University at Buffalo, State University of New York, Buffalo, NY, United States, [4]Università degli Studi di Milano, Milan, Italy, [5]Radiology, Fondazione Don Carlo Gnocchi ONLUS, Milan, Italy
		We aimed to assess if resting state functional connectivity (FC) changes were related to hypoperfusion in a group of Parkinson's disease (PD) patients. Independent component analysis was performed to identify common spatial patterns of FC and of arterial spin labeling perfusion separately, in the whole group of PD and healthy controls. Concurrent FC and perfusion group differences were assessed. The observed FC alteration in the visual network may be influenced by the significantly reduced cerebral blood flow in the lateral occipital cortex, and *vice-versa*. The cross-talk between functional and perfusion findings should be considered when interpreting the results.

3636	Computer 84	Alteration of brain structure network in Parkinson's disease with and without rapid eye movement sleep behavior disorder
		Tao Guo[1], Xiaojun Guan[2], Qiaoling Zeng[2], Min Xuan[2], Quanquan Gu[2], Xiaojun Xu[2], and Minming Zhang[2]
		[1]Radiology, Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China, [2]Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China
		We detected the alteration of structure correlation network in Parkinson's disease (PD) patients with and without Rapid eye movement sleep behavior disorder (RBD). 191 PD patients including 51 possible RBD (pRBD) and 140 non-possible RBD (npRBD) and 76 normal controls were included. Structure brain networks were constructed by thresholding gray matter volume correlation matrices and analyzed using graph theoretical approaches. Significant enhanced nodal properties and hub recruitment were found mainly in limbic system while decreased nodal parameters were observed in cerebellum in PD-pRBD. This study may contribute to understand the pathophysiology of PD-RBD.

3637	Computer 85	White Matter Property of the Reward Circuits in Impulse Control Disorders in Parkinson's Disease
		Ru-Jen Lin[1], Weng-Ming Liu [2], Yung-Chin Hsu[3], Yu-Chen Wei[3], Pin-Yu Chen [3], Joshua O Goh[4], Wen-Yih Tseng[3], and Ruey-Meei Wu[5]
		[1]Neurology Department, National Taiwan University Hospital Hsinchu branch, Hsinchu city, Taiwan, [2]Neurology Department, Tzu Chi Hospital, Hualien City, Taiwan, [3]Institute of Medical Device and Imaging, National Taiwan University, Taipei City, Taiwan, [4]Graduate Institute of Brain and Mind Sciences, National Taiwan University, Taipei City, Taiwan, [5]Neurology Department, National Taiwan University Hospital, Taipei City, Taiwan
		Approximately 10-20% of Parkinson's disease (PD) patients treated with dopamine agonist may develop impulse control disorder (ICD). We aimed to investigate microstructural characteristics of the white matter (WM) tracts in the reward circuits in PD-ICD by DSI images. ReMAP (Mean Apparent Propagator) was used for DSI reconstruction and TBAA (tract-based automatic analysis) for further tract analysis. Among the frontostriatal tracts (FS) and amygdala-related tracts, we found larger AD and/or RD in FS_motor cortex and amygdala-related tracts in ICD subjects, which may indicate a less healthy WM microstructure, and may further underlie the vulnerability to dopamine stimulation and result in hyper-gambling behavior.

3638	Computer 86	Differential diagnosis in Parkinsonism using diffusion tensor as measured from multiple cortical regions
		Fan Huang[1], Sung-han Lin[2], Chin-Song Lu[3], Yi-Hsin Weng[3], Yao-Liang Chen[4], Shu-Hang Ng[5], Yi-Ming Wu[5], Chih-Chien Tsai[1], Yi-peng Liu[6], and Jiun-Jie Wang[1]

		[1]Medical Imaging and Radiological Science, Chang Gung University, Taoyuan, Taiwan, [2]Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan, [3]Neurology, Chang Gung Memorial Hospital, Taoyuan, Taiwan, [4]Diagnostic Radiology, Keelung Chang Gung Memorial Hospital, Keelung, Taiwan, [5]Diagnostic Radiology, Chang Gung Memorial Hospital, Taoyuan, Taiwan, [6]University of Electronic Sciencee and Technology of China, School of Electronic Engineering, Chengdu, China
		Parkinsonism is a long-term degenerative disorder of the central nervous system that mainly affects the motor system. The cortical parcellation algorithm was applied to evaluate the cortical involvement in the patients with PD by using diffusion tensor image. The fractional anisotropy is feasible in the brain of patients with Parkinsonism. Therefore fractional anisotropy could be a potential image based biomarker for monitoring Parkinson progression.

3639	Computer 87	Motor compensation in Parkinson's disease (PD): a multimodal neuroimaging study
		Nicolas Villain[1,2], Stéphane Lehéricy[2,3], Nadya Pyatigorskaya[2,3], Romain Valabrègue[2], Sara Fernandez-Vidal[2], Rahul Gaurav[2], Olivier Jaubert[2], Marie-Odile Habert[4], Graziella Mangone[2,5], Jean-Christophe Corvol[1,2,5], Marie Vidailhet[1,2], and David Grabli[1,2]
		[1]Neurology, Groupe Hospitalier Pitié Salpêtrière, Paris, France, [2]Institut du Cerveau et de la Moelle Epinière, Paris, France, [3]Neuroradiology, Groupe Hospitalier Pitié Salpêtrière, Paris, France, [4]Nuclear Medicine, Groupe Hospitalier Pitié Salpêtrière, Paris, France, [5]Centre d'Investigation de Recherche Clinique, Groupe Hospitalier Pitié Salpêtrière, Paris, France
		Motor compensation mechanisms in PD rely on very distinct levels of evidence and have never been assessed altogether. They were tested among 68 early PD patients who underwent dopaminergic imaging and MRI (T1 neuromelanin, fMRI, DTI). We created an adjusted motor severity index (ratio between akinetic motor severity and neuromelanin substantia nigra alteration) and performed correlations between this index and the hypothesized compensation mechanisms. As a result, new dopaminergic synapses or more active dopaminergic synapses, reorganization of motor and cognitive subcortical loops and of the associative areas of the cerebellum are the main motor compensation mechanisms in early PD.

3640	Computer 88	The roles of sensorimotor and default mode-memory retrieval networks in staging PD cognitive decline
		Meng-Hsiang Chen[1], Weiyan Yin[2], Wei-Che Lin[1], and Weili Lin[3]
		[1]Department of Diagnostic Radiology, Kaohsiung Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Kaohsiung, Taiwan, [2]Department of Biomedical Engineering and Biomedical Research Imaging Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [3]Department of Radiology and Biomedical Research Imaging Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

		In addition to motor disability, the development of cognitive decline is one of the most notorious symptoms in Parkinson's disease (PD). Yet, a biomarker capable of accurately diagnosing cognitive impairments in PD patients remains elusive. Our results, based on resting-state functional MRI, suggested that functional connectivity in sensorimotor together with default mode-memory retrieval networks may serve a promising biomarker either for staging cognitive decline or neuropsychiatric scores.

3641	Computer 89	Cerebellum and Sensory Motor Resting State Network Behaviors in tremor- and akinetic rigid - predominant patients with Parkinson's disease
		Jiaming Lu[1], Prasanna Karunanayaka[2], Eunyoung Lee[3], Qing Yang[2], Mechelle Lewis[3], Paul Eslinger[3], and Xuemei Huang[3]
		[1]Radiology, Drum Tower Hospital, Medical School of Nanjing University, Nanjing, Nanjing, China, [2]Radiology, Center for NMR Research, Penn State University College of Medicine, Hershey, PA, United States, [3]Neurology, Penn State University College of Medicine, Hershey, PA, United States
		The striatal dopamine depletion in Parkinson's disease (PD) explains clinical symptoms such as bradykinesia and rigidity, but not resting tremor thought to be associated with cerebellothalamic (CTC) circuit dysfunction. In this study we used resting state fMRI to investigate differences in the CTC network in akinetic-rigid (PD_{AR}) and tremor predominant (PD_T) PD patients with closely matched demographic and cognitive variables. The results support a type dependent functional disruption in the cerebellum and SMA rs-networks in PD patients with otherwise comparable disease severity, neurocognitive performance, and overall brain morphology.

3642	Computer 90	Neuromelanin sensitive MRI features of substantia nigra and locus coeruleus in de novo Parkinson's disease and its phenotypes
		Lirong Jin[1], Jian Wang[2,3], Yuanfang Li[1], Zhen Huang[1], Yong Zhang[4], Kai Liu[2,3], and Mengsu Zeng[2,3]
		[1]Neurology, Zhongshan Hospital, Fudan University, Shanghai, China, [2]Radiology, Zhongshan Hospital, Fudan University, Shanghai, China, [3]Shanghai Medical Imaging Institute, Shanghai, China, [4]GE Healthcare, Shanghai, China
		This current study provides in vivo evidence that width and high signal were significantly decreased in SNc and LC of *de novo* PD patients using NM-MRI, compared with controls. We also observed that the neuromelanin changes in substantia nigra were across both motor phenotypic expressions and non-motor (with vs. without depressive symptoms) subtypes, while LC neuron reduction is more notable in PD with depressive symptoms. Our finding implies that the NM-MR imaging have potential applications to improve the clinical diagnosis and detect the heterogeneityof PD.

3643	Computer 91	Deep Learning on Anatomical Brain MRI to Classify Motor Dysfunction in Parkinson's Disease
		Yu-Hsueh Wu[1], Yasi Jiang[2], Yu-Chun Lo[3], Yumei Yue[2], Ting Shen[2,4], Fu-Shan Jaw[1], You-Yin Chen*[5], Baorong Zhang*[4], and Hsin-Yi Lai*[2]
		[1]Institute of Biomedical Engineering, National Taiwan University, Taipei City, Taiwan, [2]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou City, China, [3]The PhD Program for Neural Regenerative Medicine, Taipei Medical University, Taipei City, Taiwan, [4]Department of neurology, Second Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou City, China, [5]Department of Biomedical Engineering, National Yang Ming University, Taipei City, Taiwan
		We introduced an innovative two-staged deep artificial neural network (DNN) model focusing on diagnostic prediction of Parkinson's disease (PD) using T1-weighted images, given a training set consisting of cortical thickness, surface area, grey matter volume and corresponding clinical scales, our proposed model was trained to classify the PD with different motor symptoms and performed the diagnostic prediction on basis of generated clinical scales. Results showed our DNN classifier and generator reached the averaged accuracy of 100% and 97.9%, respectively. To our knowledge, our technique was the first to tackle the classification of motor dysfunction in PD from anatomical brain MRI.

3644	Computer 92	^{1}H-[^{13}C]-NMR Evaluation of Neurometabolism in Rotenone Mouse Model of Parkinson's disease
		Anant Bahadur Patel[1], Shoumik Roy[1], and Varadarajan S Komanduri[1]
		[1]NMR Microimaging and Spectroscopy, Centre for Cellular and Molecular Biology, Hyderabad, India
		Parkinson's disease (PD) is a common progressive neurodegenerative disorder, which affects motor coordination and movement. Currently there is no biomarker for the early diagnosis of disease. In the current study we have evaluated the neurometabolism in rotenone mouse model of PD using ^{1}H-[^{13}C]-NMR NMR spectroscopy in conjunction with an infusion of [1,6-$^{13}C_2$]glucose. Our results show that the neurometabolism is compromised in rotenone treated mice suggesting that both the excitatory and inhibitory neurotransmission are impaired in PD.

3645	Computer 93	Non-invasive Characterization of the Cerebellar Nuclei in Degenerative Cerebellar Ataxias (SCA3, SCA6) with Quantitative Susceptibility Mapping (QSM) at 3 Tesla
		Andreas Deistung[1,2,3], Dominik Jäschke[2], Sophia L Göricke[4], Dae-In Chang[2], Katharina M Steiner[2], Andreas Thieme[2], Jens Claaßen[2], Ellen Uslar[2], Markus Gerwig[2], Mark E Ladd[3,5], Jürgen R Reichenbach[1], and Dagmar Timmann[2]

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We investigated non-invasively the cerebellar nuclei of spinocerebellar ataxia type 3 (SCA3) and SCA6 patients by using quantitative susceptibility mapping (QSM) at 3 T. Absolute volumes, relative volumes (with respect to the total intracranial volume), and magnetic susceptibilities of the cerebellar nuclei were found to be significantly lower for the dentate between SCA6 patients and healthy controls but did not significantly differ between SCA3 and healthy controls. Univariate linear correlations of relative nuclei volumes with ataxia rating scales revealed statistically significant correlations for the dentate and globose nuclei in SCA6 but not in SCA3.

3646 | Computer 94

Multi-modal multi-centre MRI study of rare spinocerebellar ataxia, type 14

Farida Grinberg[1,2], Ezequiel Farrher[1], Peter Pieperhoff[3], Elena Schlapakow[4], Vincent Gras[1], Tanja Schmitz-Hübsch[5], Silke Lux[3,6], Ute Kopp[7], Hanna Gärtner[3], Eylem Kirlangic[3], Dagmar Timmann[8], Matthis Synofzik[9,10], Peter Bauer[11], Friedemann Paul[5,7], Matthias Endres[5,7,12], Thomas Klockgether[4,13], N. Jon Shah[1,2], Katrin Amunts[3,14], Sarah Doss[5,7], and Martina Minnerop[3,4,15]

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Diffusion MRI studies reveal significant white matter degeneration in cerebellar and cerebral regions of spinocerebellar ataxia patients, however, only common pathology types have been included. Here, we present the first combined deformation-based morphometry (to depict regions of volume loss), and diffusion tensor/kurtosis imaging study to analyse microstructural changes in the largest reported sample of rare spinocerebellar ataxia, type 14, enrolled in a coordinated multi-centre study. Beyond expected strong changes observed for all metrics in cerebellar regions, axial diffusion kurtosis exhibited additional extracerebellar alterations in compliance with observed extracerebellar symptoms. Our results also suggest that patients might develop compensatory mechanisms.

3647	Computer 95	Phase Sensitive Inversion Recovery (PSIR) spinal cord imaging as a potential biomarker for Motor Neuron Disease Antje Bischof[1], Nicholas T. Olney[1,2], Howard J. Rosen[1], Eduardo Caverzasi[1], William A. Stern[1], Catherine Lomen-Hoerth[2], Bruce L. Miller[1], Roland G. Henry[1], and Nico Papinutto[1] *[1]Neurology, UCSF, San Francisco, CA, United States, [2]Neurology, UCSF ALS center, UCSF, San Francisco, CA, United States* With this study we investigated whether spinal cord gray and white matter atrophy could be detected *in vivo* in patients with a diagnosis within the motor neuron disease spectrum using PSIR imaging. Gray and white matter were successfully delineated in ten patients. Gray and white matter atrophy was detected in the majority of patients even if the lower or upper motor neuron was clinically unaffected. Patients with predominantly bulbar symptoms did not show relevant spinal cord abnormalities. This suggests a possible role of PSIR imaging as a biomarker for the spatial and temporal distribution of pathological changes in motor neuron disease.

3648	Computer 96	Intracortical T1-weighted/T2-weighted ratio signal changes in Huntington's Disease Christopher D Rowley[1], Sarah J Tabrizi[2], Blair R Leavitt[3], Raymund A.C. Roos[4], Alexandra Durr[5], and Nicholas A Bock[1] *[1]Neuroscience, McMaster University, Hamilton, ON, Canada, [2]University College London, London, United Kingdom, [3]University of British Columbia, Vancouver, BC, Canada, [4]Leiden University Medical Centre, Leiden, Netherlands, [5]Institut du Cerveau et de la Moelle Epinière, Paris, France* Huntington's disease (HD) is a genetic neurodegenerative disorder that is characterized by motor and cognitive dysfunction. Previous imaging studies have shown cortical thickness is reduced in HD, and here we investigated potential changes in cortical tissue composition in Huntington's based on previously acquired T_1-weighted (T1W) and T_2-weighted (T2W) images. We analyzed T_1W/T_2W ratios formed using images collected in 321 subjects from the TRACK-HD dataset representing various stages of HD and healthy controls. Intracortical T_1W/T_2W signal analysis revealed significant changes in the most advanced HD group. This may reflect HD related increases in myelin and/or iron in the cortex or a change in cytoarchitecture.

Electronic Poster

Genes, Their Correlates & Other Biomarkers

Exhibition Hall	Monday 16:15 - 17:15

3649	Computer 97	Genome-wide association studies of brain structure and function from UK Biobank data Gwenaelle Douaud[1], Lloyd Elliott[2], Kevin Sharp[2], Fidel Alfaro-Almagro[1], Sinan Shi[2], Karla Miller[1], Jonathan Marchini*[2,3], and Steve Smith*[1] *[1]FMRIB Centre, WIN, University of Oxford, Oxford, United Kingdom, [2]Department of Statistics, University of Oxford, Oxford, United Kingdom, [3]The Wellcome Centre for Human Genetics, University of Oxford, Oxford, United Kingdom* The genetic basis of brain structure and function is largely unknown. We carried out genome-wide association studies of 3,144 distinct brain imaging derived phenotypes in UK Biobank. Notable significant associations include: iron-related genes linked to T2* in subcortical regions; extracellular matrix associated with white matter microstructure and lesion volume; genes regulating midline axon guidance related to pontine crossing tract organisation. More broadly, effects were mainly seen in imaging measures associated with genes involved in brain development and transport of nutrients. Genes implicated in neurodegenerative disorders were largely related to iron and cardiovascular traits, and to brain development for psychiatric disorders.

3650	Computer 98	The Protective Effects of Ultramicronized Palmitoylethanolamide on the glutamatergic system in a triple transgene mouse model of Alzheimer disease Rossella Canese[1], Giulia Carpinelli[1], Gianmauro Palombelli[1], Maria Rosaria Brunzuoli[2], Silvio Calcagnini[2], Luca Steardo[2], Tommaso Cassano[3], and Caterina Scuderi[2] *[1]Dept. of Cell Biology and neurosciences, Istituto Superiore di Sanita', Rome, Italy, [2]Dept. of Physiology and Pharmacology "V. Erspamer", SAPIENZA University of Rome, Rome, Italy, [3]Dept. of Clinical and Experimental Medicine, University of Foggia, Foggia, Italy* We investigate the effects of a chronic treatment with an endogenous lipid mediator palmitoylethanolamide on the onset and progression of AD in 3xTg-AD mice. Behavioural tests showed improvements in learning and memory, and in both the depressive and anhedonia-like phenotype in PEA-treated 3×Tg-AD mice. MRI/MRS in vivo analysis, microdialysis and western blot, RT-PCR, and immunofluorescence show that PEA normalizes astrocytic function, rebalances glutamatergic transmission, and restrains neuroinflammation. The efficacy of PEA is particularly potent in younger mice, suggesting its potential as an early treatment.

3651	Computer 99	Relationship between brain and gut in autism spectrum disorder using diffusion MRI and intestinal bacteria gene analysis Ting-Chun Lin[1], Ssu-Ju Li[1], Ching-Wen Chang[1], Hui-Ching Lin[2], Yin-Chieh Liu[1], Han-Fang Wu[2], Ming-Chia Chu[2], You-Yin Chen[1], and Yu-Chun Lo[3]

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Brain-behavior-gut-microbiome interaction, a bidirectional communication, was proposed as an important role in autism spectrum disorders (ASD). However, the correlation among gut microbiota, behavioral performance, and brain microstructure in ASD are remained unclear. We chose a VPA-exposed rat model which performed autistic behaviors to investigate their brain-behavior-gut interaction. Diffusion MRI, behavioral tests, and intestinal bacteria gene analysis were applied in this study. The findings implied that the altered brain microstructure and atypical distribution of the gut microbiota associate with the severity of the autistic behavior in ASD compared to the control group.

3652 | Computer 100

Rapamycin treatment increases cerebral blood flow and attenuates anxiety in pre-symptomatic APOE4 mice: effects of sex and APP transgene

Ishita Parikh[1], David Ma[1], Jared D. Hoffman[1,2], Amy Wang[3], and Ai-Ling Lin[1,2,4]

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APOE4 is the strongest genetic risk factor for Alzheimer’s disease (AD). Pre-symptomatic APOE4 carriers have developed neurovascular deficits decades before amyloid beta (Aβ) aggregation. Here we show that with Rapamycin treatment for 16 weeks, pre-symptomatic APOE4 mice had restored cerebral blood flow (CBF) and attenuated anxiety, compared to those of APOE3 mice. The CBF restorations were particularly significant in female mice or those with APP transgene. As Rapamycin and MRI and are readily to be used in humans, the findings may provide valuable information for future clinical trials to prevent AD for APOE4 carriers.

3653 | Computer 101

Genetic influence on Brain Microstructure and Cognitive Function and Change in an Ageing Cohort

Kiyana Zarnani[1,2], Jayachandra Raghava[2], Naja Hansen[3], Erik Mortensen[1], Merete Osler[1], Martin Lauritzen[1], and Egill Rostrup[4]

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		The notion that the brain's early-life retains hints to its end is an evolving avenue explored by basic and clinical researchers alike. Implementing neuroimaging, genetics and neuropsychological tests, our focus is to unravel the complex process of brain ageing through characterisation of normal brain development in a longitudinal ageing cohort. This approach has the power to unveil robust candidate determinants responsible for the vulnerability of the ageing brain to late-life pathology. We demonstrate statistically significant correlations between common genetic variants, white-matter integrity and cognitive ability and change, highlighting biological risk-factors as mediators of differential trajectories of ageing.

3654	Computer 102	Differences in Metabolite Concentration and fMRI Activation in Subjects with Low and High Genetic Risk During Face-Name Paired-Associates Encoding and Retrieval Task in Healthy Adults
		H Zhang[1], PW Chiu[1,2], SWH Wong[3], T Liu [4], GHY Wong[4], Q Chan[5], and HKF Mak[1,2,6]
		[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, Hong Kong, Hong Kong, [3]Department of Educational Psychology, Chinese University of Hong Kong, Hong Kong, Hong Kong, [4]Department of Social Work and Administration, The University of Hong Kong, Hong Kong, Hong Kong, [5]Philips Healthcare, Hong Kong, Hong Kong, [6]Alzheimer's Disease Research Network, The University of Hong Kong, Hong Kong, Hong Kong
		APOE-ε4 is an important genetic risk factor of early onset of AD. To investigate the possible differences in metabolite concentration and fMRI activation in subjects with high risk of developing AD (APOE-ε4 positive) compared to those with low risk, we employed Face-Name Paired-Associates (FN-PA) Encoding and Retrieval Task and evaluated the absolute concentrations of Glx in bilateral hippocampi and whole brain BOLD signal changes. Significant metabolic and activation differences were observed in the left hippocampus of pre-symptomatic subjects with high genetic risk of developing AD compared to subjects with low risk.

3655	Computer 103	Deep learning convolutional neural networks accurately classify genetic mutations and survival in gliomas
		Peter Chang[1], Melissa Khy[2], Yang Zhang[2], Min-Ying Su[2], and Daniel Chow[2]
		[1]Radiology, University of California, San Francisco, San Francisco, CA, United States, [2]Department of Radiological Sciences, University of California, Irvine, Orange, CA, United States

		Gliomas represents a heterogeneous group of tumors with variable response to therapy despite sharing overlapping morphologic features. These differing outcomes partly relates to the multiple genetic mutations. For example, mutations in isocitrate dehydrogenase (IDH1) demonstrate significantly better survival compared to their wild counterparts[1,2]. Therefore, an obstacle in glioma imaging analysis is that radiographic interpretation fails to account for the tumoral genetic variance, making it difficult to integrate clinically relevant biological activities. The primary objective of this abstract is to use a convolutional neural network (CNN) approach to discover specific imaging patterns predictive of the underlying genetic alterations of gliomas.

3656	Computer 104	Mapping the functional and anatomical signatures of chemogenetically modulated neurons in the salience network.
		Joanes Grandjean[1], Francesca Mandino[1], Ling Yun Yeow[1], Teoh Chai Lean[1], Chris Jun Hui Ho[1], Amalina B. E. Attia[1], Lai Guan Ng[2], Malini Olivo[1], Fu Yu[1], and Akhila Balachander[2]
		[1]Singapore Bioimaging Consoritum, Agency for Science, Technology and Research, Singapore, Singapore, [2]Singapore Immunology Network, Agency for Science, Technology and Research, Singapore, Singapore
		BOLD functional magnetic resonance imaging (fMRI) provides crucial information about the large-scale organisation and function of the healthy and diseased brain. Despite its widespread use, identifying the neuronal-basis for specific functional imaging-based signatures, identified in human disorders and animal models, remains a mostly unmet challenge. Presently, we combine chemogenetic neuromodulation with whole-brain resting-state mouse fMRI and tissue clearing, to reveal both the functional contribution and spatial localization of a targeted neuronal population on resting-state functional connectivity. This approach enables researchers to examine the functional role played by selected neuronal populations on distributed neuronal networks.

3657	Computer 105	Clinico-genetic-anatomical comparisons of paroxysmal kinesigenic dyskinesia with and without PRRT2 mutations
		Lei Li[1], Xueling Suo[1], and Qiyong Gong[1]
		[1]Department of Radiology, Huaxi MR Research Center, Chengdu, China
		Paroxysmal kinesigenic dyskinesia (PKD) is a rare movement disorder characterized by sudden, brief attacks of involuntary movements. This study aims to detect the topological organization of white matter structural connectivity in PKD with and without PRRT2 mutations using graph theoretical approaches. Compared with non-PRRT2 mutation carriers, PRRT2 mutations carriers are significantly associated with a younger age of onset, a complicated form of PKD, combined phenotypes of dystonia and chorea, and a tendency for a family history of PKD in our population, as well as showed topological trends for randomization.

3658	Computer 106	Neuroimaging based biomarkers for detecting craving and predicting relapse in methamphetamine dependence
		Chang Qi[1], Xiaobing Fan[2], Sean Foxley[2], Yanhui Liao[1], Qiuxia Wu[1], Jingsong Tang[1], Wei Hao[1], and Tieqiao Liu[1]
		[1]Central South University, Changsha, China, [2]The University of Chicago, chicago, IL, United States
		This study investigates whether insula cortex abnormalities of methamphetamine-dependent subjects (MADs) can detect craving state and predict relapse susceptibility. Voxel based morphometry and statistical parametric mapping were used on structural MRI of MADs. Total 142 MADs were divided into two groups: model-group (n=112) and validation-group (n=30) from follow-up MADs. The results showed that MADs without craving had significantly smaller insula volume. Optimal insula volume determined from Youden index cut-off point on ROC analysis could be used as MRI bio-markers with acceptable accuracy for detecting craving state. Our results could help guide optimally timed intervention, prevention, and treatment strategies for MADs.

3659	Computer 107	Epileptogenesis Imaging biomarker identification in the Mesial Temporal lobe epilepsy (MTLE) mouse model
		Yvan Dietrich[1], Gabriel Dieuset[1], Mélanie Lagarrigue[2], Hervé Saint-Jalmes[1], Benoit Martin[1], Charles Pineau[2], Fabrice Wendling[1], and Pierre-Antoine Eliat[3]
		[1]Laboratoire du Traitement du Signal et de l'Image (LTSI) - Inserm UMR 1099, Université de Rennes 1, Rennes, France, [2]Protim Core Facility Biogenouest, IRSET - Inserm UMR 1085, Université de Rennes 1, Rennes, France, [3]PRISM - Biosit CNRS UMS 3480, INSERM UMS 018, Université de Rennes 1, Rennes, France
		This work presents preliminary promising results on Mesial temporal lobe epilepsy (MTLE) mouse model suggesting that MRI/MRS-based biomarkers could be of great interest to detect early changes in the lesioned brain and to characterize epileptogenesis after traumatic brain injury.

3660	Computer 108	Quantifying acrolein with MRS: a viable biomarker to assess location and severity of TBI
		Nicole Vike[1], Jonathan Tang[2], Riyi Shi[1,2], and Joseph Rispoli[2,3]
		[1]Basic Medical Sciences, Purdue University, West Lafayette, IN, United States, [2]Biomedical Engineering, Purdue University, West Lafayette, IN, United States, [3]Electrical and Computer Engineering, Purdue University, West Lafayette, IN, United States

		Currently, only invasive methods exist to study the molecular effects of traumatic brain injury (TBI). By instead using magnetic resonance spectroscopy (MRS), a non-invasive, quantitative method can be used to safely assess the severity and location of injury. Acrolein, a biomarker of TBI, increases in rat brain tissue following TBI. Acrolein shows signature peaks downfield of water at 6.5 and 9.4 ppm. We have successfully measured whole-brain phantom-injected acrolein using Bruker 7T MRS sequences and determined T_1 for acrolein, using NMR, so MRS parameters can be adjusted to maximize acrolein signal. Quantifying acrolein with MRS could provide a viable method to assess injury location and severity.

3661	Computer 109	BIOmarkers of DEPression (BIODEP) study: Raised peripheral inflammation associated with changes in striatal microstructure
		Charlotte L Clarke[1], Manfred G Kitzbichler[2], Gareth J Barker[3], Marta M Correia[2,4], Nick G Dowell[1], Samuel A Hurley[5], John Mclean[6], Tobias Wood[3], NIMA Consortium[7], Mara Cercignani[1], Ed T Bullmore[2,8,9], and Neil A Harrison[1]
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		Inflammation is implicated in the aetiology of major depressive disorder (MDD) and is known to affect brain microstructure: e.g. the striatum as found with neurite orientation dispersion and density imaging (NODDI) and quantitative magnetization transfer (qMT) imaging. Further, individuals with high inflammation (C-reactive protein (CRP)>3mg) respond less well to antidepressants. The BIOmarkers of DEPression (BIODEP) multi-centre study is aiming to characterise the inflamed MDD phenotype. We report across-site data harmonization and interim results demonstrating a negative correlation between the water fraction content (NODDI) and CRP within the ventral striatum. Multi-modal imaging results (qMT, multi-component relaxometry) across the full cohort will be reported.

3662	Computer 110	A survey of best practice guidelines to harmonize neuroimaging biomarkers for neurodegenerative diseases
		Jorge Jovicich[1], Frederik Barkhof[2,3], Claudio Babiloni[4], Karl Herholz[5], Christoph Mullert[6], Bart N.M. van Berckel[7], Giovanni B Frisoni[8,9], and SRA-NED JPND Working Group[1]

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Current challenges in neurodegenerative diseases (ND): need for early and accurate markers for differential diagnosis, prognosis, progression tracking and intervention assessments.

Big-data neuroimaging studies might help addressing these challenges. However, large-sample neuroimaging data still lacks standardization (multi-vendor acquisition, analysis) and cross –validation (across markers, across large populations), in particular with state-of-the-art MRI hardware (≥32 head RF channel coils and powerful gradients).

Here we: i) evaluate current barriers perceived by the broad neuroimaging research/clinical/industry communities for the large-scale harmonization of MRI/PET-SPECT/EEG neuroimaging methods in the context of ND studies, and ii) propose actions that may help addressing these barriers.

3663 | Computer 111

Development of an MR-based Biomarker of Arteriolar Sclerosis

Nazanin Makkinejad[1], Arnold M. Evia[1], Ashish Tamhane[2], Chantal Sopacua[1], Sue E. Leurgans[2,3], Julie A. Schneider[2,3,4], David A. Bennett[2,3], and Konstantinos Arfanakis[1,2,5]

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Arteriolar sclerosis is often present in the brain of older adults and has been associated with lower cognitive performance and higher risk of dementia. There is currently no standard biomarker for arteriolar sclerosis. Future clinical trials of therapeutic interventions targeting arteriolar sclerosis will require an approach for participant selection with high positive predictive value (PPV). The purpose of this work was to develop a classifier with high PPV for arteriolar sclerosis based on information about regional white matter hyperintensities, magnetic susceptibility, cerebral microbleeds, and demographics.

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Parameters From Dynamic Contrast-Enhanced Magnetic Resonance Imaging Are Biomarkers Predicting Response after Radiotherapy to Brain Metastases

Zhuo Shi[1], Lizhi Xie[2], Peng Wang[1], XinMing Zhao[1], and Han Ou-Yang[1]

		[1]National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China, [2]GE Healthcare, China, Beijing, China
		Dynamic contrast-enhanced (DCE) MRI provides additional information regarding blood-brain barrier integrity, and Ktrans is directly proportional to the level of permeability of the blood-brain barrier. In our study, we found demonstrates that SRS of cerebral metastasis is associated with a reduction of Ktrans values in the early post-treatment period. DCE-MRI derived parameters of may be a promising imaging biomarker of tumor aggressiveness.

3665	Computer 113	23Na-MRI demonstrates a sodium gradient within gliomas as a biomarker of tumor heterogeneity
		Fulvio Zaccagna[1], Frank Riemer[1], Mary A McLean[2], James T. Grist[1], Joshua Kaggie[1], Rolf Schulte[3], Sarah Hilborne[1], Tomasz Matys[1], Jonathan H. Gillard[1], Colin Watts[4], Stephen J. Price[4], Martin J. Graves[1], and Ferdia A. Gallagher[1]
		[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [3]GE Global Research, Munich, Germany, [4]Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom
		Glioma grade and the extent of local infiltration are important for guiding management. Imaging tumor heterogeneity may improve diagnosis and therapy planning. 23Na-MRI has been used here to demonstrate a gradient in sodium concentration across gliomas: necrosis > viable tissue > edema. This gradient was evident in all the tumors analyzed and is consistent with the expected underlying cellular microstructure where the sodium concentration is dominated by the extracellular fluid in edema and by an absence of cells in the necrotic core. The study provides evidence that 23Na-MRI represents an imaging biomarker of tumor heterogeneity and tissue microstructure in glioma.

3666	Computer 114	Is occipital bending a structural biomarker of risk for depression and sensitivity to treatment?
		Karen Fullard[1], Jerome Maller[2,3], Thomas Welton[3], Matthew Lyon[3], Fraser Callaghan[3], Leanne Williams[4], Mayuresh Korgaonkar[5], A. John Rush[6], Evian Gordon[7], Stephen Koslow[8], and Stuart Grieve[1,3]
		[1]Department of Radiology, Royal Prince Alfred Hospital, Sydney, Australia, [2]General Electric Healthcare, Richmond, Australia, [3]Sydney Translational Imaging Laboratory, Heart Research Institute, University of Sydney, Sydney, Australia, [4]Department of Psychiatry and Behavioural Sciences, Stanford University, Stanford, CA, United States, [5]The Brain Dynamics Centre, Westmead Institute for Medical Research, University of Sydney, Sydney, Australia, [6]Duke-National University of Singapore, Singapore, Singapore, [7]Brain Resource Ltd, Sydney, Australia, [8]Department of Psychiatry and Behavioral Sciences, Miller School of Medicine, University of Miami, Miami, FL, United States

		Occipital Bending (OB) was investigated as an MRI imaging biomarker for major depressive disorder (MDD) using data from large, well characterized, international, randomised study recruiting non-geriatric adult participants (iSPOT-D, n=68 control, 231 MDD). The presence of OB and the angle of occipital bending (OBA) was correlated with a repeated battery of neuropsychiatric assessments, and response to 6 weeks of antidepressant treatment. A greater proportion of rightward bending was present in MDD in comparison to control individuals. Underlying association between OB and MDD is likely.

3667	Computer 115	Multivariate MR Biomarkers Predict Cognitive Decline in Mouse Models of Alzheimer's Disease
		Alexandra Badea[1], Robert J Anderson[1], Russell Dibb[1], Yi Qi[1], Natalie A Delpratt[1], Hongjiang Wei[2], Chunlei Liu[2], William C Wetsel[3], Brian B Avants[4], and Carol A Colton[5]
		[1]Radiology, Duke University Medical Center, Durham, NC, United States, [2]University of California, Berkeley, CA, NC, United States, [3]Psychiatry and Behavioral Sciences, Duke University Medical Center, Durham, NC, United States, [4]BIOGEN, Cambridge, MA, United States, [5]Neurology, Duke University Medical Center, Durham, NC, United States
		We propose a multivariate approach for characterizing mouse models of Alzheimer's disease (AD), which integrates imaging and behavior in a joint analysis. We used manganese enhanced MRI (MEMRI) to identify brain areas associated with reduced performance in a spatial memory task. We quantified genotype differences based on morphometry, T1 weighted (T1W) signal and quantitative susceptibility maps (QSM). We find that the integration of multiple imaging biomarkers is a better predictor of cognitive decline, relative to using single biomarkers in isolation.

3668	Computer 116	Is MRI all we need? Prediction of conversion between normal cognitive function, mild cognitive impairment and Alzheimer's disease
		Shiyang Chen[1], Ke Qi[2], and Deqiang Qiu[1,2]
		[1]BioMedical Engineering, Georgia Institute of Technology and Emory University, Atlanta, GA, United States, [2]Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States
		. In this study, we aimed to use machine learning methods to establish the quantitative value of MRI alone in the prediction of changes between disease states such as from normal cognitive function (NC) to mild cognitive impairment (MCI), and MCI to AD, and compare with the combined predictive power of MRI, PET, neuropsychological evaluations and CSF analysis. Very high overall accuracy can be achieved using both RF and DNN methods. Interestingly, predictive power of MRI features is very close to all features combined, suggesting MRI might contain much of the information provided by neuropsychological evaluations, PET scans among others combined. The methodology adopted in this study also provides a framework for evaluating the value of different imaging techniques in a quantitative manner.

3669	Computer 117	Rapid and robust high-resolution mapping of proton pool size ratio in spinal cord after injury in squirrel monkeys
		Feng Wang[1,2], Tung-Lin Wu[1,3], Ke Li[1], Li Min Chen[1,2], and John C. Gore[1,2,3]
		[1]Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States
		High-resolution quantitative magnetization transfer (qMT) MRI provides a noninvasive means to detect and characterize myelination before and after neural injury and during repair. This study aims to systematically evaluate the accuracy and precision of pool size ratio (PSR) measurements using either 5-, 2- or 1-parameter modeling for assessing injury-associated changes in spinal cords in squirrel monkeys in order to optimize a rapid, sensitive, and high-resolution PSR mapping protocol for applications in primates at high field. In addition, the sensitivity of PSR to demyelination in the dorsal pathway rostral and caudal to an injury site has been evaluated.

3670	Computer 118	Time makes the difference: Comparison of ADC values obtained with OGSE and PGSE sequences for differentiation of human head and neck tumors
		Mami Iima[1,2], Akira Yamamoto[1], Ichiro Tateya[3], Morimasa Kitamura[3], Thorsten Feiweier[4], Koichi Omori[3], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [2]Hakubi Center for Advanced Research, Kyoto University, Kyoto, Japan, [3]Department of Otolaryngology, Head and Neck Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [4]Siemens Healthcare GmbH, Erlangen, Germany
		The correlation of ADC values with different diffusion times, as obtained from OGSE and PGSE, was investigated in patients with head and neck tumors. A significant decrease of ADC values in head and neck cancers was noted with the increase of diffusion time ($p < .0.05$). Care needs to be taken when interpreting OGSE-ADC and PGSE-ADC values, as flow effects will contribute to these values, which was suspected in light of the (artefactual) increase of ADC values using PGSE compared to OGSE.

3671	Computer 119	Improving classifications of brain tumor tissue with Sparse Dictionary Learning based analysis of dynamic susceptibility contrast enhanced MRI data
		Silun Wang[1], Shu Zhang[2], Liya Wang[3], Bing Ji[4], Tianming Liu[5], and Hui Mao[1]
		[1]Emory University School of Medicine, Atlanta, GA, United States, [2]The University of Georgia, Athens, China, [3]Long Hua Hospital, Shenzhen, China, [4]Emory University School of Medicine, Atlanta, China, [5]The University of Georgia, Athens, GA, United States

		We analyzed the DSC MRI signals based on patterns of descriptive DSE-MR parameters by using Sparse Dictionary Learning (SDL) coding method. We successfully decomposed DSC MRI signals into linear combinations of multiple components based on sparse representation of DSC MRI signals in the tumor region of tumor core and peritumoral edema which might be represent multiple heterogeneity component in brain tumors. Assessment of diagnostic performance of SVM classification after cross validation revealed that the combination of conventional DSC temporal characteristics and dictionary learning based DSC temporal features would result in the best classification accuracy between tumor core and peritumoral edema (with total diagnostic accuracy of 77%, AUC 0.78).

3672	Computer 120	The effects of LIS1 deletion in the adult mouse brain and partial rescue by LiCl: A T2 mapping, magnetization transfer and diffusion MRI study
		Hagit Dafni[1], Liraz Kaidar[2], Inbal E Biton[1], Aditya Kshirsagar[2], and Orly Reiner[2]
		[1]Department of Veterinary Resources, Weizmann Institute of Science, Rehovot, Israel, [2]Department of Molecular Genetics, Weizmann Institute of Science, Rehovot, Israel
		LIS1, a gene mutated in lissencephaly (“smooth brain”) have been investigated mainly in the developing brain. Initial studies demonstrated distinct ataxia and rapid lethality following *Lis1* conditional deletion in adult mice. Therefore, our aim was to investigate the postnatal roles of *LIS1* and the underlying mechanism. Conditional *Lis1* knockout mice studied by MRI pre, and 5 days post, tamoxifen-induced *Lis1* deletion, showed increase in T2 and ADC and decrease MTR and FA0, in the lateral ventricles and in brain regions related to motion and auditory functions. These alterations and changes in the Wnt pathway were partially rescued by LiCl treatment.

Electronic Poster

MR/PET & Molecular Imaging

Exhibition Hall	Monday 17:15 - 18:15

3673	Computer 1	Stability of silica coating of magnetic nanoparticles for cell tracking
		Vít Herynek[1], Lenka Kubíčková[2], Ondřej Kaman[3], Pavel Veverka[3], and Milan Hájek[1]
		[1]Institute for Clinical and Experimental Medicine, Prague, Czech Republic, [2]Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic, [3]Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic

		Magnetic nanoparticles are broadly used for cell tracking in vivo using magnetic resonance imaging. Silica coating, often used for magnetic nanoparticles, represents an inert and stable barrier between the nanoparticle core and cell environment. However, the coating may disintegrate at high temperatures and expose the core. We monitored this process using dynamic relaxometry and confirmed substantial extend of dissolution by transmission electron microscopy. The process probably reflected the equilibrium of solid silica and soluble silicic species in highly dilute suspensions at higher temperature.

3674	Computer 2	Optimized Fluorine-19 MRI Quantification and Characterization of Inflammation in Atherosclerotic Plaques in Mice at 3T
		Emeline Darçot[1], Roberto Colotti[1], Jérôme Yerly[1,2], Maxime Pellegrin[3], Anne Wilson[4], Stefanie Siegert[4], Matthias Stuber[1,2], and Ruud B. van Heeswijk[1,2]
		[1]Department of Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [3]Division of Angiology, Lausanne University Hospital (CHUV), Lausanne, Switzerland, [4]Department of Fundamental Oncology, University of Lausanne (UNIL), Lausanne, Switzerland
		Establishing a direct quantification and monitoring of inflammation in diseases such as atherosclerosis in a clinical setting is one of the main goals of fluorine-19 (^{19}F) MRI of perfluorocarbons (PFCs). To this end, with ^{19}F imaging and a denoising algorithm, we demonstrated the feasibility of quantitative ^{19}F MRI in small inflammation sites such as atherosclerotic plaques in mice at 3T (average PFCs concentration per plaque=0.49±0.10mM; average plaque volume=2.8±1.1mm^3). In a second step, with imaging flow cytometry, we characterized and visualized the PFC-incorporating immune cell populations involved in the inflammation process, which were mainly dendritic cells, macrophages and neutrophils (ratio 9:1:1).

3675	Computer 3	Contrast Agent Assessment: Comparison of Quantitative Techniques
		Matthew Tarasek[1], Jeannette Roberts[2], Deirdre Cassidy [3], Jason Castle[2], Concetta Gringeri[3], Desmond Yeo[1], Randall Carter[2], and Brian Bales[2]
		[1]MRI, GE Global Research, Niskayuna, NY, United States, [2]Life Sciences, GE Global Research, Niskayuna, NY, United States, [3]Life Sciences, GE Healthcare UK, United Kingdom, United Kingdom
		Contrast agents are widely used in magnetic resonance imaging (MRI) examinations to enhance the visualization of certain pathologies and anatomical structures to improve diagnostic accuracy. Contrast agents shorten the longitudinal relaxation time (T1) of water molecules, and subsequent signal enhancement in T1-weighted (T1W) images can be observed. In this work, we compare quantitative T1W imaging and T1 mapping for detection of contrast agent deposition in select rat brain structures. Results are presented for two distinct brain structures in a cohort of six rats: three saline controls and three injected with manganese chloride contrast agent.

3676	Computer 4	Including bone in DIXON-based PET/MRI attenuation correction for primary and recurrent prostate cancer Mattijs Elschot[1], Kirsten M Selnæs[1,2], Håkon Johansen[3], Brage Krüger-Stokke[1,3], Helena Bertilsson[4,5], and Tone F Bathen[1,2] *[1]Department of Circulation and Medical Imaging, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [2]St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway, [3]Department of Radiology and Nuclear Medicine, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway, [4]Department of Urology, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway, [5]Department of Cancer Research and Molecular Medicine, NTNU, Norwegian University of Science and Technology, Trondheim, Norway* Accurate correction for bone attenuation may be important for PET/MRI of prostate cancer due to the high bone-density of the pelvis. In this study we evaluated a previously proposed method that includes bone attenuation coefficients in the DIXON-based attenuation map by co-registration with an atlas of the major bones in the body. We found that the inclusion of bone significantly increased the standardized uptake values of soft tissue lesions, but the effect was only in the order of 3%. In addition, we observed that bone registration errors were present near 31% of the lesions, which may hamper widespread clinical applicability.

3677	Computer 5	Automated tumour definition in diffusion imaging from Gaussian mixture modelling of intrinsically-registered PET data in breast cancer: pilot study Maren Marie Andreassen[1], Tone Bathen[1,2], Pål Erik Goa[3,4], Steinar Lundgren[5,6], Roja Hedayati[5,6], Torill Sjøbakk[1], Hans Petter Eikesdal[7,8], and Neil P. Jerome[1,4] *[1]Department of Circulation and Medical Imaging, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [2]St.Olavs Hospital, Trondheim University Hospital, Trondheim, Norway, [3]Department of Physics, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [4]Department of Radiology and Nuclear Medicine, Trondheim University Hospital, Trondheim, Norway, [5]Department of Clinical and Molecular Medicine, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [6]Department of Oncology, Trondheim University Hospital, Trondheim, Norway, [7]Section of Oncology, Department of Clinical Science, University of Bergen, Bergen, Norway, [8]Department of Oncology, Haukeland University Hospital, Bergen, Norway* Simultaneous positron emission tomography and magnetic resonance imaging (PET/MRI) is an emerging technique in breast cancer practice, allowing collection of morphologic parameters in addition to real-time metabolism. Though feasibility has been demonstrated, the best approach to utilize PET/MRI has not yet been validated. This study focus on evaluating a Gaussian mixture model (GMM) based segmentation technique from PET images with intrinsic MRI registration as a proxy for regions-of-interest (ROIs) manually drawn on post contrast images. The application of the method has been evaluated in a neoadjuvant treatment response assessment setting using apparent diffusion coefficient (ADC) values.

3678	Computer 6	Learning-based attenuation correction for Head and Neck PET/MR

		Maya Khalifé[1], Romain de Laroche[2,3], Sandeep Kaushik[4], Brian Sgard[2,3], Fernando Pérez-García[1], Melika Sahli Amor[5], Didier Dormont[5], Marie-Odile Habert[2,3], Florian Wiesinger[6], and Aurélie Kas[2,3]
		[1]Centre de NeuroImagerie de Recherche (CENIR), Institut du Cerveau et de la Moelle Epinière (ICM), Paris, France, [2]Department of Nuclear Medicine, Groupe Hospitalier Pitié-Salpêtrière C. Foix, Paris, France, [3]Laboratoire d'Imagerie Biomédicale, Sorbonne Universités, UPMC Univ Paris 06, Inserm U 1146, CNRS UMR 7371, Paris, France, [4]GE Global Research, Bangalore, India, [5]Department of diagnostic and functional neuroradiology, Groupe Hospitalier Pitié-Salpêtrière C. Foix, Paris, France, [6]GE Healthcare, Munich, Germany
		PET/MR in head and neck cancer lacks accurate attenuation correction (AC). In this work we implemented and tested three PET/MR-AC methods: 1) Dixon-based AC as used in clinical routine ignoring facial and cervical bones (Dixon), 2) Zero TE (ZTE)-based AC for segmenting bone and combined with Dixon-based fat-water separation (hZTE), 3) a deep learning approach (DL), trained on CT-ZTE datasets. PET images were reconstructed on six patients testing three AC methods (Dixon, hZTE, DL) and compared to reference CT-AC. PET comparison showed underestimated SUV with Dixon-AC, decreased error with hZTE-AC compared to CT-AC and the lowest error with DL-AC.

3679	Computer 7	Evaluation of Diagnostic Accuracy of Gallium-68 DOTATATE PET-MRI Hybrid Imaging in Staging and Restaging Neuroendocrine Tumors
		James Bai[1], Robert Matthews[1], Kavitha Yaddanapudi[1], Rao Chimpiri[1], and Dinko Franceschi[1]
		[1]Department of Radiology, Stony Brook University Hospital, Stony Brook, NY, United States
		The purpose of our study is to evaluate diagnostic accuracy of DOTATATE PET-MR hybrid imaging in detecting neuroendocrine tumor. We demonstrated Ga-68 PET-MRI has high accuracy in detection of NET in the abdomen and pelvis. Lesion characterization with combined MRI helps to distinguish benign lesions from malignant ones.

3680	Computer 8	Ultra-low-dose Amyloid PET Reconstruction using Deep Learning with Multi-contrast MRI Inputs
		Kevin T Chen[1], Enhao Gong[2], Fabiola Bezerra de Carvalho Macruz[1], Junshen Xu[3], Mehdi Khalighi[4], John Pauly[2], and Greg Zaharchuk[1]
		[1]Radiology, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford, CA, United States, [3]Engineering Physics, Tsinghua University, Beijing, China, [4]GE Healthcare, Menlo Park, CA, United States

		Simultaneous PET/MRI is a powerful hybrid imaging modality that allows for perfectly correlated morphological and functional information. With deep learning methods, we propose to use multiple MR images and a noisy, ultra-low-dose amyloid PET image to synthesize a diagnostic-quality PET image resembling that acquired with typical injected dose. This technique can potentially increase the utility of hybrid amyloid PET/MR imaging in clinical diagnoses and longitudinal studies.

3681	Computer 9	Radial MS-CAIPIRINHA Efficiently Extends the Anatomical Coverage in MR Myocardial Perfusion Studies on MR-PET Systems
		Tobias Wech[1,2], Karl P. Kunze[3], Christoph Rischpler[3], Daniel Stäb[4], Peter Speier[5], Herbert Köstler[1,2], and Stephan G. Nekolla[3]
		[1]Department of Diagnostic and Interventional Radiology, University Hospital Würzburg, Würzburg, Germany, [2]Comprehensive Heart Failure Centre, University Hospital Würzburg, Würzburg, Germany, [3]Department of Nuclear Medicine, Klinikum rechts der Isar der Technischen Universität München, München, Germany, [4]The Centre for Advanced Imaging, The University of Queensland, Brisbane, Germany, [5]Magnetic Resonance, Siemens Healthcare GmbH, Erlangen, Germany
		Integrated MR-PET imaging is a versatile tool for the non-invasive characterization of cardiovascular disease. In this work, we developed an MS-CAIPIRINHA-based imaging technique to extend the anatomical coverage of the MRI perfusion assessment to six slices per RR. As a proof of principle, the described approach was combined with simultaneous 18F-FDG viability imaging and Late Gadolinium Enhancement (LGE) imaging investigating improvements in anatomical coverage for a relevant patient cohort.

3682	Computer 10	PETcoil: Elements of an RF-penetrable positron emission tomography insert for simultaneous PET/MRI
		Brian Jun Lee[1,2], Chen-Ming Chang[1,3], Ilaria Sacco[1], Ronald Watkins[1], and Craig S Levin[1,4,5,6]
		[1]Radiology, Stanford University, Stanford, CA, United States, [2]Mechanical Engineering, Stanford University, Stanford, CA, United States, [3]Applied Physics, Stanford University, Stanford, CA, United States, [4]Electrical Engineering, Stanford University, Stanford, CA, United States, [5]Physics, Stanford University, Stanford, CA, United States, [6]Bioengineering, Stanford University, Stanford, CA, United States
		A PET insert dedicated to brain PET/MRI offers several advantages compared to the commercial integrated whole-body PET/MRI systems, including better sensitivity, spatial resolution, and significantly lower price. We are developing an RF-penetrable PET insert integrated with a custom RX-only phased-array coil, termed collectively as “PETcoil”, dedicated for brain PET/MRI (30 cm diameter, 16 cm axial FOV). In this presentation, we will present the design and preliminary results of the PETcoil with regards to minimizing mutual interference between the PET and MRI while maintaining excellent performance.

3683	Computer 11	Optimization of MR-Based Attenuation Correction for Cardiac PET/MR Using Free-Breathing Multi-Echo Golden-Angle Radial Stack-of-Stars MR Philip Robson[1], Thomas Benkert[2], MariaGiovanna Trivieri[3], Nicolas Karakatsanis[1], Ronan Abgral[4], Marc Dweck[5], Jason Kovacic[3], Tobias Block[2], and Zahi Fayad[1] *[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research, New York University School of Medicine, New York, NY, United States, [3]Cardiovascular Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [4]Department of Nuclear Medicine, European University of Brittany, Brest, France, [5]British Heart Foundation Centre for Cardiovascular Science, University of Edinburgh, Edinburgh, United Kingdom* Recently hybrid PET/MR has gained much interest for its potential to combine PET imaging of disease activity with the benefits of cardiac MR. MR-based attenuation correction (MRAC) is an important aspect of accurate PET tracer quantification. For imaging the heart, optimal MRAC is required to both compensate for cardiac motion and also to optimize segmentation of tissues for accurate PET reconstruction. In this work we investigate the use of multi-echo golden-angle radial stack-of-stars MR to combine these 2 key attributes.

3684	Computer 12	Metabolic reprogramming in the heart and lung in a murine model of pulmonary arterial hypertension Jose Luis Izquierdo-Garcia[1,2], Teresa Arias[1], Yeny Rojas[1], and Jesus Ruiz-Cabello[2,3] *[1]CNIC, Madrid, Spain, [2]CIBERES, Madrid, Spain, [3]Universidad Complutense de Madrid, Madrid, Spain* Pulmonary Arterial Hypertension is a rare disease of the pulmonary circulation that produces narrowing of small pulmonary arteries, increasing of pulmonary vascular resistance and right ventricular failure. We studied the associated metabolic reprogramming in lung and heart tissues, which is essential for disease progression, in a mouse model of hypoxia induced PAH. Lung and heart metabolism were monitored by HR-MAS NMR spectroscopy and PET imaging. We identified an alteration in energetic and proliferative metabolism of the lungs. We also found a shift in energy metabolism in cardiac tissue.

3685	Computer 13	Applications of ZTE-derived Attenuation Correction Maps to Neuropediatric Cases: A Preliminary Analysis Brice Fernandez[1], Gaspar Delso[2], Gisèle Depas[3], Maya Khalifé[4], Irène Buvat[5], Claude Comtat[5], and Catherine Chiron[3]

		[1]Applications & Worflow, GE Healthcare, Orsay, France, [2]Applications & Workflow, GE Healthcare, Cambridge, United Kingdom, [3]INSERM U1129, Université Paris Descartes, CEA-SHFJ, Paris, France, [4]Centre de NeuroImagerie de Recherche (CENIR), Institut du Cerveau et de la Moelle épinière (ICM), Paris, France, [5]Imagerie Moléculaire In Vivo, IMIV, CEA, INSERM, CNRS, Université Paris-Sud, Université Paris Saclay, CEA-SHFJ, Orsay, France
		PET/MR is a promising imaging modality for pediatric applications due to its lower radiation dose compared to PET/CT. However, commonly implemented MR-derived Attenuation Correction (MRAC) methods have not been fully evaluated for pediatrics brain applications. Consequently, we aimed at comparing different MRAC methods (Atlas, ZTE and High-resolution ZTE) on pediatric patients. Since the current gold standard AC data (i.e. CT) is missing, the different MRAC methods are ranked in comparison with the results found in the literature to determine if current knowledge regarding MRAC methods applied on adults might be extended to the considered pediatric population.

3686	Computer 14	Joint estimation applied to attenuation correction for quiescent period respiratory gated PET data in PET/MR
		Sangtae Ahn[1], Jaewon Yang[2], Jing Liu[2], Youngho Seo[2], Thomas A. Hope[2], Peder E. Z. Larson[2], and Florian Wiesinger[3]
		[1]GE Global Research, Niskayuna, NY, United States, [2]Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [3]GE Healthcare, Munich, Germany
		Quiescent period gating of PET data reduces respiratory motion artifacts in PET imaging. However, a respiratory phase mismatch between attenuation map and gated PET data results in PET quantitation errors particularly for lesions in the dome of the liver. To address the problem, we apply a joint estimation (JE) technique to attenuation correction for respiratory phase gated PET data. We demonstrate on clinical PET/MR data that the JE method improves PET quantitation accuracy without an additional process of respiratory phase gating of MR data. JE has additional potential to estimate patient-specific lung tissue density and provide robustness to metallic implants.

3687	Computer 15	Quantitative Imaging for Development of PET/MRI phantoms
		Peder Eric Zufall Larson[1], Misung Han[1], Peng Cao[1], Hongyu An[2], Kathryn Fowler[2], Kathryn Keenan[3], Karl F. Stupic[3], Richard Laforest[2], and Thomas Hope[1]
		[1]Radiology and Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States, [2]Radiology, Washington University, St. Louis, MO, United States, [3]National Institute of Standards and Technology, Boulder, CO, United States

		This project aims to develop PET/MR phantoms to evaluate MR-based attenuation correction (MRAC) methods and allow standardization of PET results across PET/MRI scanners. This will be accomplished using quantitative ultrashort echo-time (UTE) imaging methods for measurement of T1, T2* and proton density of in vivo tissue types and candidate phantom materials, along with CT measurements of attenuation coefficients. UTE methods are required to characterize bone and choose bone mimics, as this is the most challenging tissue type for MRAC methods to capture.

3688	Computer 16	CSF transport of 18F and 18FDG via the brain-wide glymphatic pathway visualized by Integrative PET-MRI
		Helene Benveniste[1], Hedok Lee[1], Michael Budassi[2], S. David Smith[3], Mark Schweitzer[4], Nora Volkow[5], Maiken Nedergaard[6], and Paul Vaska[4]
		[1]Anesthesiology, Yale School of Medicine, New Haven, CT, United States, [2]Biomedical Engineering, Stony Brook Medicine, Stony Brook, NY, United States, [3]SAII, Stony Brook, NY, United States, [4]Radiology, Stony Brook Medicine, Stony Brook, NY, United States, [5]NIAAA, Bethesda, MD, United States, [6]University of Copenhagen, Copenhagen, Denmark
		The glymphatic pathway was recently re-discovered as a CSF transport system for brain waste removal. The peri-vascular space functions as the ”front end” for toxic waste clearance via the ‘glymphatic pathway. To facilitate future translation to the clinic we executed experiments to map glymphatic transport in the live rodent brain using dynamic integrated MRI-PET imaging in combination with CSF administration of a paramagnetic contrast agent and two different 18F-labeled radioisotopes.

3689	Computer 17	Quantification of Oxygen Metabolism in Human Brain: Comparison of Direct ^{17}O with Indirect ^{1}H MR Method
		Dmitry Kurzhunov[1], Jan Sedlacik[2], Robert Borowiak[1], Divya Sanam Bolar[3], Johannes Fischer[1], Ali Caglar Özen[1,4], and Michael Bock[1]
		[1]Department of Radiology, Medical Physics, Medical Center – University of Freiburg, Freiburg, Germany, [2]Department of Neuroradiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [3]Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [4]German Consortium for Translational Cancer Research Freiburg Site, German Cancer Research Center (DKFZ), Heidelberg, Germany

		In this study, quantification of the cerebral metabolic rate of oxygen consumption ($CMRO_2$) in human brain using direct dynamic ^{17}O-MRI with inhalation of ^{17}O gas was compared to indirect ^{1}H-MRI using QUantitative Imaging of eXtraction of Oxygen and TIssue Consumption (QUIXOTIC) method. The $CMRO_2$ results of both methods are in a good agreement with ^{15}O-PET studies (^{17}O-MRI: 0.83–1.09/1.13–1.48 μmol/g_{tissue}/min in WM/GM regions; ^{1}H-MRI: 0.40–1.45/0.74–1.73 μmol/g_{tissue}/min in WM/GM regions). QUIXOTIC offers smaller pixels which also results in a higher variation of $CMRO_2$ values, whereas MRI with the intracellular tracer ^{17}O provides averaged values with less variation due to the lower spatial resolution.

3690	Computer 18	Robust MR-based attenuation correction for PET near metal implants
		Daehyun Yoon[1], Mohammad Mehdi Khalighi[2], Xinwei Shi[1], Harsh Gandhi[1], Dawn Holley[1], Sandip Biswal[1], and Brian Andrew Hargreaves[1]
		[1]Stanford University, Stanford, CA, United States, [2]Applied Science Lab, GE Healthcare, Menlo Park, CA, United States
		In simultaneous PET/MRI, the reconstruction of PET image uses an MRI-based attenuation coefficient (AC) map for accurate quantization of radiotracer activity. The AC map is typically derived from SPGR images, but these are severely distorted near metallic implants due to strong off-resonance artifacts. We investigated the influence of the metal artifacts in the MR-based AC map upon the PET image accuracy. To correct the metal artifacts in PET, we present the use of multi-spectral imaging with field-map-based determination of meta boundary and type. Our correction result mitigated the signal underestimation near metal in PET images from 50% to 8%.

3691	Computer 19	Metabolic Interactions of Simultaneous 18F-FDG PET and Hyperpolarized 13C MRI
		Mette H. Lauritzen[1], Milton Merchant[2], Taichang Jang[2], Keshav Datta[1], Ralph E. Hurd[1], Shie-Chau Liu[1], Jae Mo Park[1], Lawrence Recht[2], and Daniel M. Spielman[1]
		[1]Department of Radiology, Stanford University School of Medicine, Stanford, CA, United States, [2]Department of Neurology, Stanford University School of Medicine, Stanford, CA, United States
		Simultaneous hyperpolarized ^{13}C-pyruvate MRI and ^{18}F-FDG PET imaging have the several potential applications, especially for understanding the complex metabolic processes of cancer. However, we hypothesized the relatively high concentrations of ^{13}C-pyruvate used in hyperpolarized MRI could interfere with the ^{18}F-FDG uptake when administrated simultaneously, because their metabolic products compete for the same pathways. In this study, we examined the effect of injected pyruvate and lactate on ^{18}F-FDG uptake in healthy rats and in rats with implanted C6 gliomas, and discuss the metabolic interactions observed.

3692	Computer 20	M2 Tumor Associated Macrophage Targeted Magnetic Resonance Imaging Using Mannose Conjugated Anti-Biofouling Iron Oxide Nanoparticle Probes Yuancheng Li[1], Liya Wang[2], Hui Wu[3], Weiping Qian[4], Bing Ji[1], Lily Yang[4], and Hui Mao[1] *[1]Radiology and Imaging Sciences, Emory University School of Medicine, Atlanta, GA, United States, [2]Radiology, Long Hua Hospital, Shenzheng, China, [3]Emory University School of Medicine, Atlanta, GA, United States, [4]Surgery, Emory University School of Medicine, Atlanta, GA, United States* By reducing non-specific macrophage uptake, anti-biofouling polymer coated iron oxide nanoparticles (IONPs) conjugated with mannose as the ligand (Man-IONP) was developed for specifically targeting sub-type tumor associated macrophage M2 with mannose receptor 1 expression. This novel MRI probe demonstrated specific M2 macrophage targeting in vitro with M1 and R264.7 macrophages as controls. Immuno-staining of 4T1 breast tumor tissues with Man-IONPs showed the probe targeting M2 similarly to anti-CD206 antibody. NIR and MR imaging of 4T1 tumor-bearing mice showed significant contrast changes after receiving i.v. injection of NIR dye labeled Man-IONP, while little change was observed for mice receiving non-targeted IONP.

3693	Computer 21	Manganese Complex of EDTA-Ethoxybenzyl Conjugate as a New Hepatobiliary MRI Contrast Agent Md Kamrul Islam[1], Soyeon Kim[1], Hee-Kyung Kim[2,3], Garam Choi[1], Ah Rum Baek[1], Taekwan Lee[4], DongKyu Kim[4], Hoe Su Jung[4], and Yongmin Chang[1,2,5] *[1]Medical and Biological Engineering, Kyungpook National University, Daegu, Republic of Korea, [2]Department of Molecular Medicine & BK21 Plus KNU Biomedical Convergence Program, Kyungpook National University, Daegu, Republic of Korea, [3]Institute of Biomedical Engineering Research, Kyungpook National University, Daegu, Republic of Korea, [4]Laborstory Animal Center, Daegu Gyeongbuk Medical Innovation Foundation, Daegu, Republic of Korea, [5]Department of Radiology, Kyungpook National University, Daegu, Republic of Korea* The purpose of the current study is to design and synthesis of novel Mn^{2+} complex as an alternative to well-established Gd^{3+} chelates for use as a liver-targeting MR imaging agent. This new complex exhibits high R_1 relaxivity (2.3 mM^{-1} s^{-1}) than clinically approved Mn-DPDP® (1.6 mM^{-1} s^{-1}) at 1.5 T. It is also kinetically much inert than that of Magnevist®. In vivo MRI enhancement pattern compares well with those of liver-specific MRI CAs such as Primovist® and Multihance®. It shows greater tumor detection in a liver tumor model with negligible toxicity in a clinical dose.

3694	Computer 22	Gadolinium complexes conjugated with nonsteroidal anti-inflammatory drugs (NSAIDs) as potential inflammation targeting MRI contrast agents. Heekyung Kim[1,2], Bokyung Sung[3], Soyeon Kim[3], Garam Choi[3], Ah Rum Baek[3], Md Kamrul Islam[3], Taekwan Lee[4], DongKyu Kim[4], Hoe Su Jung[4], and Yongmin Chang[2,3,5]

		[1]Department of Molecular Medicine & BK21 Plus KNU Biomedical Convergence Program, Kyungpook National University, Daegu, Republic of Korea, [2]Institute of Biomedical Engineering Research, Kyungpook National University, Daegu, Republic of Korea, [3]Department of Medical & Biological Engineering, Kyungpook National University, Daegu, Republic of Korea, [4]Laboratory Animal Center, Daegu-Gyeongbuk Medical Innovation Foundation, Daegu, Republic of Korea, [5]Department of Radiology, Kyungpook National University, Daegu, Republic of Korea
		Inflammation targeting MR CAs conjugated with NSAIDs were prepared according to the general synthetic methods, and characterized by spectroscopic analysis. The relaxivities of theses gadolinium complexes are slightly higher than those of Gadovist®. From in vivo T_1-weighted MR images, strong enhancement was observed in the inflammatory region. Also our new gadolinium complexes represent high kinetic inertness in chemically competitive environment compared with other clinically used MR CAs.

3695	Computer 23	Small CaF2 nanocrystals as nano-sized tracers for in vivo 19F-MRI
		Idan Ashur[1], Hyla Allouche-Arnon[1], and Amnon Bar-Shir[1]
		[1]Organic Chemistry, The Weizmann Institute of Science, Rehovot, Israel
		In this study we present a novel class of ^{19}F-nanoformulations based on small (<10 nm) fluoride-nanocrystals (specifically CaF_2 nanofluorides) for MRI applications. We show that homonuclear dipolar interactions can be averaged out by the fast tumbling of the PEG-coated nanocrystals thus enabling the acquisition of high-resolution ^{19}F-NMR. Using this feature, we demonstrate that our newly developed nanofluorides could be used as ^{19}F-MRI tracers and present a “hot-spot” mapping in an animal model inflammation. The proposed nanofluorides combine the advantages of using nanocrystals (small, high ^{19}F-equivalency, maximal ^{19}F-density, and surface modifiability) with the merits of ^{19}F-MRI tracers.

3696	Computer 24	Fluorine labeling and imaging of biomaterial scaffolds for regenerative medicine
		Marcin Piejko[1,2], Piotr Walczak[1,3], Xiaowei Li[4], Jeff W.M. Bulte[1], and Miroslaw Janowski[1,5]
		[1]Radiology, Johns Hopkins University, Baltimore, MD, United States, [2]3rd Department of General Surgery, Jagiellonian University, Cracow, Poland, [3]Neurology and Neurosurgery, University of Warmia and Mazury, Olsztyn, Poland, [4]Materials Science and Engineering, Johns Hopkins University, Baltimore, MD, United States, [5]Mossakowski Medical Research Centre, Warsaw, Poland

		There is growing interest in stem cell-based regenerative medicine. Hydrogels can serve as injectable scaffolds for transplanted stem cells in order to provide mechanical support, as well as to mimic natural 3D tissue composition, while allowing for minimally invasive needle- or catheter-based delivery. However, the precision of hydrogel injections, as well as monitoring of gel biodegradation, remains challenging. We have shown that clinical grade fluorine nanoemulsion effectively and firmly labels hyaluronian-based hydrogel, supports survival of embedded stem cells, while only mildly changing rheological properties. Additionally, 19F MRI is very attractive as it does not interfere with anatomical and functional MRI.

Electronic Poster

Hyperpolarisation: Applications

Exhibition Hall	Monday 17:15 - 18:15

3697	Computer 25	Toward investigating cerebral metabolism using hyperpolarized pyruvate on a human 7T system
		Sergey Cheshkov[1,2], Edward Hackett[1], Richard Martin[1], Sandeep Ganji[1,3], Ivan Dimitrov[1,3], and Jae Mo Park[1,2,4]
		[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Philips Healthcare, Dallas, TX, United States, [4]Electrical and Computer Engineering, University of Texas at Dallas, Richardson, TX, United States
		Advances in hyperpolarized MR technology and pre-clinical investigations have recently led to translational studies using clinical 3T human systems. While hyperpolarization provides large increase in MR sensitivity, spectral dispersion at 3T is limited which makes assessment of various metabolic pathways difficult. This work demonstrates the feasibility of using hyperpolarized ^{13}C-pyruvate to study brain metabolism in a whole-body human 7T system. In particular, the benefit of increased chemical shift dispersion and ^{1}H-decoupling were tested in phantom and rat brains *in vivo* using hyperpolarized [1-^{13}C]- and [2-^{13}C]-labeled pyruvate. Longitudinal relaxation times of these hyperpolarized substrates at 7T are also reported.

3698	Computer 26	Integrated B1+ Mapping for Hyperpolarized 13C MRI in a Clinical Setup using Multi-Channel Receive Arrays
		Rie B Hansen[1], Peter J Shin[2], Jeremy W Gordon[2], Mark Van Criekinge[2], Lucas Carvajal[2], Lars G Hanson[1], Jan H Ardenkjær-Larsen[1], and Daniel B Vigneron[2]
		[1]Department of Electrical Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark, [2]Department of Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States

		For hyperpolarized ^{13}C MRI acquisitions aimed at metabolic rate constant estimation, the Bloch-Siegert shift enables encoding of the transmit field (B_1^+-field) amplitude within a single hyperpolarized substrate injection. This ability is needed since most clinical hyperpolarized MRI studies use inhomogeneous transmit coils, and because kinetic modeling based on incorrect flip angles can lead to incorrect rate constant estimations. This study demonstrates the feasibility of integrated B_1^+ mapping for large volume thermal and hyperpolarized phantoms in a clinical setup using a clamshell transmit coil and a 16-channel receive array, and a 3D stack-of-spirals sequence. Phase-sensitive coil-combination was achieved using ESPIRiT.

3699	Computer 27	Hyperpolarized [1-13C]pyruvate MRS detects dynamic glucose metabolism according to stages of diabetes in mouse model
		Young-suk Choi[1], Somang Kang[2], Hansol Lee[3], Jae Eun Song[3], Dong-Hyun Kim[3], Jong Eun Lee[2], and Ho-Taek Song[1]
		[1]Yonsei University College of Medicine, Seoul, Republic of Korea, [2]Department of Anatomy, Yonsei University College of Medicine, Seoul, Republic of Korea, [3]Department of Electrical and Electronic Engineering, Yonsei University, Seoul, Republic of Korea
		Recently, diabetes has been suggested as a risk factor for inducing cognitive impairment. Thus, a quantitative imaging method to validate the metabolic status of the brain according to the stages of diabetes may help elucidate the relationship between the development of cognitive impairment and glucose metabolism of the brain. This study performed hyperpolarized [1-13C]pyruvate imaging in the brain of both pre-diabetes (Pre-DM) and type 2 diabetes (T2DM) mouse model. It shows dynamic brain glucose metabolism according to the stages of diabetes with excellent sensitivity.

3700	Computer 28	Hyperpolarized carbon-13 MRS of liver in a high-fat/high sugar diet guinea pig model
		Lauren Smith[1], Lanette Friesen-Waldner[1], Kevin Sinclair[1], Trevor Wade[1,2], Timothy Regnault[3,4,5], and Charles McKenzie[1,2,5]
		[1]Medical Biophysics, Western University, London, ON, Canada, [2]Robarts Research Institute, London, ON, Canada, [3]Physiology and Pharmacology, Western University, London, ON, Canada, [4]Obstetrics and Gynaecology, Schulich Medicine & Dentistry, London, ON, Canada, [5]Maternal, Fetal & Newborn Health, Children's Health Research Institute, London, ON, Canada
		Effects of a life long high-fat/high sugar diet (Western diet: WD) upon pyruvate liver metabolism were observed in a group of young adult male guinea pigs (N=26). Proton density fat-fraction images were reconstructed using IDEAL water fat separation. Metabolism data were obtained using dynamic spectroscopy of hyperpolarized carbon-13 enriched pyruvate. Guinea pigs fed a life long WD displayed a significantly higher hepatic fat fraction and a delayed time to peak for the conversion of pyruvate to lactate. These results indicate that life long consumption of a WD in growing animals is associated with markers of dysfunctional hepatic metabolic function.

3701	Computer 29	Case Report: Hyperpolarized 13C Metabolic Imaging of a Castration-Resistant Prostate Cancer Patient
		Casey Y. Lee[1,2], Benjamin J. Geraghty[1,2], Justin Y. C. Lau[1,2,3], Albert P. Chen[4], William J. Perks[5], Masoom A. Haider[6], Urban Emmenegger[7,8], and Charles H. Cunningham[1,2]
		[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [3]Cardiovascular Medicine, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [4]GE Healthcare, Toronto, ON, Canada, [5]Pharmacy, Sunnybrook Research Institute, Toronto, ON, Canada, [6]Medical Imaging, University of Toronto and Ontario Institute of Cancer Research, Toronto, ON, Canada, [7]Sunnybrook Odette Cancer Centre and Research Institute, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [8]Institute of Medical Science, University of Toronto, Toronto, ON, Canada
		The feasibility of applying hyperpolarized ^{13}C MRI to acquire metabolic (lactate, pyruvate) images of the vertebral region of a castration-resistant prostate cancer patient was investigated in this pilot study. The lactate and pyruvate signal-to-noise ratios (SNRs) of spine, back muscle, aorta, and kidney are reported. The summary of patient's clinical history is illustrated to aid the understanding of implications of ^{13}C-lactate signals observed in this study.

3702	Computer 30	Correlation Between Hyperpolarized 13C-signal and Lactate Concentration in a Human Breast Cancer Xenograft Model
		Casey Y. Lee[1,2], Benjamin J. Geraghty[1,2], Justin Y. C. Lau[1,2,3], Albert P. Chen[4], Yi-Ping Gu[2], and Charles H. Cunningham[1,2]
		[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [3]Cardiovascular Medicine, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [4]GE Healthcare, Toronto, ON, Canada
		Hyperpolarized ^{13}C MRI has enabled metabolic (lactate- and pyruvate-) imaging in various clinical and pre-clinical studies to probe the production of lactate in tumours. A number of biological factors has been proposed to influence ^{13}C-signal, with the total lactate pool size thought to be the dominant contributor based on the *in vitro* cell study by Day *et al*. In this study, we investigate whether the same relationship holds in a human breast cancer xenograft model in rats, as well as assessing the contributions from other biological components, including the rate of perfusion, transporters, and enzymes.

3703	Computer 31	Noninvasive assessment of treatment response to histone deacetylase inhibitor and radiation for pediatric diffuse midline glioma using hyperpolarized carbon-13 metabolic imaging
		Ilwoo Park[1], Adam Autry[2], Xiaodong Yang[3], Yuying Zhai[3], Renuka Sriram[2], Dave Korenchan[2], John Kurhanewicz[2], Adam Cunha[4], I-Chow Hsu[4], and Sabine Mueller[5]

		[1]Radiology, Chonnam National University, Gwangju, Republic of Korea, [2]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [3]Neurology, University of California San Francisco, San Francisco, CA, United States, [4]Radiation Oncology, University of California San Francisco, San Francisco, CA, United States, [5]Neurology, Neurosurgery and Pediatrics, University of California San Francisco, San Francisco, CA, United States
		Diffuse midline glioma is one of the most difficult pediatric cancers to treat. This study investigated the feasibility of ^{13}C magnetic resonance metabolic imaging of hyperpolarized [1-^{13}C]pyruvate for monitoring response to novel therapies in diffuse midline glioma. Treatment with panobinostat was associated with a reduction in hyperpolarized lactate and a reduced LDHA activity in an in vitro experiment. Radiotherapy led to a reduction in the ratio of lactate to pyruvate in rats bearing diffuse midline glioma. The results suggest that hyperpolarized ^{13}C metabolic imaging may provide an early noninvasive biomarker to monitor therapy response in diffuse midline glioma.

3704	Computer 32	Establishing a Dose-Response Relationship for Lithium-Induced Modulation of [1-13C]Pyruvate Metabolism in the Heart
		Jonas Steinhauser[1], Patrick Wespi[1], Grzegorz Kwiatkowski[1], and Sebastian Kozerke[1]
		[1]Institute for Biomedical Engineering, ETH and University Zurich, Zürich, Switzerland
		Lithium is the first-line drug used in bipolar disorder, a chronic widespread psychiatric disease. Lithium is a narrow therapeutic index drug and shows cardiac side effects. The present work demonstrates the detectability of lithium induced changes of mitochondrial metabolism in cardiomyocytes using hyperpolarized [1-13C]pyruvate magnetic resonance imaging of the in-vivo rat heart. Metabolic and functional response to lithium was examined for different lithium plasma concentrations.

3705	Computer 33	In Vivo Imaging with Hyperpolarized Aspirin
		Argentina Ornelas[1], Niki Zacharias Millward[1], Jaehyuk Lee[1], Jingzhe Hu[1], David Menter[2], Eduardo Vilar Sanchez[3], Pratip K Bhattacharya[1], and Steven Wesley Millward[1]
		[1]Cancer Systems Imaging, UT MD Anderson Cancer Center, Houston, TX, United States, [2]GI Med Oncology, UT MD Anderson Cancer Center, Houston, TX, United States, [3]Clinical Cancer Prevention, UT MD Anderson Cancer Center, Houston, TX, United States
		Epidemiological evidence strongly suggests that chronic low-dose aspirin usage leads to a significantly lower incidence of cancer and metastatic disease. Given its emergent role as a chemopreventive, it is highly desirable to develop a method to monitor aspirin pharmacokinetics and metabolism in real time and in vivo. We have recently synthesized and hyperpolarized single and double 13C-labeled aspirin, monitored chemical acetylation in hyperpolarized phantom experiments, and determined metabolism and biodistribution of hyperpolarized 13C aspirin in mice.

3706	Computer 34	Pulmonary Metabolism and Inflammation During Mechanical Ventilation: A Hyperpolarized Carbon-13 Study
		Mehrdad Pourfathi[1], Shampa Chatterjee[2], Maurizio Cereda[3], Yi Xin[1], Stephen Kadlecek[1], Hooman Hamedani[1], Ian Duncan[1], Sarmad Siddiqui[1], Harrilla Profka[1], Kai Ruppert[1], Luis Loza[1], Faraz Amzajerdian[1], Ryan Baron[1], Mary Spencer[1], Tahmina Achekzai[1], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Physiology, University of Pennsylvania, Philadelphia, PA, United States, [3]Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA, United States
		We showed that secondary inflammation due to atelectasis increases pulmonary anaerobic metabolism (lactate-to-pyruvate ratio). Recruitment with PEEP limits anaerobic metabolism and contains injury progression. Measuring tissue metabolism with hyperpolarized MRI can disclose novel pathways of tissue damage during lung injury and assess secondary injury progression in ventilated lungs.

3707	Computer 35	Imaging Regional Distribution of Metabolic Activity During Progression of Acute Lung Injury using Hyperpolarized Carbon-13 MRI
		Mehrdad Pourfathi[1], Maurizio Cereda[2], Shampa Chatterjee[3], Yi Xin[1], Stephen Kadlecek[1], Hooman Hamedani[1], Ian Duncan[1], Sarmad Siddiqui[1], Harrilla Profka[1], Kai Ruppert[1], Luis Loza[1], Faraz Amzajerdian[1], Ryan Baron[1], Mary Spencer[1], Tahmina Achekzai[1], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA, United States, [3]Physiology, University of Pennsylvania, Philadelphia, PA, United States
		We used hyperpolarized [1-^{13}C] pyruvate MRI to assess regional alterations in lactate production during progression of acute lung injury. While the average lactate-to-pyruvate ratio and its standard deviation increased globally in lungs ventilated without recruitment, the average ratio increased more significantly in the posterior regions than the average ratio in the anterior region. The average lactate-to-pyruvate remained unchanged in lungs ventilated with recruitment maneuver. Our finding suggests that stretch-induced atelectasis and inflammation are the root of increased lactate-to-pyruvate ratio in the lungs ventilated without recruitment.

3708	Computer 36	Evaluating hyperpolarized lactate as a theranostic agent for stroke
		Jean-Noël Hyacinthe[1,2], Lara Buscemi[3], Mario Lepore[4], Rolf Gruetter[4,5,6,7], Lorenz Hirt[3], and Mor Mishkovsky[5]

		[1]School of Health Sciences - Geneva, University of Applied Sciences and Arts Western Switzerland, Geneva, Switzerland, [2]Image Guided Intervention Laboratory, Faculty of Medicine, University of Geneva, Geneva, Switzerland, [3]Department of Clinical Neurosciences, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland, [4]Centre d'Imagerie Biomédicale (CIBM), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [5]Laboratory of Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [6]Department of Radiology, University of Geneva, Geneva, Switzerland, [7]Department of Radiology, University of Lausanne, Lausanne, Switzerland
		Stroke is the leading cause of disability and the third leading cause of death worldwide. Lactate administration into the ischemic brain directly after blood reperfusion was found to be neuroprotective. MR with hyperpolarized (HP) probes enables *in vivo* real-time measurement of biochemical transformations of HP ^{13}C-labeled precursors, including lactate. The aim of this study was to demonstrate the feasibility of probing HP [1-^{13}C]L-lactate metabolism in mice brain after ischemic stroke, and to study the influence of the time window after reperfusion on its conversion in order to evaluate the potential of HP lactate as a theranostic agent for stroke.

3709	Computer 37	Imaging metabolic development of patient-derived glioblastoma xenografts in vivo employing hyperpolarized magnetic resonance
		Travis Salzillo[1,2], Joy Gumin[3], Jaehyuk Lee[2], Islam Hassan[4], Niki Zacharias[2], Rivka Colen[1,2,4], Frederick Lang[1,3], and Pratip Bhattacharya[1,2]
		[1]MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences, Houston, TX, United States, [2]Cancer Systems Imaging, University of Texas M.D. Anderson Cancer Center, Houston, TX, United States, [3]Neurosurgery, University of Texas M.D. Anderson Cancer Center, Houston, TX, United States, [4]Diagnostic Radiology, University of Texas M.D. Anderson Cancer Center, Houston, TX, United States
		Hyperpolarized MRI was employed to non-invasively assess aerobic glycolysis in a well-characterized, patient-derived, orthotopic glioblastoma mouse model which recapitulates the complexity of tumor microenvironment. Aberrant energy metabolism is a hallmark of cancer, and in order to understand this metabolic rewiring during the course of tumor development, in vivo hyperpolarized pyruvate metabolic imaging and NMR spectroscopy of ex vivo tumor tissue were performed at three separate time points. A positive correlation of dynamic lactate production with tumor progression was observed. Additionally, NMR metabolomics revealed several key metabolites that are positively or negatively correlated with tumor growth.

3710	Computer 38	Hyperpolarized [1-13C] pyruvate as a biomarker for treatment monitoring in lymphoma murine models
		Brice Tiret[1,2], Adam Autry[2], IlWoo Park[2], Min Lu[3], Rana Anjum[4], Lisa Drew[4], Sebastien Degorce[5], Michele Mayo[4], Keith Dillman[4], John Kurhanewicz[2], James Rubenstein[3], and Myriam Chaumeil[1,2]

[1]Department of Physical Therapy and Rehabilitation Science, UCSF, San Francisco, CA, United States, [2]Department of Radiology & Biomedical Imaging, UCSF, San Francisco, CA, United States, [3]Helen Diller Family Comprehensive Cancer Center, UCSF, San Francisco, CA, United States, [4]Oncology Innovative Medicines and Early Development, AstraZeneca, Waltham, MA, United States, [5]Oncology Innovative Medicines, AstraZeneca, Cheshire, United Kingdom

In primary CNS lymphoma (PCNSL), MYD88 mutation is the most common, and induces a constitutive activation of IRAK4 and NF-kB signaling. AZ1495, a IRAK4 inhibitor, significantly improved OS in MYD88mut PCNSL models, highlighting the clinical potential of IRAK inhibition. However, monitoring of such targeted therapies remains challenging using conventional imaging. Because NF-kB controls metabolism, we questioned if hyperpolarized 13C MRSI could monitor IRAK inhibition in PCNSL. We show that HP-13C MRSI was able to detect a decreased HP lactate production following IRAK inhibition in MYD88mut tumors, not wild-types, highlighting the potential of metabolic imaging for monitoring therapy response in lymphomas.

3711 Computer 39

Hyperpolarized In vivo pH Imaging Reveals Grade-Dependent Interstitial Acidification

David E Korenchan[1], Robert Bok[1], Renuka Sriram[1], Romelyn Delos Santos[1], Hecong Qin[1,2], Daniel B Vigneron[1,2], David M Wilson[1], John Kurhanewicz[1,2], and Robert R Flavell[1]

[1]Radiology and Biomedical Imaging, UC San Francisco, San Francisco, CA, United States, [2]Bioengineering, UC San Francisco, San Francisco, CA, United States

Changes in cellular metabolism, perfusion, and proton export that occur during indolent-to-aggressive transition in prostate cancer (PCa) likely lead to a lower extracellular pH (pH_e) *in vivo*, promoting an aggressive, treatment-resistant phenotype. To measure this interstitial acidification, we implemented a hyperpolarized (HP) imaging protocol that measured lactate-to-pyruvate ratio, perfusion, and pH_e in a murine model of prostate cancer, the TRAMP mouse. Our results indicated higher pyruvate-to-lactate conversion, lower perfusion, and lower pH_e in high-grade tumors, suggesting a correlation between the three parameters and implicating low pH_e in the development of aggressive PCa.

3712 Computer 40

Characterization of Distinctive in vivo Metabolism between Enhancing and Non-enhancing Brain Tumors Using Hyperpolarized Carbon-13 MRI

Seongwoong Kang[1] and Ilwoo Park[2]

[1]Radiology, Chonnam National University Hwasun Hospital, Hwasun, Republic of Korea, [2]Radiology, Chonnam National University Medical School and Hospital, Gwanju, Republic of Korea

		This study applied ^{13}C MR metabolic imaging with hyperpolarized [1-^{13}C]pyruvate for the differential characterization of metabolic profiles between enhancing and non-enhancing brain tumors. The levels of lactate, which was normalized by vascular total carbon signal, were significantly different between the contralateral brain, non-enhancing and enhancing tumor, while the levels of pyruvate were similar between these three tissues. The results from this study suggested that this technique may be useful in distinguishing functional characteristics between normal brain tissue and heterogeneous anatomical lesions in brain tumors.

3713	Computer 41	Detection of Targeted Therapy Treatment Response using Hyperpolarized Magnetic Resonance Spectroscopy in Breast Cancer Cell Lines
		Sui Seng Tee[1], Kristin L Granlund[1], Roozbeh Eskandari[1], Sangmoo Jeong[1], Steven Truong[1], and Kayvan Rahimi Keshari[1]
		[1]Memorial Sloan Kettering Cancer Center, New York, NY, United States
		Hyperpolarized magnetic resonance spectroscopy (HP-MRS) allows non-invasive real-time monitoring of cancer metabolism. This unique ability allows investigation of changes in cancer metabolism after therapy. This study demonstrates the utility of this modality to detect lowered conversion of hyperpolarized pyruvate to lactate after targeted therapy against a commonly mutated growth signaling pathway in cancer. We also demonstrate changes in enzyme phosphorylation that may explain changes in HP-MRS.

3714	Computer 42	HP [1-13C] Pyruvate-derived metabolic biomarkers are an early predictor of lung rejection in the rat lung transplantation model
		Sarmad Siddiqui[1], Mehrdad Pourfathi[1], Andreas Habertheuer[2], Yi Xin[1], Hooman Hamedani[1], Prashanth Vallabhajosyula[2], Ali Naji[2], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]University of Pennsylvania, Philadelphia, PA, United States
		Post-transplant lungs are clinically monitored using regular radiography and/or CT scans to detect rejection. We proposed that a metabolic biomarker may provide higher sensitivity than conventional tools at the onset of rejection, before permanent structural changes in the lungs. Using HP [1-13C] pyruvate CSI, we found that the HP lactate-to-pyruvate ratio in the transplanted lung was significantly elevated in the rejected cohort (~1.7-fold on day 3, ~2.7-fold on day 7) compared to the non-rejected cohort and can be potentionally used as an early predictor of lung rejection.

3715	Computer 43	A Multimodal Imaging Approach to Characterize the Onset of Pulmonary Fibrosis

		Sarmad Siddiqui[1], Mehrdad Pourfathi[1], Stephen Kadlecek[1], Yi Xin[1], Harrilla Profka[1], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States
		Pulmonary fibrosis is typically an progressive, irreversible disease. However, in many cases, the onset of fibrosis is preceded by persistent inflammation; unfortunately, the two presentations are challenging to assess radiologically, and misdiagnoses can limit treatment options. In this *in vivo* rat study, the metabolic state the lung—derived via HP [1-13C]-pyruvate MRSI—and the structural heterogeneity of the lung—imaged via CT—were used in tandem to distinguish healthy lungs, inflamed lungs, and lungs with early onset fibrosis, creating an extremely sensitive tool for differentiating between the different phases of pulmonary fibrosis.

3716	Computer 44	Investigating Ferumoxytol as a Relaxation Agent for Hyperpolarized 13C Magnetic Resonance
		Michael A. Ohliger[1,2], Cornelius von Morze[1], Jeremy Gordon[1], Eugene Milshteyn[1], Chengcheng Zhu[1], David Saloner[1], John Kurhanewicz[1], and Daniel Vigneron[1]
		[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Zuckerberg San Francisco General Hospital, San Francisco, CA, United States
		Hyperpolarized carbon-13 MRI is a powerful emerging molecular imaging technique but it lacks tissue specificity. Selective relaxation of hyperpolarized signals by targeted gadolinium chelates has been explored to increase specificity. However, gadolinium agents have very low ^{13}C relaxivities. We explore the use of the super paramagnetic iron oxide, ferumoxytol, by measuring the transverse and longitudinal relaxivity for two commonly imaged hyperpolarized ^{13}C metabolites, namely [1-^{13}C]pyruvate and [1-^{13}C]lactate in comparison to gadopentetate. Longitudinal relaxivity of ferumoxytol is nearly 30 times higher for 13C compounds than gadopentetate. This enhanced relaxivity is expected to lead to especially low dose requirements in eventual biological translation.

3717	Computer 45	Developing a therapeutic strategy for a glycolytic cancer model by monitoring on-target in vivo efficacy of a newly developed LDH inhibitor using hyperpolarized 13C Magnetic Resonance Imaging
		Nobu Oshima[1], Shun Kishimoto[1], Krisitin Beebe[1], Dan Crooks[1], Kazutoshi Yamamoto[1], Jeffery R. Brender[1], Ganesha Rai[2], Daniel Urban[2], Goria Benavides[3], Giuseppe Squadrito[3], Victor Darley-Usmar[3], Matt Hall[2], James B. Mitchell[1], Murali C. Krishna[1], and Leonard M. Neckers[1]
		[1]NCI/NIH, Bethesda, MD, United States, [2]National Center for Advancing Translational Sciences (NCATS), NIH, Rockville, MD, United States, [3]University of Alabama School of Medicine, Birmingham, AL, United States

		This study aimed to develop a new therapeutic strategy with a novel Lactate Dehydrogenase A inhibitor (LDHi) for cancers bearing the Warburg phenotype by monitoring the impact on *in vivo* metabolic flux of the LDHi using hyperpolarized ^{13}C-MRI. ^{13}C-MRI with hyperpolarized [1-^{13}C]pyruvate revealed *in vivo* pharmacodynamics and an effective dose of the LDHi without the need for tissue sampling. In addition, based on these results, we developed a therapeutic strategy with the LDHi for mice harboring a MiaPaCa-2 (a glycolytic pancreatic cancer cell line) xenograft. This methodology can be a novel approach to treat glycolytic cancers.

3718	Computer 46	Esterase-catalyzed production of hyperpolarized 13C carbon dioxide in tissues for measuring pH
		Nesmine R Maptue[1], Weina Jiang[1], Alexander M Funk[1], Wei Chen[1], Craig R Malloy[1,2,3,4], A. Dean Sherry[1,2,5], and Chalermchai Khemtong[1,2]
		[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Department of Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Department of Internal Medicine, University of Texas Southwestern Medical Center, Dallas, TX, United States, [4]Veteran Affairs North Texas Health Care System, Dallas, TX, United States, [5]Department of Chemistry, University of Texas at Dallas, Richardson, TX, United States
		^{13}C-MRI HP ^{13}C-bicarbonate ($H^{13}CO_3^-$) and carbon dioxide ($^{13}CO_2$) is a novel technique for tissue pH mapping. Here, we report ^{13}C-enriched ethyl acetyl carbonate (^{13}C-EAC) for esterase-catalyzed production of HP-$^{13}CO_2$ and HP-$H^{13}CO_3^-$ for pH measurements. Our results showed that ^{13}C-EAC was rapidly hydrolyzed by esterase to ^{13}C-monoacetyl carbonate, which decomposed to HP-$^{13}CO_2$. Equilibrium between the newly produced $^{13}CO_2$ and $H^{13}CO_3^-$ was established and the ^{13}C-NMR signals can be quantified for pH measurements. Finally, in vivo pH measurements using H-$_{13}$C-EAC was demonstrated in rat livers. These results suggest that HP-^{13}C-EAC is a novel imaging probe for in vivo pH measurements of tissues.

3719	Computer 47	Hyperpolarized [13C,15N2]urea T2 relaxation changes in acute kidney injury
		Christian Østergaard Mariager[1], Per Mose Nielsen[1], Haiyun Qi[1], Steffen Ringgaard[1], and Christoffer Laustsen[1]
		[1]The MR Research Centre, Department of Clinical Medicine, Aarhus University, Aarhus N, Denmark
		BOLD T2* MRI is a surrogate marker of tissue pO2 alterations associated with renal disease, but is limited by perfusion. Hyperpolarized [13C,15N2]urea is an alternative marker of renal function that correlates with normal renal oxygenation. We investigated the correlation between BOLD T2* and 13C-urea T2 in an acute kidney injury (AKI) model. We found that hyperpolarized urea T2 correlates with renal BOLD T2* in the healthy but not in the AKI kidney, and that whole kidney T2 is modulated significantly by the blood volume in addition to oxygen availability. 13C-urea T2 mapping therefore has potential to assist the BOLD estimation.

3720	Computer 48	Hyperpolarized [1-13C]pyruvate MRS reveals early-phase transition of energy metabolism in multicellular spheroid tumors Yoichi Takakusagi[1,2], Kaori Takakusagi[1], Kaori Inoue[2], and Kazuhiro Ichikawa[2,3] *[1]National Institute of Radiological Sciences, QST, Chiba, Japan, [2]Incubation Center for Advanced Medical Science, Kyushu University, Fukuoka, Japan, [3]Department of Pharmacy, Nagasaki International Unversity, Sasebo, Japan* Hyperpolarized [1-^{13}C]pyruvate MRS was conducted to directly monitor the transition of energy metabolism in tiny multicellular tumor spheroids as a model of early tumorigenesis. As compared with normal tumor cells, the lactate formation from pyruvate was significantly amplified in the tumor spheroids, even in a few hundred micrometer i.d. of smaller ones with no blood vessel formation. These results imply that formation of the sterical structure itself causes the transition of energy metabolism from mitochondria to cytoplasm in tumor tissues. HP [1-^{13}C]pyruvate MRS may thus allow detection of early tumorigenesis by targeting the increased aerobic glycolysis in the initial stage, if much higher performance of HP measurement is realized.

Electronic Poster

Neurodegeneration

Exhibition Hall	Monday 17:15 - 18:15

3721	Computer 49	Brain microstructural abnormalities in cirrhotic patients without overt hepatic encephalopathy: A voxel-based diffusional kurtosis imaging study Hua-Jun Chen[1] *[1]Fujian Medical University Union Hospital, Fuzhou, China* Brain microstructural change in cirrhotic patients without overt hepatic encephalopathy: A DKI study

3722	Computer 50	Altered Dynamic Functional Connectivity in the Default Mode Network in Patients with Cirrhosis and Minimal Hepatic Encephalopathy Hua-Jun Chen[1] *[1]Fujian Medical University Union Hospital, Fuzhou, China*

		Altered Dynamic Functional Connectivity in Default Mode Network in Minimal Hepatic Encephalopathy

3723	Computer 51	Quantitative MRI comparison of neurological and hepatic forms of Wilson disease
		Monika Dezortova[1], Vit Herynek[1], Petr Dusek[2], Julio Acosta-Cabronero[3], Radan Bruha[4], Filip Jiru[1], and Milan Hajek[1]
		[1]MR-Unit, Dept. Diagnostic and Interventional Radiology, Institute for Clinical and Experimental Medicine, Prague, Czech Republic, [2]Dept Neurology and Center of clinical Neuroscience, Charles University, 1st Faculty of Medicine and General University Hospital, Prague, Czech Republic, [3]Wellcome Centre for Human Neuroimaging, UCL Institute of Neurology, University College London, London, United Kingdom, [4]4th Dept. Internal Medicine, Charles University, 1st Faculty of Medicine and General University Hospital, Prague, Czech Republic
		We examined 40 patients with neurological and hepatic form of Wilson disease by susceptibility mapping at 3T and T1 and T2 relaxometry at 1.5T and 3T. We were able to distinguish patients with neurological form from hepatic form and healthy controls based on quantitative relaxometry and susceptibility mapping. Higher susceptibility observed in the globus pallidus, putamen, and caudate nucleus in patients with neurological form corresponds to higher iron content while higher susceptibility in the thalamus corresponds rather to demyelination.

3724	Computer 52	Global Cerebral Metabolic Rate of Oxygen in Older People: Gender Differences
		Ana E Rodríguez-Soto[1], John A Detre[2], David A Wolk[2], Joseph E Harrison[2], and Felix W Wehrli[1]
		[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States
		Cerebral metabolic rate of oxygen ($CMRO_2$) has been reported to vary as a function of age and gender. Here, we re-examined possible gender differences as part of an ongoing study in people over the age of 60 years by means whole-brain MR oximetry. Data corroborate earlier findings that cognitively normal females appear to have higher $CMRO_2$ than their male peers. This difference may be largely due to greater oxygen extraction rather than changes in cerebral blood flow. Possible biological causes of this gender bias will need detailed scrutiny, as do the underlying physiologic assumptions that may impact the results.

3725	Computer 53	Tract based spatial statistics analysis of DKI metrics in type 2 diabetes patients
		Zaheer Abbas[1,2], Ezequiel Farrher[1], Elene Iordanishvili[1], Nino Kobalia[1], Krzysztof Dzieciol[1], Farida Grinberg[1,2], and Nadim Jon Shah[1,2,3,4,5]

		[1]Institute of Neuroscience and Medicine – 4, Medical Imaging Physics, Forschungszentrum Jülich GmbH, Jülich, Germany, [2]Department of Neurology, Faculty of Medicine, Aachen, Germany, [3]Translational Medicine, RWTH Aachen University, JARA – BRAIN, Aachen, Germany, [4]Forschungszentrum Jülich GmbH, Institute of Neuroscience and Medicine – 11, Jülich, Germany, [5]Monash Biomedical Imaging, School of Psychological Sciences, Monash University, Melbourne, Victoria, Australia
		In addition to cardiovascular risk factors, Type 2 diabetes mellitus (T2DM) is associated with microstructural, structural, functional, and metabolic changes in the brain. Patients with T2DM tend to develop cognitive impairment and dementia. In this study, we report differences between groups of T2DM patients and age-matched healthy volunteers by comparing diffusion tensor and diffusion kurtosis metrics using the tract-based spatial statistics (TBSS) method. We found that all diffusivities are larger and the axonal water fraction is reduced in the T2DM group compared to the controls. This suggests presence of more water in the extra-axonal space.

3726	Computer 54	Gray matter cortical thickness changes in Hypothyroid patients: A study using high-resolution structural imaging
		Mukesh Kumar[1], Poonam Rana[1], Pooja Rathore[1], Deepak Sharma[1], Prabhjot Kaur[1], Tarun Sekhri[2], and Subash Khushu[1]
		[1]NMR Research Center, Institute of Nuclear Medicine and Allied Sciences, New Delhi, India, [2]Thyroid Research Center, Institute of Nuclear Medicine and Allied Sciences, New Delhi, India
		The aim of our study was to assess changes in cortical thickness, cortical area and cortical volume of gray matter (GM) for hypothyroid patients. We had acquired high-resolution 3D T1 weighted structural data for both control (24) and hypothyroid subjects (22). Reduced gray matter cortical thickness was observed in lateraloccipital cortex, postcentral gyrus, medialorbitofrontal cortex, lingual gyrus, superior and inferior parietal cortex in hypothyroid patients as compare to controls. These findings of reduced gray matter (CTh) suggest abated activities of motor, attention, working memory and executive cognitive function in hypothyroid patients.

3727	Computer 55	On the Importance of Using High-Resolution Atlases for Voxel-Based Morphometry of High-Resolution MRI Data: A Case-Control Study on Essential Tremor
		Eric M Cameron[1,2], Jonathan P Dyke[3], Elan D Louis[4,5,6], and Ulrike Dydak[1,2]

		[1]School of Health Sciences, Purdue University, West Lafayette, IN, United States, [2]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States, [3]Department of Radiology, Weill Cornell Medicine, New York, NY, United States, [4]Department of Neurology, Yale School of Medicine, New Haven, CT, United States, [5]Department of Chronic Disease Epidemiology, Yale School of Public Health, New Haven, CT, United States, [6]Center for Neuroepidemiology and Clinical Neurological Research, Yale School of Medicine, New Haven, CT, United States
		The use of a high resolution atlas for segmentation and normalization greatly improves the accuracy of voxel-based morphometry analysis of magnetic resonance images. An adjusted method including the high resolution atlas was compared to the default method with the standard resolution atlas in a case-control study on essential tremor to demonstrate the impact of higher resolution segmentation. After multiple comparison correction using extent cluster thresholding, the adjusted method showed bilaterally consistent results, while the default method showed some false positive results in peripheral regions of the brain. A high resolution atlas should be used to segment equally high resolution images.

3728	Computer 56	Developmental alteration of mean diffusivity in striatum of transgenic Huntington’s disease monkey
		Yuguang Meng[1], Jocelyne Bachevalier[2,3], Anthony W.S. Chan[4,5], and Xiaodong Zhang[1,5]
		[1]Yerkes Imaging Center, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States, [2]Department of Psychology, Emory University School of Medicine, Atlanta, GA, United States, [3]Division of Developmental and Cognitive Neuroscience, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States, [4]Department of Human Genetics, Emory University School of Medicine, Atlanta, GA, United States, [5]Division of Neuropharmacology and Neurologic Diseases, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States
		Huntington Disease (HD) is a neurodegenerative disorder with a primary etiology of striatal pathology. Abnormal mean diffusivity changes have been seen previously in HD patients. However, it remains not fully understood how the diffusivity property of striatum evolves during the development of the disease. This study examined the progressive changes of striatum of rhesus monkey brains with HD gene mutation using diffusion tensor imaging (DTI), and it was found that there was significant MD difference from the control animals in striatum at very early age.

3729	Computer 57	Radiological Imaging of Brain Iron Deposits and T1 quantification feasibility using 3D UTE Cones.
		Piotr Wielopolski[1], Elene vroegindeweij[2], Agnita Boon[3], Janneke Langendonk[2], and Juan Antonio Hernandez-Tamames[1]
		[1]Radiology and Nuclear Medicine, Erasmus MC, Rotterdam, Netherlands, [2]Porphyria Center Rotterdam, Center for lysosomal and metabolic disease, Erasmus MC, Rotterdam, Netherlands, [3]Neurology, Erasmus MC, Rotterdam, Netherlands

		In this work, we demonstrate that 3D UTE cones enables the possibility of T1 contrast and T1 relaxometry of iron deposits in the brain. We present radiological images of brain iron and T1 quantification of iron deposits in a pathology with an exacerbated amount of iron in the brain. We demonstrate that even for conventional T2 and T2* mapping is challenging to obtain relaxometry. However, it is feasible for a 3D UTE cones sequence.

3730	Computer 58	Longitudinal Diffusion Tensor Imaging in the brain in Friedreich's Ataxia: follow-up at 12 and 24 months
		Pierre-Gilles Henry[1], James Joers[1], Dinesh Deelchand[1], Diane Hutter[1], and Christophe Lenglet[1]
		[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States
		We report 12-month and 24-month longitudinal diffusion tensor imaging (DTI) data in the brain of subjects with Friedreich's ataxia (FRDA). Significant longitudinal changes were observed in several brain areas (including the corpus callosum, internal capsule and superior corona radiata) in a group of 13 patients over 24 months. Our data suggest that diffusion MRI of the brain could be useful to better understand the impact of FRDA on brain microstructure and connectivity, and to assess the effect of potential treatments on neurodegeneration in upcoming clinical trials in FRDA.

3731	Computer 59	Magnetic susceptibility of the dentate in a longitudinal study of Friedreich ataxia
		Phillip G D Ward[1,2,3], Ian H Harding[2], Parnesh Raniga[4], Tom G Close[1], Louise A Corben[2,5,6], Martin B Delatycki[5,6,7], Monique R Stagnitti[2], Elsdon Storey[8], Nellie Georgiou-Karistianis[2], and Gary F Egan[1,2,3]
		[1]Monash Biomedical Imaging, Monash University, Melbourne, Australia, [2]Monash Institute of Cognitive and Clinical Neurosciences, Monash University, Melbourne, Australia, [3]Centre of Excellence for Integrative Brain Function, Australian Research Council, Melbourne, Australia, [4]The Australian eHealth Research Centre, CSIRO Health and Biosecurity, Herston, Australia, [5]Bruce Lefroy Centre for Genetic Health Research, Murdoch Childrens Research Institute, Melbourne, Australia, [6]Department of Paediatrics, University of Melbourne, Parkville, Australia, [7]Victorian Clinical Genetics Service, Parkville, Australia, [8]Department of Medicine, Monash University, Melbourne, Australia
		We performed in-vivo measurements of the magnetic susceptibility in the dentate nucleus in individuals with Friedreich ataxia and healthy controls over a two-year longitudinal study using quantitative susceptibility mapping. The results show a significant susceptibility difference between individuals with Friedreich ataxia and control subjects, and a strong correlation with disease severity in the Friedreich ataxia cohort. These findings may lead to the development of a sensitive biomarker of disease severity and progression in Friedreich ataxia.

3732	Computer 60	Delivery of mHTT to the rhesus macaque brain leads to a reduction in caudate volume in a new monkey model of Huntington’s disease
		Zheng Liu[1], Alison R. Weiss[1], Christopher D. Kroenke[1,2,3], and Jodi L. McBride[1,3]
		[1]Neuroscience, Oregon National Primate Research Center, Beaverton, OR, United States, [2]Advanced Imaging Research Center, Oregon Health and Science University, Portland, OR, United States, [3]Behavioral Neuroscience, Oregon Health and Science University, Portland, OR, United States
		Huntington’s disease (HD) is a genetic, neurodegenerative disorder caused by CAG repeat expansion in mutant huntingtin gene (mHTT) on Chromosome 4 and is characterized by degeneration of several brain regions, with the caudate nucleus and the putamen being the most heavily affected. Structural MRI was used to investigate the longitudinal striatal atrophy in a new rhesus macaque HD model, especially the reduction of rostral caudate volume. According to the longitudinal volumetric analysis, the delivery of 82Q mHTT to rhesus macaque striatum leads to a significant reduction in caudate volume. However, no such significant differences following delivery of 16Q mHTT model was observed. These data indicate that viral delivery of 82Q mHTT serves as a nonhuman primate model of Huntinton’s disease that reproduces neuropathological characteristics of the disease.

3733	Computer 61	MRI Connectivity Impairment Associated with Timing of Seizure Recurrence After Surgery in Temporal Lobe Epilepsy
		Victoria L Morgan[1,2], Dario J Englot[3], Baxter P Rogers[1], Adam W Anderson[1,2], Bennett A Landman[4], and Bassel Abou-Khalil[5]
		[1]Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [3]Neurosurgery, Vanderbilt University Medical Center, Nashville, TN, United States, [4]Electrical Engineering and Computer Science, Vanderbilt University, Nashville, TN, United States, [5]Neurology, Vanderbilt University Medical Center, Nashville, TN, United States
		Surgical resection of the seizure focus in the mesial temporal lobe is a common treatment of drug-resistant temporal lobe epilepsy (TLE) with an approximately 80% success rate. Our previous work showed that presurgical MRI-based functional and structural network connectivity can identify those TLE patients with the most unfavorable seizure outcomes. The goal of this work was to increase specificity of our prediction by characterizing those with seizure free and favorable outcomes. The results suggest that when impairment in functional connectivity of the seizure propagation network extends to the contralateral hemisphere, patients will experience rare post-surgical seizures sooner.

3734	Computer 62	Vertex-based thalamus morphometry and tract-based spatial statistics of the white matter show differences between patients with chronic low back pain and fibromyalgia
		Huiling Peng[1], Alyssa Smith[1], Kelly Boland[1], and Jason Craggs[1]

		[1]University of Missouri, Columbia, MO, United States
		Chronic low back pain (CLBP) is now considered a disease of the central nervous system. Two-thirds of individuals with CLBP also have fibromyalgia (FM) which is a chronic pain syndrome characterized by widespread deep musculoskeletal pain and cognitive deficits. The aim of this study was to investigate gray and white matter changes between FM and CLBP groups using vertex analysis of thalamus and tract-based spatial statistics (TBSS). Significant surface depression was detected in right thalamus of patients with FM compare to CLBP. TBSS analysis showed significantly reduced FA in several white matter tracts of patients with FM compared to CLBP.

3735	Computer 63	The association between brain volumes and physical frailty in older individuals
		Ilse Kant[1,2], Jeroen de Bresser[1,3], Simone van Montfort[2], Ellen Aarts[1,2], Ilona Bader[2], Yarit Wiggerts[2], Georg Winterer[4], Claudia Spies[4], Arjen Slooter[2], and Jeroen Hendrikse[1]
		[1]Radiology, UMC Utrecht, Utrecht, Netherlands, [2]Intensive Care, UMC Utrecht, Utrecht, Netherlands, [3]Radiology, Leiden University Medical Center, Leiden, Netherlands, [4]Anesthesiology and Intensive Care, Charité Universitätsmedizin, Berlin, Germany
		Physical frailty develops with increasing age and is a chronic state of vulnerability that is associated with disability and cognitive decline. Few studies have assessed the underlying structural brain abnormalities of physical frailty. We therefore examined the association between brain volumes on MRI and physical frailty in a group of 214 non-demented elderly participants. Frail participants showed a lower total brain volume and a lower grey matter volume compared to pre-frail and non-frail participants. Furthermore, pre-frail participants showed more cortical infarcts compared to non-frail participants. These brain abnormalities could be the underlying substrate of the physical frailty phenotype.

3736	Computer 64	Changes in brain connectivity of the first-episode idiopathic epilepsy patients before and after treatment: A comparative study of resting-state fMRI
		Pengfei Qiao[1], Guang-ming Niu[1], Yang Gao[2], and Lizhi Xie[3]
		[1]Department of Radiology, Affiliated Hospital of Inner Mongolia Medical University, Hohhot, China, [2]Department of Radiology, he Affiliated Hospital of Inner Mongolia Medical University, Hohhot, China, [3]GE Healthcare, China, Beijing, China
		This study investigates the fractional amplitude of low frequency fluctuation (fALFF) of the first-episode complex partial seizures epilepsy patients before and after treatment by using resting state fMRI (rfMRI). It is found that fALFF can be used to detect interictal epileptiform change before and after treatment.

3737	Computer 65	Investigation of cognition associated cerebral perfusion changes in Alzheimer's disease and mild cognitive impairment using a novel 3D arterial spin labeling technique
		Yong Zhang[1], Hua-Wei Lin[2], Bei Ding[2], Fu-Hua Yan[2], and Bing Wu[3]
		[1]GE Healthcare, Shanghai, China, [2]Radiology, Ruijin Hospital, Shanghai, China, [3]GE Healthcare, Beijing, China
		This preliminary study investigated cognition associated cerebral perfusion changes in Alzheimer's disease (AD) and mild cognitive impairment (MCI) measured with a novel 3D arterial spin labeling technique. The voxel-wise regression analysis against MMSE scores was performed using whole brain CBF maps. Cognition associated CBF deficits in the hippocampus and insular cortex might cause the typical AD symptoms including memory loss and emotion issues. CBF decrease in MCI patients in the lingual gyrus could affect vision and wording functions. CBF increase in the frontal lobe might serve as an early indicator for high-level cognitive function disturbance.

3738	Computer 66	Multi-parametric MRI of the Proximal and Distal Nerves of the Leg: Longitudinal Findings in Patients with Inherited Neuropathies
		Michael Pridmore[1], Richard Dortch[2], and Jun Li[3]
		[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Radiology and Radiological Sciences, Vanderbilt Medical Center, Nashville, TN, United States, [3]Neurology, Vanderbilt Medical Center, Nashville, TN, United States
		This project proposes a multi-parametric set of MRI tools for assaying human inherited neuropathies in vivo, with the longer-term goal of establishing biomarkers of disease progression for future clinical trials. Previous research shows magnetization transfer ratio (MTR) values, which assay myelin content changes from demyelination and axonal loss, relate to disability in neuropathy patients. Here, we proposed additional fat-water (Dixon) imaging to assay fat replacement following deinnervation. MTR/Dixon data were collected in the sciatic/tibial nerves in patients with primary dysmyelinating inherited neuropathies. Longitudinal results showed lower that MTR/Dixon were responsive to disease progression.

3739	Computer 67	Structural remodeling of the sciatic nerve differs between painful and painless diabetic polyneuropathy: an in vivo study using magnetic resonance neurography.
		Johann Malte Enno Jende[1], Jan B Groener[2], Stefan Kopf[2], Tim Hilgenfeld[1], Sabine Heiland[3], Mirko Pham[4], Peter Nawroth[2], Martin Bendszus[1], and Felix Tobias Kurz[1]
		[1]Neuroradiology, Heidelberg University Hospital, Heidelberg, Germany, [2]Endocrinology, Heidelberg University Hospital, Heidelberg, Germany, [3]Experimental Neuroradiology, Heidelberg University Hospital, Heidelberg, Germany, [4]Neuroradiology, Würzburg University Hospital, Würzburg, Germany

		Diabetic polyneuropathy (DN) is one of the most severe complications of diabetes. It is yet uncertain why patients either suffer from painful (PDN) or painless (NPDN) diabetic polyneuropathy. We prospectively performed magnetic resonance neurography of the sciatic nerve in 120 patients suffering from DN of varying severity and correlated the results with clinical symptoms and electrophysiological data. We found a higher load of lesions to the sciatic nerve in PDN compared to PDN (p<0.0001), extending over longer distances (p<0.0001). This indicates that proximal nerve damage is one of the main contributors to the development of PDN.

3740	Computer 68	Quantitative Susceptibility Mapping of post-mortem ALS brains at 7T
		Chaoyue Wang[1], Benjamin Tendler[1], Menuka Pallebage-Gamarallage[2], Olaf Ansorge[2], Ricarda AL Menke[1], Martin R Turner[2], Sean Foxley[3], and Karla L Miller[1]
		[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Clinical Neurology, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [3]Department of Radiology, University of Chicago, Chicago, IL, United States
		Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative disease of the motor system and its wider cortical connections. Progress in therapeutic development in ALS is compromised by a lack of specific biomarkers. In this work, we describe a platform for acquiring QSM data in post-mortem brains and propose a protocol for post-mortem QSM reconstruction. Preliminary results have shown that ALS brains had substantially greater mean susceptibility in motor cortex than control brains, which indicates that QSM has the potential to accurately quantify iron concentration and thus serve as an imaging biomarker for ALS.

3741	Computer 69	Diffusion Kurtosis Imaging of the Motor Cortex in Amyotrophic Lateral Sclerosis
		Thomas Welton[1], Fraser Callaghan[1], Jerome J Maller[2], Matthew Middione[3], R Marc Lebel[4], Ek T Tan[5], Dominic B Rowe[6], Ajit Shankar[3], and Stuart M Grieve[1,7]
		[1]Sydney Translational Imaging Laboratory, University of Sydney, Sydney, Australia, [2]GE Healthcare, Richmond, Australia, [3]GE Healthcare, Palo Alto, CA, United States, [4]GE Healthcare, Calgary, AB, Canada, [5]GE Global Research, Niskayuna, NY, United States, [6]MND Research Centre, Sydney, Australia, [7]Department of Radiology, Royal Prince Alfred Hospital, Sydney, Australia
		Amyotrophic lateral sclerosis (ALS) is characterised by degeneration of the motor neurons. Diffusion kurtosis imaging (DKI) may be a suitable biomarker for neuronal injury in ALS. We imaged 30 people with ALS and 63 controls with a 140-direction DKI protocol and explored group differences diffusion and kurtosis scalar values within the motor cortex. Our preliminary data show that significant microstructural changes are measurable by DKI in people with early ALS. DKI may represent a viable biomarker of early ALS progression.

3742	Computer 70	Initial Experience of Cerebral Quantitative Susceptibility Mapping in the HIV Neurocognitive Disorder Sara Marie Dupont[1], Yan Li[2], Ycheng Chen[2,3], Janine Lupo[2], Felicia Chow[4], and Jared Narvid[1] *[1]Department of Radiology and Biomedical Imaging, Zuckerberg San Francisco General Hospital, University of California San Francisco, San Francisco, CA, United States, [2]Surbeck Laboratory of Advanced Imaging, Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [3]Graduate program in BIoengineering, University of California Berkeley and University of California San Francisco, San Francisco, CA, United States, [4]Department of Neurology, Zuckerberg San Francisco General Hospital, University of California San Francisco, San Francisco, CA, United States* This study investigates the patterns of tissue susceptibility within brains of older HIV+ participants using quantitative susceptibility mapping (QSM) as marker of iron deposition in the brain. Four HIV+ participants and one healthy control were recruited, and QSM and T1w (for cortical parcellation) data were acquired on a 3T MRI scanner. Comparison of QSM values by brain region for each HIV+ participant with the control shows a pattern of increased susceptibility in frontal regions, especially in the frontal medial and subcallosal cortices. Although these results warrant further investigation in a larger cohort, this is the first study investigating changes in QSM in the HIV+ population.

3743	Computer 71	The Abnormal Cerebral Perfusion Profile in older adults with HIV-Associated Neurocognitive Disorder: Discriminative Power of Arterial Spin Labelling MRI Sara Marie Dupont[1], David McCoy[1], Andrew Callen[1], Duygu Tosun[1], Joanna Hellmuth[2], Victor Valcour[2,3], and Jared Narvid[1] *[1]Department of Radiology and Biomedical Imaging, Zuckerberg San Francisco General Hospital, University of California San Francisco, San Francisco, CA, United States, [2]Department of Neurology, University of California San Francisco, San Francisco, CA, United States, [3]Division of Geriatric Medicine, University of California San Francisco, San Francisco, CA, United States* This study aimed at evaluating the pattern of cerebral blood flow (CBF) abnormalities in older adults with HIV-associated neurocognitive disorder (HAND) compared to cognitively healthy controls. Pulsed ASL (for CBF quantification) and T1-weighted images (for registration to cortical parcellation atlas) were collected in a retrospective cohort of 19 HIV+ participants and 15 age and education matched controls. To investigate differences in CBF patterns between HIV+ and controls, CBF values were used to train generalized linear models (GLMnet) to predict patient diagnosis. Older HIV+ exhibited lower CBF values in the temporal and occipital lobes compared to controls suggesting a specific pattern of CBF in individuals aging with HAND.

3744	Computer 72	Structural connectivity alterations in amyotrophic lateral sclerosis are modulated by the topology of the anatomical brain connectome

Silvia Basaia[1], Federica Agosta[1], Nilo Riva[2], Edoardo G. Spinelli[1], Yuri Falzone[2], Adriano Chiò[3], Andrea Falini[4], Giancarlo Comi[2], and Massimo Filippi[1,2]

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In this study, we used graph theory and connectomics to test whether the spatial patterning of structural brain alterations in amyotrophic lateral sclerosis (ALS) is modulated by the topology of the anatomical brain network. In the healthy subject connectome, brain regions of subsequent stages of ALS pathology are shown to be more closely interconnected (shorter topological distance) with the primary motor cortex (ALS epicenter) than regions of more distant stages. Altered structural connectivity was greater between closely connected regions. Axonal connections may influence the spatial spreading of pathology in ALS.

Electronic Poster

Alzheimer's Disease & Other Dementias

Exhibition Hall	Monday 17:15 - 18:15

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3745 Computer 73

Evaluation of the Full Z Spectrum Obtained from Demented Patients

Geon-Ho Jahng[1], Bo Guem Choi[2], Hak Young Rhee[3], Chang-Woo Ryu[1], Dal Mo Yang[1], and Wook Jin [1]

[1]Radiology, Kyung Hee Univ. Hospital at Gangdong, Seoul, Republic of Korea, [2]Biomedical Engineering, Kyung Hee University, Suwon, Republic of Korea, [3]Neurology, Kyung Hee Univ. Hospital at Gangdong, Seoul, Republic of Korea

To evaluate the characteristics of chemical exchange proton pools using a CEST MRI technique in dementia patients, 19 demented and 22 non-demented subjects were scanned a full Z spectrum data using a 3D GRASE sequence. The 6 pool maps with the Lorentzian fitting and MTR asymmetry map pool were calculated and compared between the two groups. The amide, amine, hydroxyl, DWS, NOE, MT, and MTR asymmetry values at 1 ppm, 3ppm, and 3.5 ppm were higher in the demented group than in the non-demented group.

3746 Computer 74

MRI based assessment of cerebrovascular pathology in Alzheimer's disease

		Ying Xia[1], Nawaf Yassi[2,3], Pierrick Bourgeat[1], Parnesh Raniga[1], Patricia Desmond[4], Jurgen Fripp[1], David Ames[5,6], Paul Maruff[3,7], Chris Fowler[3], Ralph Martins[8], Victor Villemagne[9,10], Collin Masters[3], Christopher Rowe[9,10], and Olivier Salvado[1]
		[1]The Australian e-Health Research Centre, CSIRO Health and Biosecurity, Brisbane, Australia, [2]Departments of Medicine and Neurology, The Royal Melbourne Hospital, Parkville, Australia, [3]Florey Institute of Neuroscience and Mental Health Research, Parkville, Australia, [4]Department of Radiology, The Royal Melbourne Hospital, University of Melbourne, Parkville, Australia, [5]National Ageing Research Institute, Melbourne, Australia, [6]Academic Unit for Psychiatry of Old Age, University of Melbourne, Melbourne, Australia, [7]Cogstate, Melbourne, Australia, [8]Centre of Excellence for Alzheimer's Disease Research and Care, Edith Cowan University, Joondalup, Australia, [9]Department of Medicine, Austin Health, University of Melbourne, Heidelberg, Australia, [10]Department of Nuclear Medicine and Centre for PET, Austin Health, Heidelberg, Australia
		Cerebrovascular disease often coexists with Alzheimer's disease (AD) and its contribution to the development of AD remains unclear. This study assessed cerebrovascular pathology in terms of brain infarction and white matter hyperintensities (WMH) in the AIBL study, and investigated its impact on amyloid deposition. Our data revealed significantly greater WMH burden and higher prevalence of cerebrovascular pathology in AD patients. No correlation was found between amyloid load and WMH in either healthy controls, mild cognitive impairment or AD. Moreover, the presence of cerebrovascular pathology showed no association with amyloid deposition in subjects with or without AD.

3747	Computer 75	Assessment of different molecular iron forms in the brain tissue of Alzheimer patients
		Lucia Bossoni[1,2], Marjolein Bulk[1], Wico H. Breimer[2], Andrew G. Webb[1], Jelle Goeman[3], Martina Huber[2], Tjerk H. Oosterkamp[2], and Louise van der Weerd[1,4]
		[1]Radiology Dept., Leiden University Medical Center, Leiden, Netherlands, [2]Leiden Institute of Physics, Leiden, Netherlands, [3]Biostatistics Dept., Leiden University Medical Center, Leiden, Netherlands, [4]Human Genetics Dept., Leiden University Medical Center, Leiden, Netherlands
		Magnetic Resonance Imaging (MRI) has the potential to measure iron accumulation in the brain of Alzheimer patients. However, current MRI techniques cannot differentiate between different molecular iron forms. We have recently developed a combination of MRI, EPR and SQUID magnetometry, to quantify specific molecular iron forms in brain tissue. In this current study of AD patients and controls we found significant differences in R_2^*, ferritin concentration, and magnetic moment of magnetite nanoparticles between patients (N=22) and controls (N=14). Additionally, we identified correlations between some iron forms.

3748	Computer 76	Oxygen extraction fraction is differentially affected in aging and Alzheimer's disease: cross-sectional and longitudinal investigations in mice at 11.7T
		Zhiliang Wei[1,2], Lin Chen[1,2,3], Zixuan Lin[4], Jiadi Xu[1,2], Siyuan Cheng[5], Zheyu Wang[5], Peter van Zijl[1,2], and Hanzhang Lu[1,2,4]

		[1]Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Research Institute, Baltimore, MD, United States, [3]Department of Electronic Science, Xiamen University, Baltimore, MD, United States, [4]Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States, [5]Division of Biostatistics & Bioinformatics, Johns Hopkins University, Baltimore, MD, United States
		Quantification of oxygen extraction fraction (OEF) is traditionally challenging and often requires the use of radiotracers or other invasive procedures, but has become feasible with recent advances in MR oximetry techniques. Here, we investigated the OEF in aging and Alzheimer's disease (AD) with the T2-Relaxation-Under-Spin-Tagging (TRUST) technique. Based on the cross-sectional and longitudinal investigations, we demonstrated that normal aging and AD have different effects on brain OEF, which may reflect the dynamic nature of changes in brain energy homeostasis during these two processes. TRUST MRI may be a useful tool in elucidating physiological mechanisms of brain diseases in mouse models.

3749	Computer 77	The estimation of diagnostic accuracy of FDG-PET/MR imaging for Alzheimer's disease— simulation study using ADNI-data
		Tetsuro Sekine[1], Alfred Buck[2], Gaspar Delso[3], Edwin ter Voert[2], Martin W Huellner[2], Patrick Veit-Haibach[4], and Geoffrey Warnock[2]
		[1]Nippon Medical School, Tokyo, Japan, [2]University Hospital Zurich, Zurich, Switzerland, [3]GE Healthcare, Waukesha, WI, United States, [4]University of Toronto, Toronto, ON, Canada
		The purpose of this study was to estimate the impact of commercial MRAC on the evaluation of dementia, especially in Alzheimer's disease (AD). We combined ADNI-data and patients data. We multiplied 14 error map derived from commercial Atlas-based MRAC method and each 203 ADNI data after the same nomalization and smoothing. To clarify the statement of prediction of AD, PET score was calculated by using PALZ. The accuracy, sensitivity and specificity for the discrimination of AD-patients from the normal control was not so impaired by MR-AC (Original vs. Error; 83.2%, 83.3% and 83.1% vs. 81.3% [range 77.6-83.2], 82.6% [range 79.2-85.4%,] and 80.3% [range71.2-86.4%]).

3750	Computer 78	In-vivo mapping of monoaminergic network disruption in Alzheimer's disease: implications for neuropsychiatric symptoms
		Laura Serra[1], Marcello D'Amelio[2], Carlotta Di Domenico[1], Camillo Marra[3], Nicola Biagio Mercuri[4], Carlo Caltagirone[5], Mara Cercignani[1,6], and Marco Bozzali[1,6]

		[1]Neuroimaging Laboratory, Santa Lucia Foundation IRCCS, Rome, Italy, [2]Laboratory Molecular Neurosciences, Santa Lucia Foundation IRCSS, Rome, Italy, [3]Institute of Neurology, Catholic University, Rome, Italy, [4]Laboratory of Experimental Neurology, Santa Lucia Foundation IRCCS, Rome, Italy, [5]Department of Clinical and Behavioural Neurology, Santa Lucia Foundation IRCCS, Rome, Italy, [6]Department of Neuroscience, Brighton & Sussex Medical School, Brighton, United Kingdom
		Some recent animal models and neuropathological evidence highlighted the loss of noradrenergic neurons in the locus coeruleus and dopaminergic neurons in the ventral tegmental area (VTA) as important pathophysiological events in Alzheimer's disease. Here we use resting-state functional MRI to show reductions in VTA connectivity in patients with Alzheimer's disease and mild cognitive impairment, which are more prominent in patients with neuropsychiatric symptoms.

3751	Computer 79	Loss of Intra- and Inter-Network Resting State Functional Connectivity in Patients with Mild and Moderate Alzheimer’s Disease
		Yiqiu Liu[1], Man Sun[2], Yuanyuan Chen[3], Xiuwei Fu[1], Tianyi Qian[4], and Hongyan Ni[5]
		[1]Department of Radiology, First Central College,Tianjin medical university, Tianjin, China, [2]Department of Radiology, Tianjin Hospital, Tianjin, China, [3]Academy of Medical Engineering and Translational Medicine, Tianjin University, Tianjin, China, [4]MR Collaboration NEA, Siemens Healthcare, Beijing, China, [5]Department of Radiology, Tianjin first center hospital, Tianjin, China
		This study aimed to investigate the differences in the alteration of the entire brain network functional connectivity of mild and moderate AD patients based on fMRI, taking the cerebellum network into consideration. There have seldom been reports regarding the cerebellum and cerebral connectivity alteration during the progression of clinical AD. Moreover, the cerebellum network functional connectivity is significantly changed in moderate AD, and we further suspected that the cerebellum network is a pivotal one in the progression to the moderate AD stage.

3752	Computer 80	Apolipoprotein E e4 allele is associated with higher structural brain changes in patients with mild cognitive impairment
		Sheema Hashem[1], Santosh K Yadav[1], Asma Al-Sulaiti[1], Ajaz A Bhat[1], Tooba Ahmed[2], Deepak Kaura[3], Ari Borthakur[4], and Mohammad Haris [1]
		[1]Division of Translational Medicine,Research Branch, Sidra Medicine, Doha, Qatar, [2]American School, Doha, Qatar, [3]Diagnostic Imaging, Sidra Medicine, Doha, Qatar, [4]Center for Magnetic Resonance and Optical Imaging, Radiology, University of Pennsylvania, Philadelphia, PA, United States

		The aim of this study was to measure the difference in cortical thickness, subcortical volume and CSF biomarkers between MCI patients who carry or lack ApoE ε4 allele. High-resolution T1-weighted images were used for the measurement of cortical thickness and subcortical volume using FreeSurfer. MCI patients who carry ApoE ε4 showed significant reduction in cortical thickness and subcortical volume in multiple brain regions than non-carriers. This suggests that having an ApoE ε4 allele could be a risk factor for the larger tissue damage in the brain of MCI, and these patients may have higher chance of developing Alzheimer’s or other dementia.

3753	Computer 81	White matter free water content at different stages of Alzheimer’s disease
		Matthieu Dumont[1], Koene R. A. Van Dijk[2], Felix C. Morency[1], Jean-Christophe Houde[1,3], Pierre-Marc Jodoin[1,4], Zhiyong Xie[2], Cici Bauer[5], Tarek A. Samad[6], Maxime Descoteaux[1,3], and James A. Goodman[2]
		[1]Imeka Solutions, Inc, Sherbrooke, QC, Canada, [2]Clinical & Translational Imaging, Pfizer, Inc, Cambridge, MA, United States, [3]Sherbrooke Connectivity Imaging Laboratory (SCIL), University of Sherbrooke, Sherbrooke, QC, Canada, [4]Computer Science, University of Sherbrooke, Sherbrooke, QC, Canada, [5]ECD Non-Clinical Statistics, Pfizer, Inc, Cambridge, MA, United States, [6]Internal Medicine Research Unit, Pfizer, Inc, Cambridge, MA, United States
		Recent evidence shows that neuroinflammation plays a role in many neurological diseases including Alzheimer’s disease (AD), and that free water (FW) diffusion imaging can be sensitive to this phenomenon. We processed MRI data from the ADNIGO and ADNI2 databases with a state-of-the-art processing pipeline that uses T1 weighted (T1w), diffusion weighted (DW), and fluid-attenuated inversion recovery (FLAIR) scans to extract FW fractional volume in normal appearing white matter. We call this metric relative FW volume (rFW volume). We demonstrate for the first time that rFW volume in white matter is higher for subjects with greater cognitive impairments.

3754	Computer 82	Semiautomatic Quantification of Cortical Amyloid with 18F-florbetaben PET/MRI in Alzheimer's disease and Other Neurodegenerative Disorders
		JeeYoung Kim[1,2], Audrey P. Fan[2], Fabiola Bezerra de Carvlho Macruz[2], Jia Guo[2], Athanasia Boumis[3], Michael Greicius[3], Sharon Sha[3], Minal Vasanawala[2], Michael Moseley[2], Michael Zeineh[2], and Greg Zaharchuk[2]
		[1]Radiology, Yeouido St. Mary's Hospital, The Catholic University of Korea, Seoul, Republic of Korea, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Neurology and Neurological Sciences, Stanford University, Stanford, CA, United States

		Amyloid PET is a useful quantitative biomaker in patients with dementia. We compared cortical amyloid deposition in Alzheimer's disease (AD), Parkinson's disease (PD), mild cognitive impairment (MCI) and cognitively normal elderly subjects and correlated it with cortical CBF and volume using simultaneous 18F-florbetaben PET/MRI. Total cortical SUV is significantly higher in AD than PD and MCI. Precuneus, superior temporal, and calcarine cortices were identified as significant regions on amyloid PET to discriminate between AD and other neurodegenerative diseases.

3755	Computer 83	Fixel-based fiber-specific analysis of white matter lesions in Binswanger disease
		Rajikha Raja[1], Josef Ling[1], Gary Rosenberg[2], and Arvind Caprihan[1]
		[1]The Mind Research Network, Albuquerque, NM, United States, [2]Department of Neurology, University of New Mexico Health Sciences Center, Albuquerque, NM, United States
		Binswanger's disease (BD) is a form of vascular dementia which is prevalent in older population. BD is characterized by the presence of white matter lesions due to injured small vessels in the brain. Magnetic resonance imaging findings related to BD reported large white matter lesions in FLAIR and high blood-brain barrier permeability in dynamic contrast enhanced MRI. Changes in water diffusion in white matter lesions and axonal damage were reported using diffusion tensor imaging metrics. While all the studies focused on exploring the voxel level measures as BD markers, we aimed to quantify the WM integrity through measures estimated for fibers within a voxel. In this study, we apply fixel-based analysis (FBA) to multi-shell diffusion data to evaluate the fiber specific measures such as fiber density (FD) and fiber cross-section (FC) in regions of white matter lesions in BD subjects and compared the measures with healthy controls. Reduced FD and FDC are revealed in areas of white matter lesions in BD subjects as compared to those in control group.

3756	Computer 84	Non-Invasive Imaging of Brain Clearance Pathways using Multiple Echo Time ASL: An Aquaporin-4 Study
		Yolanda Ohene[1], Ian F Harrison [1], Payam Nahavandi [1], Ozama Ismail [1], Ole P Ottersen [2], Erlend A Nagelhus[3], David L Thomas [4,5], Mark F Lythgoe [1], and Jack A Wells [1]
		[1]UCL Centre for Advanced Biomedical Imaging, Division of Medicine, University College London, London, United Kingdom, [2]Karolinska Institutet, Stockholm, Sweden, [3]University of Oslo, Oslo, Norway, [4]Neuroradiological Academic Unit, UCL Institute of Neurology, University College London, London, United Kingdom, [5]Leonard Wolfson Experimental Neurology Centre, UCL Institute of Neurology, University College London, London, United Kingdom

		We have developed the first non-invasive technique that is able to detect changes in brain AQP4-mediated clearance pathways. Our multi-TE ASL technique measures the exchange of vascular water into cortical brain tissue of mouse brain. We report a significant increase in the cortical exchange time between WT (377 ± 89ms) and AQP4-deficient (536 ± 92ms) mice. While measured CBF, ADC and δ_a did not detect differences, suggesting preserved haemodynamic and energetics between groups. This highlights the novelty of the technique being targeted method to assess water transport in brain clearance pathways, to help better understand neurodegenerative diseases.

3757	Computer 85	What reference for reference ranges? How scanner and subject data heterogeneity impact MR hippocampal volumetry statistics in Alzheimer's Disease
		Jonas Richiardi[1,2], Bénédicte Maréchal[1,2,3], Alexis Roche[4], Reto Meuli[1], and Tobias Kober[1,2,3]
		[1]Department of Radiology, CHUV, Lausanne, Switzerland, [2]Advanced Clinical Imaging Technology, Siemens Healthineers, Lausanne, Switzerland, [3]LTS5, EPFL, Lausanne, Switzerland, [4]CoVii Ltd, Porto, Portugal
		The volume of specific brain structures is of clinical interest in many brain diseases. By using a volumetric reference range for healthy subjects, radiologists can contribute to refining diagnosis. However, both scanner and subject characteristics impact the construction and use of these reference ranges. Using a diverse dataset with 80 MRI scanners and 302 subjects, we show Alzheimer's disease detection from hippocampal volume is robust to mismatch between training (development) and testing (deployment) environments despite showing some influence, but that estimates of atrophy rates can vary considerably depending on the training set used. Radiologists should interpret volumetry statistical results accordingly.

3758	Computer 86	Automatic classification of patients with Alzheimer's disease (AD) and mild cognitive impairment (MCI) who will convert to AD using deep neural networks
		Federica Agosta[1], Silvia Basaia[1], Luca Wagner[2], Giuseppe Magnani[3], and Massimo Filippi[1,3]
		[1]Neuroimaging Research Unit, INSPE, Division of Neuroscience, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy, [2]Effeventi, Milan, Italy, [3]Department of Neurology, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy
		We built and validated a deep learning algorithm that predicts the individual diagnosis of Alzheimer's disease (AD) and the development of AD in mild cognitive impairment (MCI) patients based on a single cross-sectional brain structural MRI scan. The deep neural network (DNN) procedure discriminated AD and heathy controls with an accuracy up to 98%, and MCI converters and MCI stable with an accuracy up to 75%. DNNs provide a powerful tool for the automatic classification of AD and MCI prognosis.

3759	Computer 87	Quasi-Periodic patterns contribute to rsfMRI functional connectivity in a mouse model of Alzheimer's disease Michaël Eddy F Belloy[1], Disha Shah[1], Behnaz Yousefi[2], Anzar Abbas[2], Amrit Kayshap[3], Annemie van Der Linden[1], Georgios A. Keliris[1], Shella Keilholz[2], and Marleen Verhoye[1] *[1]University of Antwerp, Antwerpen, Belgium, [2]Emory university, Atlanta, GA, United States, [3]Emory University, Georgia, GA, United States* We show the detection of Quasi-Periodic patterns (QPPs) in a mouse model of Alzheimer's disease and illustrate that QPP detection was altered between wild-type and transgenic animals. We show that QPPs contributed to BOLD functional connectivity (FC) within groups and to FC differences between groups. Regression of QPPs diminished FC in co-active regions within the QPP, while anti-correlated regions became correlated. Regression of similar QPPs in wild-type and transgenic animals altered between-group FC differences by 30-50%. These findings shed light on how QPPs contribute to FC and are promising for the application of QPPs as a new pre-clinical tool.

3760	Computer 88	Evaluate the Methanol-induced Alzheimer's Disease Monkey Model by Resting-state Functional MRI Yin-Chieh Liu[1], Chaoyang Tian[2], Ssu-Ju Li[1], Xudong Zhao[3], Ting-Chun Lin[1], Jianjun Li[4], Ching-Wen Chang[1], Kaimin Wang[2], Yingshan Yang[2], Yu-Chun Lo[5], YuanYe Ma[2], You-Yin Chen*[1], Feng Chen*[4], and Hsin-Yi Lai*[6] *[1]Department of Biomedical Engineering, National Yang Ming University, Taipei City, Taiwan, [2]Department of Research and Development, Hainan Jingang Biotech Co.,Ltd, Haikou, China, [3]Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [4]Department of Radiology, Hainan General Hospital, Haikou, Haikou, China, [5]The PhD Program for Neural Regenerative Medicine, Taipei Medical University, Taipei City, Taiwan, [6]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou City, China* Alzheimer's disease (AD) is the most comment neurodegenerative disorder that results in the irreversible loss of neurons, especially in the cortex and hippocampus. The aim of this study is to evaluate the changes of brain functional connectivity in methanol-induced AD monkey. To find the corresponding response areas of AD, five brain regions defined by independent component analysis (ICA) were analyzed using seed-based correlation analysis (SCA). Results of resting-sate fMRI showed that the AD Monkey presented abnormal functional connectivity in anterior cingulate cortex (ACC), primary visual cortex (V1) and ventrolateral prefrontal cortex (VLPFC), those were also shown in AD patient.

3761	Computer 89	Assessment of cerebrovascular alterations in Alzheimer's disease with simultaneous multislice Look-Locker arterial spin labeling Tae Kim[1], Oscar L Lopez[2], and James T Becker[3]

		[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States, [2]Neurology, University of Pittsburgh, Pittsburgh, PA, United States, [3]Psychiatry, University of Pittsburgh, Pittsburgh, PA, United States
		The ASL dynamics, the transit time to arterial and capillary, CBVa and CBF, were measured in control and mild cognitive impairment subjects to access cerebrovascular alteration in AD progression. The MCI subjects had prolonged transit time, lower CBVa and CBF in comparison to control subjects. Detailed aseesements of cerebrovascular alterations can provide better characterization of AD pathophysiology.

3762	Computer 90	Bilateral salpingo-oophorectomy prior to natural menopause is associated with Alzheimer’s disease-like reductions in gray and white matter
		Suzanne T Witt[1], Åsa Rydmark Kersley[2], Elisabet Classon[3], Nina Lykke[4], Magrit Shildrick[4], Cecilia Åsberg[4], Cheryl Grady[5], Elvar Theordorsson[6], Jan Ernerudh[6], Elisabeth Åvall Lundqvist[6], Preben Kjølhede[2,6], and Gillian Einstein[5,6]
		[1]CMIV, Linköping University, Linköping, Sweden, [2]Womens' Clinic, University Hospital Linköping, Linköping, Sweden, [3]Dept. of Acute Internal Medicine and Geriatrics, Linköping University, Linköping, Sweden, [4]Unit of Gender Studies, Linköping University, Linköping, Sweden, [5]University of Toronto, Toronto, ON, Canada, [6]Dept. of Clinical and Experimental Medicine, Linköping University, Linköping, Sweden
		Women with Breast Cancer Gene mutations (BRCAm) are recommended to undergo prophylactic bilateral salpingo-oophorectomy prior to natural menopause (PNM-BSO) in order to reduce the risk of ovarian cancer. This surgery is associated with an increased risk of developing Alzheimer's disease (AD). In comparison with healthy women, BRCAm women who had undergone PNM-BSO exhibited decreased gray matter volume across frontal and medial-temporal regions, as measured using the quantitative QRAPMASTER sequence. These regions included many previously linked with AD including, parahippocampal gyrus, cingulate cortex, and inferior temporal gyrus. White matter reductions were only observed in a limited number of superior longitudinal tracts.

3763	Computer 91	Deep Learning-based MRI Image Analysis for the Prediction of Conversion from Mild Cognitive Impairment to Alzheimer's Disease
		Weiming Lin[1,2], Min Du[1], Di Guo[3], Xiaofeng Du[3], Yonggui Yang[4], Gang Guo[4], and Xiaobo Qu[5]
		[1]College of Physics and Information Engineering, Fuzhou University, Fuzhou, China, [2]School of Opto-Electronic and Communication Engineering, Xiamen University of Technology, Xiamen, China, [3]School of Computer and Information Engineering, Xiamen University of Technology, Xiamen, China, [4]Department of Radiology, Xiamen 2nd Hospital, Xiamen, Xiamen, China, [5]Department of Electronic Science, Xiamen University, Xiamen, China

		Accurate prediction of the conversion from mild cognitive impairment (MCI) to Alzheimer's disease (AD) is critically important to slow down the progression to AD with early clinical trials. In this work, this prediction for 3 years is conducted on MRI images shared in Alzheimer's Disease Neuroimaging Initiative (ADNI) dataset. Two powerful image analysis tools, including convolutional neural networks in deep learning and FreeSurfer in brain MRI analysis, are introduced to learn image features which are used for further classification. Cross validation results demonstrate that the proposed approach achieves more accurate and robust prediction comparing with the state-of-the-art grading biomarker method.

3764	Computer 92	Correlation between Apparent Diffusion Coefficient at Ultrahigh b-values and cognitive impairment: a pilot study in early stage Alzheimer's disease
		Qiong Ye[1], Zhenhua Zhang[1], Caiyun Wen[1], Zhao Zhang[1], and Jiance Li[1]
		[1]The First Affiliated Hospital of Wenzhou Medical University, Wenzhou, China
		Non-Gaussian diffusion showed the potential to advance the understanding of microstructure alternation in Alzheimer's disease (AD). Apparent Diffusion Coefficient at Ultrahigh b-values (ADC_uh) demonstrated improved sensitivity to white matter degeneration in AD. In this study we compared the quantitative change of diffusion characteristics including conventional ADC, Diffusion Kurtosis Imaging (DKI), and ADC_uh. Moreover the correlation between diffusion characteristic and cognitive impairment was investigated. The results of this pilot study showed a close link between ADC_uh in left thalamus and cognitive impairment in AD patients. But further study with larger sample size is required to draw a clear conclusion.

3765	Computer 93	The Application of NODDI in Characterizing Brain Microstructural Changes in Type 2 Diabetes with Cognitive Impairment
		Ying Xiong[1], Qiang Zhang[2], Yang Fan[3], and Wenzhen Zhu[1]
		[1]Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [2]Neurology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [3]GE Healthcare, Beijing, China
		This study aims to investigate brain microstructural changes in white-matter and gray-matter of type 2 diabetes mellitus(T2DM) patients using the NODDI model. Thirty-three T2DM patients were divided into two sub-groups (impaired and normal cognition), together with ten healthy controls, were imaged at a 3T scanner. It was found that the T2DM patients with cognitive impairment had a lower ICVF value compared to healthy controls in WM regions and the thalamus. Decreased ICVF values in the genu of corpus callosum were correlated with HbA1c level. The NODDI model shows potential feasibility in characterizing brain microstructural alterations for patients with T2DM.

3766	Computer 95	Subregional structural alterations in deep gray matter structures in alcohol-dependent patients Hyeon-Man Baek[1], Young-Tae Kim[1], and Jae-Hyuk Shim[1] *[1]Department of Molecular Medicine, Lee Gil Ya Cancer & Diabetes Institute, Incheon, Korea, Democratic People's Republic of* The aim of this study was to investigate whether the volumes of subcortical gray matter structures in alcohol-dependent patients (ADP) are different, and to localize the surface morphometric changes of these subcortical structures. Compared with healthy controls (HC), we found that the bilateral Accu, Hipp, Puta, and Thal showed significant atrophy in ADP. We also revealed that vertex analysis directly can measure localized changes in brain structures that showed significant volumetric change. It might have potential to precisely detect regional alterations of the subcortical gray matter structures.

3767	Computer 96	Brain Structural Connectome Accurately Classifies Alzheimer's Disease Related Dementia Jiook Cha[1], Yun Wang[1], Allen Liu[2,3], Jonathan Posner[1], Jong-Hun Kim[4], Shinjae Yoo[3], and Hyoung-Seop Kim[4] *[1]Department of Psychiatry, Columbia University, New York, NY, United States, [2]Computational Science Initiative, Brookhaven National Laboratory, Upton, NY, United States, [3]Brookhaven National Laboratory, Upton, NY, United States, [4]National Health Insurance Service Ilsan Hospital, Ilsan, Republic of Korea* There is an urgent, unmet need for biomarkers of risk for Alzheimer's disease related dementia (ADRD) suitable for routine examination in naïve patients. Studies suggest MRI-derived brain connectome may contain salient information about brain health status. However, it has yet to be tested in sufficiently large samples whether connectome can be used to predict reliably diagnosis of ADRD. Here we performed high-throughput computational analysis using structure and diffusion MRI in a clinical cohort (N=211) to estimate morphometry and connectome. Our results show potential utility of data-driven machine learning models using large-scale MRI-derived brain phenotypes in classifying ADRD, particularly structural connectome.

Electronic Poster

Neuroimaging: Clinical Studies

Exhibition Hall	Monday 17:15 - 18:15

3768	Computer 97	MR Spectroscopy Biomarker Discovery Algorithms (MBDA) to Discriminate PTSD from Blast Exposure and Healthy Controls

		Nathan Tosh[1,2], Laura Mariano[3], Scott Quadrelli[4], Graham Galloway[1,2], Valerie Graves[1], Aaron Urquhart[1], Peter Malycha[1,2], Katie Trickey[1], Lisa Rich[1], Rosanna Tremewan[1], John Irvine[3], and Carolyn Mountford[1]
		[1]Translational Research Institute, Brisbane, Australia, [2]Queensland University of Technology, Brisbane, Australia, [3]Draper, Boston, MA, United States, [4]University of Newcastle, Newcastle, Australia
		Single Voxel Point RESolved Spectroscopy (PRESS) was used to obtain neuro-metabolite and lipid levels from the Posterior Cingulate Gyrus (PCG) of 4 cohorts – Control, Civilian PTSD, Artillery and Close Combat soldiers. Using a wavelet based statistical analysis approach classifiers were developed to objectively diagnose and monitor neuro-deregulation associated with PTSD and blast injury to artillery and to close combat soldiers.

3769	Computer 98	ADHD and stimulant medication disrupt the temporal lag structure within default mode and salience networks
		Charlotte Clarke[1], Arjun Sethi[1,2], Mara Cercignani[1], and Neil Harrison[1]
		[1]Department of Neuroscience, Brighton and Sussex Medical School, Falmer, United Kingdom, [2]Clinical, Edu & Hlth Psychology, University College London, London, United Kingdom
		Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that has been associated with reduced Default Mode (DMN) (precuneus) and salience network (Anterior Cingulate) activity in conventional resting-state fMRI studies (rs-fMRI). However, these studies ignore the significant temporal structure in these data. Thirty ADHD patients and 30 matched controls underwent rs-fMRI on two occasions, 90-minutes after blindly administered stimulant medication and placebo. Using a novel ‘lag-thread’ analysis we demonstrate faster recruitment of the precuneus in ADHD which additionally correlated with severity of inattention. Stimulants slowed ACC recruitment, together suggesting potential importance of temporal activation of these regions in ADHD.

3770	Computer 99	BMI correlates with tissue stiffness in deep gray matter regions controlling eating behavior
		Stefan Hetzer[1,2], Martin Weygandt[1,3], Sebastian Hirsch[1,2], Jürgen Braun[4], and Ingolf Sack[5]
		[1]Berlin Center for Advanced Neuroimaging, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Bernstein Center for Computational Neuroscience, Berlin, Germany, [3]Cluster of Excellence NeuroCure Clinical Research Center, Charité - Universitätsmedizin Berlin, Berlin, Germany, [4]Institute of Medical Informatics, Charité - Universitätsmedizin Berlin, Berlin, Germany, [5]Institute of Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany

		Cerebral MR elastography was applied to a group of healthy male subjects in the normal weight range up to overweight to explore a potential relationship between the in vivo mechanical properties of brain tissue and body-mass index (BMI). We observed a highly significant negative correlation between tissue stiffness and BMI in the globus pallidus and putamen – two regions identified in the literature as being linked to eating behaviour – while the stiffness of other brain regions did not correlate with BMI. This is the first report on in vivo mechanical properties of brain tissue related to BMI.

3771	Computer 100	Fluid and White Matter Suppression sequence for detecting epileptogenic zones of focal cortical dysplasia
		Xin Chen[1], Tianyi Qian[2], Tobias Kober[3,4,5], Nan Chen[1], and Kuncheng Li[1]
		[1]Radiology, Xuanwu Hospital, Capital Medical University, Beijing, China, [2]MR Collaborations NE Asia, Siemens Healthcare, Beijing, China, [3]Advanced Clinical Imaging Technology (HC CMEA SUI DI PI), Siemens Healthcare AG, Lausanne, Switzerland, [4]Radiology, University Hospital (CHUV), Lausanne, Switzerland, [5]LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
		The aim of this study was to evaluate a novel sequence, called the fluid and white matter suppression (FLAWS) sequence, for detecting focal cortical dysplasia (FCD) lesions. FLAWS provides two sets of 3D contrast images from one acquisition and subsequently calculates another set of images that can suppress the signal from both the cerebral spinal fluid and white matter. The detection rate of the FCD lesions on FLAWS was higher than on the conventional 2D MR scan and 3D fluid-attenuated inversion recovery scan. Additionally, the transmantle sign, which is widely believed to be specific for FCD type II, could also be observed in FCD type I on the FLAWS images.

3772	Computer 101	Cortical Cerebral Blood Flow in Aging: Effects of Haematocrit, Sex and Ethnicity.
		Lorna A. Smith[1], Andrew Melbourne[2], David Owen[2], M. Jorge Cardoso[2], Carole H. Sudre[2], Therese Tillin[1], Magdalena Sokolska[3], David Atkinson[4], Nish Chaturvedi[1], Sebastien Ourselin[2], Alun D. Hughes[1], Frederik Barkhof[5,6,7], and H. R. Jager[8]
		[1]Dept. of Population Science and Experimental Medicine, Institute of Cardiovascular Sciences, University College London, London, United Kingdom, [2]Translational Imaging Group, Dept. of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [3]Dept. of Medical Physics and Biomedical Engineering, University College Hospital, London, United Kingdom, [4]Centre for Medical Imaging, University College London, London, United Kingdom, [5]Inst. of Neurology, University College London, London, United Kingdom, [6]Inst. of Healthcare Engineering, University College London, London, United Kingdom, [7]Dept. of Radiology and Nuclear Medicine, VU University Medical Centre, Amsterdam, Netherlands, [8]Neuroradiological Academic Unit, Dept. of Brain Repair and Rehabilitation, University College London, London, United Kingdom

		Cerebral blood flow (CBF) estimates using arterial spin labelling (ASL) show unexplained variability in older populations. We studied the impact of haematocrit (Hct) on CBF quantification in a tri-ethnic elderly population cohort. Hct was measured from blood samples and pseudo-continuous ASL performed on 3T MR. CBF was estimated using a fixed value of 43.5% (model 1) and individually measured Hct (model 2) to calculate the longitudinal relaxation time of blood in simplified Buxton equations. CBF estimates using individual Hct were lower than CBF estimates using a mean Hct in all ethnic and sex categories except white European men.

3773	Computer 102	Predictive value of QSM for hippocampal atrophy in pre-clinical Alzheimer's disease
		Amir Fazlollahi[1,2], Scott Ayton[3], Ibrahima Diouf [1,3], Pierrick Bourgeat[1], Vincent Dore[1,4], Parnesh Raniga[1,2], Jurgen Fripp[1], Patricia Desmond[5], David Ames[6,7], Paul Maruff [3,8], Ralph Martins [9], Chris Fowler[3], Roger Ordidge[10], Colin Masters[2,3], Christopher Rowe[3,4], Victor Villemagne[3,4], Ashley Bush[2,3], Olivier Salvado[1,2], and on behalf of the Australian Imaging Biomarkers and Lifestyle (AIBL) Research Group[11]
		[1]CSIRO Health and Biosecurity, Australian E-Health Research Centre, Brisbane, Australia, Brisbane, Australia, [2]Cooperative Research Centre for Mental Health, Parkville, Australia, Melbourne, Australia, [3]Melbourne Dementia Research Centre, Florey Institute of Neuroscience and Mental Health, The University of Melbourne, Parkville, Australia, Melbourne, Australia, [4]Austin Health, Heidelberg, Australia, Melbourne, Australia, [5]Department of Medicine and Radiology, Royal Melbourne Hospital, University of Melbourne, Parkville, Australia, Melbourne, Australia, [6]Academic Unit for Psychiatry of Old Age, University of Melbourne, Melbourne, Australia, Melbourne, Australia, [7]National Ageing Research Institute, Melbourne, Australia, [8]Cogstate, Melbourne, Australia, Melbourne, Australia, [9]Centre of Excellence for Alzheimer's Disease Research and Care, Edith Cowan University, Joondalup, Australia, Melbourne, Australia, [10]Department of Anatomy and Neuroscience, The University of Melbourne, Parkville, Australia, Melbourne, Australia, [11]https://aibl.csiro.au, Melbourne, Australia
		One-third of cognitively normal people over the age of 65 exhibit β-amyloid plaques, a defining pathology of Alzheimer's disease. The hippocampus also undergoes early and pronounced neurodegeneration in Alzheimer's disease, which underlies the memory impairment. Cognitively normal people with high β-amyloid pathology are at risk of hippocampal neurodegeneration, but the rate of decline is variable between subjects. Here, we investigate whether the iron load of the hippocampus can be used to stratify risk for future hippocampal atrophy in cognitively normal people with and without β-amyloid. We applied Quantitative Susceptibility Mapping (QSM), a relatively new MRI modality that is sensitive to tissue iron levels, to 70 cognitively normal people who also had a PET scan for β-amyloid, and were monitored for brain volume changes in MRI scans performed every 1.5 years for up to 7.5 years. We found that QSM of the hippocampus was strongly predictive of future atrophy of this region in cognitively normal subjects who had high β-amyloid pathology (P=2.3x10-6), but not in cognitively normal subjects with low pathology. These data support a role for iron in contributing to neurodegeneration in Alzheimer's disease, and QSM in combination of β-amyloid PET scans could be used to stratify patients at risk for cognitive decline in the pre-symptomatic phase.

3774	Computer 103	Biomarkers of dynamic energy metabolism in Huntington disease

		Isaac Mawusi Adanyeguh[1], Francesca Branzoli[1,2], Marie-Pierre Luton[1], Ben Cassidy[3], Emmanuel Brouillet [4], Caroline Rae[5], Pierre-Gilles Henry[6], and Fanny Mochel[1,7,8]
		[1]Inserm U 1127, CNRS UMR 7225, Sorbonne Universités, UPMC Univ Paris 06 UMR S 1127, Institut du Cerveau et de la Moelle épinière, ICM, F-75013, Paris, France, [2]Center for NeuroImaging Research, Institut du Cerveau et de la Moelle épinière, Paris, France, [3]Columbia University, Department of Statistics, New York, NY, United States, [4]MIRCeN, Fontenay-aux-Roses, France, [5]Neuroscience Research Australia, Sydney, Australia, [6]Center for Magnetic Resonance Research (CMRR), University of Minnesota, Minneapolis, MN, United States, [7]AP-HP, Pitié-Salpêtrière University Hospital, Department of Genetics, Paris, France, [8]University Pierre and Marie Curie, Neurometabolic Research Group, Paris, France
		Huntington disease (HD) is a dominantly inherited neurodegenerative disease characterized by involuntary abnormal movements, cognitive and psychiatric symptoms. Evidence suggests that energy deficit plays a critical role in the disease pathophysiology. There is however a lack of robust biomarkers for testing therapeutic strategies targeting brain energy metabolism. This study aims to measure dynamic parameters of brain energy metabolism and identify novel functional biomarkers of for use in therapeutic trials in HD. This study showed altered creatine kinase rate in patients with HD as well as altered diffusion rates of several metabolites in the corpus callosum of patients with HD.

3775	Computer 104	Pitfall of synthetic MRI: Effect of gadolinium on the estimation of brain tissue volumes and myelin based on rapid simultaneous relaxometry
		Tomoko Maekawa[1,2], Akifumi Hagiwara[1,2], Masaaki Hori[1], Koji Kamagata[1], Christina Andica[1], Takuya Haruyama[1,3], Kanako Sato[1], Saori Koshino[1,2], Ryusuke Irie[1,2], Akihiko Wada[1], and Shigeki Aoki[1]
		[1]Radiology, Juntendo University, Tokyo, Japan, [2]Radiology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan, [3]Radiological Sciences, Graduate School of Human Health Sciences, Tokyo Metropolitan University, Tokyo, Japan
		We investigated the effect of gadolinium on the automatic tissue and myelin volumetry using synthetic MRI. 17 patients with metastases and 19 patients without metastasis were retrospectively analyzed before and after administration of gadolinium. After gadolinium administration, white matter volume (ml), non-white matter/gray matter/cerebrospinal fluid volume (ml), myelin volume (ml), and myelin volume/brain parenchymal volume (%) were significantly increased, whereas gray matter volume (ml), cerebrospinal fluid volume (ml), brain parenchymal volume (ml), and intracranial volume (ml) were significantly decreased regardless of metastasis. The gadolinium had significant effects on the automatic calculation of tissue and myelin volumes estimated by synthetic MRI.

3776	Computer 105	Neuro-anatomical changes in the early blind, late blind during critical developmental time: Voxel Based Morphometry study
		Ankeeta . Ankeeta[1], Senthil S Kumaran[2], Rohit Saxena[3], and N R Jagannathan[2]

		[1]Neurology, All India Institute of Medical Sciences, New Delhi, India, [2]NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [3]Rajendra Prasad Centre of Opthalmology, All India Institute of Medical Sciences, New Delhi, India
		In the early blind individuals, the white matter plasticity during the critical developmental period may compensate for the impairment resulting from the de-afferentation of the visual information that may explain for the early blind subjects show fewer regions with white matter impairments relative to the late blind

3777	Computer 106	Increased Deposition of Iron in Deep Cerebral Gray Matter Structures in Hemodialysis Patients: A Longitudinal, Susceptibility-Weighted Image Mapping Study
		Chao Chai[1,2], Saifeng Liu[3], Huiying Wang[1], Jinping Li[4], Tianyi Qian[5], E. Mark Haacke[6], Shuang Xia[1], and Wen Shen[1]
		[1]Radiology Department, Tianjin First Central Hospital, Tianjin, China, [2]The first Central Hospital Affiliated to Nankai University, Tianjin, China, [3]The MRI Institute for Biomedical Research, Waterloo, ON, Canada, [4]Department of Hemodialysis, Tianjin First Central Hospital, Tianjin, China, [5]MR Collaboration NE Asia, Siemens Healthcare, beijing, China, [6]Department of Radiology, Wayne State University, Detroit, MI, United States
		The aim of this study was to explore the changes in abnormal iron deposition in hemodialysis patients by longitudinal follow-up MR exam with susceptibility-weighted image mapping (SWIM). SWIM was reconstructed from the magnitude and phase data of SWI to quantify the susceptibility of deep gray matter nuclei in patients with a baseline examination and follow-up examination, and in healthy controls. The results suggest that iron deposition in the gray matter nuclei in patients increased over time, and this process may be a risk factor for neurocognitive dysfunction. The independent risk factors for abnormal iron deposition included the follow-up interval, creatinine, and abnormal calcium-phosphorus metabolism.

3778	Computer 107	Assessment of white matter de-differentiation in mild cognitive impairment using tract covariance matrix derived from diffusion spectrum imaging
		Tao-Han Hung[1], Yung-Chin Hsu[1], Yu-Ling Chang[2], and Isaac Wen-Yih Tseng[1,3]
		[1]Institute of Medical Device and Imaging, National Taiwan University, Taipei, Taiwan, [2]Department of Psychology, National Taiwan University, Taipei, Taiwan, [3]Molecular Imaging Center, National Taiwan University, Taipei, Taiwan

		In this study, we compared the degree of white matter de-differentiation between the patients with mild cognitive impairment (MCI) and normal-aging population using diffusion spectrum imaging (DSI) and whole brain tract-based automatic analysis (TBAA). The degree of de-differentiation, defined as the global level of generalized fractional anisotropy (GFA) covariance between each white matter tract, was found to be significantly higher in the MCI group, as revealed by two-sample T test of partial correlation matrices of the two subject groups. Further analysis showed that covariance was higher among projection tracts.

3779	Computer 108	Altered Hippocampal Structure and Functional Connectivity Associated with Memory Impairment in Patients with End-stage Renal Disease
		Xueying Ma[1], Dun Ding[1], Peng Li[2], Pan Zhang[1], and Ming Zhang[1]
		[1]Department of Medical Imaging, First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China, [2]Department of Medical Imaging, NO.215 Hospital of Shaanxi Nuclear Industry, Xianyang, China
		Memory impairment was common among ESRD patients, but the physiopathologic mechanisms were largely unclear. Hippocampus and prefrontal cortex played an important role in the human memory. Here we analyzed the structurre and functional connectivity of hippocampus and its correlation with memory scores (AVLT-H). We found that the hippocampal volume and FC between the rostral/caudal hippocampi and ventrolateral prefrontal cortex, dorsolateral prefrontal cortex as well as middle temporal gyrus. Correlations were found between hippocampal changes and memory impairment. Our study indicated that the hippocampus should be taken into consideration in the further mechanism study of neurol damage in ESRD patients.

3780	Computer 109	In-vivo Quantitative Structural Imaging of the Superior Colliculus at 9.4T
		Joana Loureiro[1,2], Marc Himmelbach[3], Thomas Ethofer[1,4], Rolf Pohmann[2], Pascal Martin[4], Jonas Bause[2], Klaus Scheffler[1,2], and Gisela E Hagberg[1,2]
		[1]Biomedical Magnetic Resonance, University Hospital Tübingen, Tübingen, Germany, [2]High Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [3]Division of Neuropsychology, Centre for Neurology, Hertie-Institute for Clinical Brain Research, Tübingen, Germany, [4]Department of General Psychiatry and Psychotherapy, University Hospital Tübingen, Tübingen, Germany
		We investigated the possibility to observe the anatomical details of the superior colliculus (SC), a layered structure located on the tectum of the midbrain, by in vivo MRI at 9.4T. Through image analysis in native space, several brain structures of the mid brain could be identified. The signal variation of all imaging modalities (T1, R2* and QSM) along and across the superior colliculus consistently highlighted the deep white layer VII, adjacent to the periaqueductal grey; the myelinated fibres in the superficial optic layer (layer III) and an iron-rich layer attributed to the intermediate grey layer (IV).

3781	Computer 110	White matter fibre tract changes in patients treated with MR imaging-guided focused ultrasound are associated with lesion location and clinical outcome Christian Thaler[1,2], Qiyuan Tian[1,3], Max Wintermark[1], Pejman Ghanouni[1], Casey H. Halpern[4], Jamie M. Henderson[4], Raag D. Airan[1], Michael Zeineh[1], Kim Butts Pauly[1,3], and Jennifer A. McNab[1] *[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Diagnostic and Interventional Neuroradiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [3]Department of Electrical Engineering, Stanford University, Stanford, CA, United States, [4]Department of Neurosurgery, Stanford University, Stanford, CA, United States* DTI is sensitive to tract-specific FA changes and thereby can be used to inform on therapeutic mechanisms and optimal targeting strategies for MRI-guided high intensity–focused ultrasound. Here, we used probablilistic tractography to investigate white matter fibre tract changes in essential tremor patients treated with MRIgHIFU. On the treated side, a significant decrease in FA was detected in the tracts projecting between the thalamus and motor cortex and between the dentate nucleus and the thalamus (i.e. the dentato-rubro-thalamic tract). These decreases in FA were correlated with the degree of tract-lesion overlap. Additionally, the post-treatment FA decrease in the tracts projecting between the thalamus and the motor cortex were positively correlated with clinical improvement. Interestingly, tract changes were also observed in the medial lemniscus of the contralesional side, possibly indicating global changes in brain connectivity.

3782	Computer 111	Associations between tissue sodium concentration, age and cross-sectional area in the healthy spinal cord Bhavana Shantilal Solanky[1], Ferran Prados[2], Marios C Yiannakas[1], Vanessa Bassan[1], Baris Kanber[2], Sebastien Ourselin[2], Olga Ciccarelli[1], and Claudia Angela Gandini Wheeler-Kingshott[1,3,4] *[1]Queen Square MS Centre, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [2]Translational Imaging Group, Centre for Medical Image Computing (CMIC), Department of Medical Physics and Bioengineering, University College London, London, United Kingdom, [3]Department of Brain and Behavioural Sciences, University of Pavia, Pavia, Italy, [4]Brain MRI 3T Research Centre, C. Mondino National Neurological Institute, Pavia, Italy* Tissue sodium concentration has recently come into the spotlight for a number of neurological conditions, given its potential role in neurodegeneration and due to the advances in MRI technology. This has led to many studies in the brain, but there is a shortage of studies characterising sodium in the spinal cord. Here we use ^{23}Na-MRS to measure sodium in the healthy spinal cord and look at the association between tissue sodium concentrations with age and spinal cord cross sectional area.

3783	Computer 112	White matter microstructural maturation in adolescent American Football athletes is affected by history of sport-participation and concussion

		Yukai Zou[1,2], Ikbeom Jang[3], Nicole Vike[2,4], Diana Svaldi[1], Larry Leverenz[5], Eric Nauman[4,6], Thomas Talavage[1,3], and Joseph Rispoli[1,3]
		[1]Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, United States, [2]College of Veterinary Medicine, Purdue University, West Lafayette, IN, United States, [3]Electrical and Computer Engineering, Purdue University, West Lafayette, IN, United States, [4]Department of Basic Medical Sciences, Purdue University, West Lafayette, IN, United States, [5]Department of Health and Kinesiology, Purdue University, West Lafayette, IN, United States, [6]Department of Mechanical Engineering, Purdue University, West Lafayette, IN, United States
		Concussion is a biomechanically induced brain injury that causes mental health concern for adolescent collision-sport athletes, whose brains are still developing and maturing. These athletes normally continue participating in collision events, regardless of history of concussion and risk for future concussion. Using diffusion tensor imaging, we investigated 93 asymptomatic adolescent athletes who participate in high school American Football. Per developmental expectations, we typically observed increasing fractional anisotropy or decreasing mean diffusivity with increasing years of high school experience, but prior history of concussion reversed this trend in a number of brain regions.

3784	Computer 113	Development and Evaluation of a contrast optimized 3D SHINKEI MR Neurography on patients with Brachial plexus injuries at 1.5T
		Prashant Prabhakaran Nair[1], Rajagopal Kadavigere[1], Yogesh Kannan Mariappan[2], Samir Mustafa Paruthikunnan[1], Narayana Krishna Rolla[2], and Indrajit Saha[3]
		[1]Radiodiagnosis and Imaging, Kasturba Medical College, Manipal, India, [2]Philips India, Bangalore, India, [3]Philips India, Gurugram, India
		The objective of this work is to optimize the 3D nerve-SHeath signal increased with INKed rest-tissue RARE Imaging (SHINKEI) sequence for the best nerve-muscle T2 contrast in 1.5T and evaluate the clinical feasibility of this optimized sequence in 24 patients with brachial plexus injuries. Based on the evaluation by two experienced radiologists and the comparison to surgical observations, the optimized SHINKEI sequence performed better than fat suppressed TSE (STIR TSE) and Diffusion Weighted Imaging with Background Suppression (DWIBS) sequences that are currently widely used in the clinical protocols

3785	Computer 114	Melanopsin retinal ganglion cells in LHON patients: an fMRI study of brain activations under monochromatic light stimulation
		Stefania Evangelisti[1,2], Claudia Testa[1,2], Chiara La Morgia[1,3], Gilles Vandewalle[4], Claudio Bianchini[1,2], David Neil Manners[1,2], Paola Fantazzini[5,6], Michele Carbonelli[3], Alfredo Sadun[7,8], Caterina Tonon[1,2], Valerio Carelli[1,3], and Raffaele Lodi[1,2]

		[1]Department of Biomedical and NeuroMotor Sciences, University of Bologna, Bologna, Italy, [2]Functional MR Unit, Policlinico S.Orsola - Malpighi, Bologna, Italy, [3]IRCCS Institute of Neurological Sciences of Bologna, Bologna, Italy, [4]Sleep Research Group; GIGA-Research, Cyclotron Research Centre/In vivo imaging unit, University of Liège, Liège, Belgium, [5]Department of Physics and Astronomy, University of Bologna, Bologna, Italy, [6]Centro Enrico Fermi, Roma, Italy, [7]Doheny Eye Institute, University of California, Los Angeles, CA, United States, [8]Doheny Eye Centers of UCLA, Department of Ophthalmology, David Geffen School of Medicine at University of California, Los Angeles, CA, United States
		We combined light stimulation and fMRI to investigate the contribution of melanopsin-expressing retinal ganglion cells (mRGCs) to visual and non-visual processes in Leber Hereditary Optic Neuropathy (LHON) paradigm of retinal degeneration . Monochromatic visual simulation showed a stronger effect in LHON visual cortex for blue vs red light with relatively long stimuli, supporting the hypothesis of a role for melanopsin in visual processes. When light was combined with a working memory task, blue light modulation of cognitive brain response was maintained in LHON; indeed the effect was stronger than in healthy subjects, probably because of the higher mRGCs/RGCs ratio in LHON retinas.

3786	Computer 115	Quantitative Dynamic Susceptibility Contrasted Perfusion in Differential Diagnosis of Recurrence and Radionecrosis for Brain Metastases after Stereotactic Radiotherapy
		Bao Wang[1], Tianyi Qian[2], Bin Zhao[3], Yingchao Liu[4], and Na Sun[1]
		[1]Shandong University, Jinan, China, [2]MR Collaborations NE Asia, Siemens Healthcare, Beijing, China, [3]Shandong Medical Imaging Research Institute, Jinan, China, [4]Shandong Provincial Hospital, Jinan, China
		Stereotactic radiotherapy (SRS) has become a widely used treatment for patients with brain metastases (BM). However, differential radionecorsis (RN) and tumor recurrence (TR) after SRS for BM by MR images is still challenging. In this study, a quantitative dynamic susceptibility contrasted perfusion weighted imaging (DSC-PWI) technique was applied to solve this problem. The results showed that quantitative DSC-PWI had higher diagnostic efficiency and smaller inter-observer differences than traditional DSC-PWI.

3787	Computer 116	Metabolic alterations in DLPFC in patients with Subclinical Hypothyroidism : An In-vivo 1H MRS study
		Subash Khushu[1], Mukesh Kumar Saini[1], Poonam Rana[1], Shilpi modi[1], and Tarun Sekhri[2]
		[1]NMR Research centre, Institute of Nuclear medicine & Allied Sciences (INMAS), Delhi, India, [2]Division of Thyroid Research, Institute of Nuclear medicine & Allied Sciences (INMAS), Delhi, India

		Altered cognitive performance is well known in both hypothyroidism and hyperthyroidism but little is known about deficits in brain functions in Subclinical hypothyroidism (SCH). Aim of the present study was to investigate the metabolic changes in Dorso-Lateral Pre-Frontal Cortex (DLPFC) of SCH patients using ^{1}H MRS. 19 freshly diagnosed SCH patients and 24 age matched healthy controls were recruited and subjected to MRS. Our result show significantly increased concentrations of GSH ($p<0.009$) and creatine ($p<0.017$) in the DLPFC and diminished cognitive performance in SCH compared to controls. The increase in the level of GSH in SCH compared to controls may be indicative of an initial compensatory, neuro-protective response due to oxidative stress.

3788	Computer 117	Aberrant Brain Iron Deposition in Gray Matter Nuclei and Hippocampus in Alzheimer Disease with Type 2 Diabetes Mellitus: A Quantitative Susceptibility Mapping Study
		Xiaoxin Li[1], Yanwei Miao[1], Liang Han[1], Junyi Dong[1], and Qingwei Song[1]
		[1]The First Affiliated Hospital of Dalian Medical University, Dalian, China
		In this study, brain iron contents in basal nuclei, thalamus and hippocampus of AD+T2DM patients and AD-T2DM patients was quantified with susceptibility values by QSM, and further to explore the correlation between brain iron deposition and cognition level and clinical factors. From the study results, we conclude that the susceptibility values were generally decreased due to aberrant iron deposition in gray matter nuclei in AD+T2DM patients relative to AD-T2DM patients. The susceptibility values of right GP has a better correlation with cognition, which administers to monitor the development of cognitive impairment.

3789	Computer 118	Motion of the cerebellum in patients with Chiari malformation compared to healthy subjects: A quantitative study using spiral cine DENSE MRI
		John Oshinski[1], Soroush Heidari Pahlavian[2], Jordan Schuster [1], Xiaodong Zhong[1,3], Rouzbeh Amini[2], Francis Loth[2], and Daniel Barrow[1]
		[1]Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States, [2]Mechanical Engineering, University of Akron, Akron, OH, United States, [3]Research and Development, Siemens Healthineers, Atlanta, GA, United States
		The goal of this study was to acquire mid-sagittal cine DENSE images to quantify displacement and strain over the cardiac cycle in patients with Chiari malformation and age-matched controls. The major finding of this study was that both tissue displacement and tissue strain in the parenchyma of the cerebellum was significantly greater in patients with Chiari malformation than healthy controls.

3790	Computer 119	Multi-modal MRI investigation of brain plasticity during prolonged Braille learning in sighted subjects – voxel-based morphometry and quantitative T1 mapping approach Bartosz Kossowski[1], Jacek Matuszewski[1], Łukasz Bola[1,2], Anna Banaszkiewicz[1], Małgorzata Paplińska[3], Michał Szczepanik[1], Marcin Szwed[2], Katarzyna Jednoróg[4], and Artur Marchewka[1] *[1]Laboratory of Brain Imaging, Nencki Institute of Experimental Biology, Warsaw, Poland, [2]Department of Psychology, Jagiellonian University, Kraków, Poland, [3]Academy of Special Education, Warsaw, Poland, [4]Laboratory of Psychophisiology, Nencki Institute of Experimental Biology, Warsaw, Poland* In order to study structural brain reorganization, multi-modal MRI combining voxel-based morphometry and quantitative T1 mapping was used in longitudinal design on sighted subjects who underwent tactile Braille reading course. Results show that methods are complimentary to each other. Combined approach like that gives insight into different aspects of tissue property changes introducing new opportunities for studying brain plasticity.

3791	Computer 120	Atlas-based volumetric assessment of T2 abnormality in acute spinal cord injury predicts motor outcomes: A transforming research and clinical knowledge in spinal cord injury (TRACK-SCI) pilot study David B McCoy[1,2], Russell Huie[2,3], Sara M Dupont[1], William Whetstone[2,4], Sanjay Dhall[2,3], Rachel Tsolinas[2], Xuan Duong-Fernandez[2,3], Leigh Thomas[2,3], Vineeta Singh[2,5], Lisa Pascual[2,6], Jared Narvid[1], Nikolaos Kyritsis[2,3], Geoff Manley[2,3], Adam R Ferguson[2,3,7,8], Michael S Beattie[2,3], Jacqueline C Bresnahan[2,3], and Jason F Talbott[1,2] *[1]Radiology and Biomedical Imaging, Zuckerberg San Francisco General Hospital and UCSF, San Francisco, CA, United States, [2]Brain and Spinal Injury Center, San Francisco, CA, United States, [3]Neurological Surgery, Zuckerberg San Francisco General Hospital and UCSF, San Francisco, CA, United States, [4]Emergency Medicine, Zuckerberg San Francisco General Hospital and UCSF, San Francisco, CA, United States, [5]Neurology, Zuckerberg San Francisco General Hospital and UCSF, San Francisco, CA, United States, [6]Orthopedic Surgery, Orthopedic Trauma Center at ZSFG, San Francisco, CA, United States, [7]San Francisco VA Medical Center, San Francisco, CA, United States, [8]Weill Institute for Neurosciences, San Francisco, CA, United States* MR evaluation of intrinsic cord signal abnormality relies on gross morphologic imaging measures such as T2-hyperintense lesion length and subjective patterns of T2 signal abnormality. In the current study, we register T2w images and manually segmented lesions from acute SCI patients to a spinal cord (SC) anatomical template in order to calculate volumes of damaged tissue in 22 probabilistic anatomical subdomains of the SC. We identify specific anatomic subdomains in the SC which serve as MR biomarkers of motor impairment and indirectly support neuro-protective strategies targeting ventral horn and lateral column white matter tissue for maximizing motor function after SCI.

Electronic Poster

Radiation Treatment Planning

Exhibition Hall	Tuesday 8:15 - 9:15

3792	Computer 1	CT synthesis for MR-only brain radiotherapy treatment planning using convolutional neural networks
		Anna M. Dinkla[1], Jelmer M. Wolterink[2], Matteo Maspero[1], Mark H.F. Savenije[1], Joost J.C. Verhoeff[1], Ivana Isgum[2], Peter R. Seevinck[2], Jan J.W. Lagendijk[1], and Cornelis A.T. van den Berg[1]
		[1]Radiation Oncology, UMC Utrecht, Utrecht, Netherlands, [2]Image Sciences Institute, UMC Utrecht, Utrecht, Netherlands
		In MR-only radiotherapy, a synthetic CT (sCT) needs to be generated from MR to allow radiation dose planning without CT acquisition. We aim for such an MR-only workflow to decrease radiotherapy preparation time. If we can plan and deliver the dose in a single day, in a ‘one stop shop’ procedure, we prevent treatment delay which is of high importance for patients with fast growing brain metastases. In this study sCTs of the head were generated in a short amount of time, that highly resemble the original CTs and that enable accurate dose calculation.

3793	Computer 2	Fast synthetic CT generation using a conditional Generative Adversarial Network and Dixon imaging for general pelvis MR-based Radiotherapy planning
		Mark HF Savenije[1,2], Matteo Maspero[1,2,3], Anna M Dinkla[1,2], Peter R Seevinck[2,3], and Cornelis AT van den Berg[1,2]
		[1]Radiotherapy Department, UMC Utrecht, Utrecht, Netherlands, [2]Center for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [3]Image Science Institute, UMC Utrecht, Utrecht, Netherlands
		To enable MR-only radiotherapy planning and accurate MR-based dose calculations, substitutes of CT images, so-called synthetic CT (sCT) images, need to be generated. In this work, we assessed whether sCT images generated by a 2D conditional Generative Adversarial Network (cGAN) using a 3D dual echo SPGR MR sequence were suited for radiation treatment planning for general pelvis cancer patients. Image evaluation showed comparable performance among prostate, rectum and cervix patients. Dose planning calculations demonstrated that accurate MR-based dose calculation on sCT images generated by the cGAN after training is feasible for treatment planning in prostate cancer patients. In addition, the generation of the sCT is fast (< 6 s) and ideally suited for applications where time duration is essential, e.g. MR-guided radiotherapy planning.

3794	Computer 3	MR-only Radiation Therapy Planning in the pelvis using Zero TE and LAVA-Flex based pseudo CT conversion.
		Cristina Cozzini[1], Mikael Bylund[2], Joakim H Jonsson[2], Josef A Lundman[2], Fredrik Illerstam[3], Mathias Engstrom[3], Tufve Nyholm[2], and Florian Wiesinger[1]

		[1]GE Healthcare, Munich, Germany, [2]Umeå University, Umeå, Sweden, [3]GE Healthcare, Danderyd AB, Sweden
		In this study, we demonstrate Zero TE (ZTE) and LAVA-Flex based pseudo CT conversion suitable for dose calculation for MR-only Radiation Therapy Planning (RTP) in the Pelvis. The dose planning performance of this method was evaluated in N=11 patients and compared to corresponding CT dose plans.

3795	Computer 4	Automated analysis of eye tumor MR-images for an improved treatment determination
		Mohamed Kilany Hassan[1], Denis Shamonin[1], Rahil Shahzad[1], Andrew Webb[1], Berend Stoel[1], and Jan-Willem Beenakker[1,2]
		[1]Radiology, LUMC, Leiden, Netherlands, [2]Ophthalmology, LUMC, Leiden, Netherlands
		The optimal treatment for uveal melanoma, the most common primary malignant eye tumor, depends on tumor thickness. Conventionally tumor thickness is determined with 2D ultrasound, but MRI allows for a full 3D analysis. It is, however, often difficult to determine the maximum tumor thickness due to its complex 3D shape. We propose a fully automatic framework to segment these MR-images to measure the tumor thickness accurately and evaluate it in four patients. The proposed method has a direct impact on the clinical practice, as a more accurate 3D assessment of the tumor dimensions directly influences therapy determination.

3796	Computer 5	CT-based surrogates of ventilation: A comparison with hyperpolarized Helium-3 and Xenon-129 MRI in lung cancer patients undergoing radiotherapy planning
		Bilal A. Tahir[1,2], Paul J. Hughes[1], Stephen D. Robinson[1,2], Helen Marshall[1], Alberto Biancardi[1], Neil J. Stewart[1], Graham Norquay[1], Ho-Fung Chan[1], Guilhem J. Collier[1], Kerry A. Hart[2], James A. Swinscoe[2], Matthew Q. Hatton[2], Jim M. Wild[1], and Rob H. Ireland[2]
		[1]Polaris, University of Sheffield, Sheffield, United Kingdom, [2]Academic Unit of Clinical Oncology, University of Sheffield, Sheffield, United Kingdom
		Image registration of lung CT images acquired at different inflation levels has been proposed as a surrogate method to map lung ‘ventilation’ and has notable applications in functionally guided radiotherapy planning. However, the technique requires validation against established ventilation modalities such as hyperpolarized gas MRI. Here, we develop an image acquisition and analysis strategy to facilitate direct spatial correlation of several CT ventilation techniques with both hyperpolarized ^{3}He and ^{129}Xe MRI and apply our method to a cohort of 11 lung cancer patients undergoing radiotherapy.

3797	Computer 6	Evaluation of MRI-Guided Radiotherapy Planning Target Volume Delineation for Colorectal Cancer Due to Variations in Image Contrast and Patient Motion Yang Zhang[1], Liming Shi[2], Xiaonan Sun[2], Tianye Niu[2], Ning Yue[3], Jeon-Hor Chen[1], Tiffany Kwong[1,3], Min-Ying Su[1], and Ke Nie[3] *[1]Department of Radiological Sciences, University of California, Irvine, CA, United States, [2]Department of Radiation Oncology, Sir Run Run Shaw Hospital, Zhejiang University School of Medicine, Hangzhou, China, [3]Department of Radiation Oncology, Rutgers-The State University of New Jersey, New Brunswick, NJ, United States* This study evaluates the difference in defining the target volume of rectal cancer with MRI-guided radiation treatment planning. Tumors show different appearances on different MR sequences, and also the motion of patients during the scan may affect defining planning target volume. A quantitative radial distance method was developed to evaluate variations coming from image contrast and patient motion. A total of 45 patients with pre- and post-radiation treatment MRI were analyzed. The mean difference in the radial distance between ROI's drawn on different post-contrast images was 2-3 mm, and the difference in the 90th percentile tumor pixel was 6-8 mm.

3798	Computer 7	An Automated Multiparametric MRI Quantitative Imaging Prostate Habitat Risk Scoring System for Defining External Beam Radiotherapy Boost Volumes Radka Stoyanova[1], Matthew C. Abramowitz[1], Felix Chinea[1], Deukwoo Kwon[2], Isildinha M Reis[2], Kyle R Padgett[1], Sanoj Punnen[3], Oleksandr N Kryvenko[4], and Alan Pollack[1] *[1]Radiation Oncology, University of Miami, Miami, FL, United States, [2]Statistics, University of Miami, Miami, FL, United States, [3]Urology, University of Miami, Miami, FL, United States, [4]Pathology, University of Miami, Miami, FL, United States* The standard of clinical care, Prostate Imaging, Reporting and Diagnosis System (PI-RADS), does not tap into the wealth of quantitative imaging information contained in the multiple sequences of mpMRI, nor does it elucidate intralesional spatial heterogeneity. A habitat risk score (HRS) approach that combines the quantitative information from the diffusion and perfusion mpMRI sequences is developed. HRS was devised in ten subcategories with increasing levels associated with a greater risk of harboring higher Gleason Score's and depicted as a heat map. The automated method is used to define radiotherapy (RT) boost volumes in the background of a randomized Phase II clinical trial.

3799	Computer 8	Longitudinal response monitoring in experimental prostate tumors by DCE-MRI after C-12 ion and photon radiotherapy Alina Leandra Bendinger[1], Christian Peter Karger[2,3], Charlotte Debus[4], Ralf Omar Floca[3,5], Jürgen Debus[3,6], Jörg Peter[1], and Christin Glowa[2,3,6]

		[1]Department of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Department of Medical Physics in Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [3]Heidelberg Institute for Radiation Oncology (HIRO), National Center for Radiation Research in Oncology (NCRO), Heidelberg, Germany, [4]Translational Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [5]Division of Medical Image Computing, German Cancer Research Center (DKFZ), Heidelberg, Germany, [6]Department of Radiation Oncology, University Hospital Heidelberg, Heidelberg, Germany
		Dynamic contrast-enhanced MRI was used for the longitudinal monitoring of two well characterized experimental prostate tumors (Dunning R3327-AT1 and -HI) after isodose and isoeffective radiotherapy. The effect of carbon (^{12}C)-ion irradition compared to photons on tumor vasculature was characterized by non-compartmental analysis and pharmacokinetic modelling employing the extended Tofts model. Isodose and isoeffective irradiation experiments indicated that the beam modality has a stronger effect on tumor perfusion and permeability than the dose. While changes in perfusion were identified for the highly undifferentiated AT1-tumor, the more differentiated HI-tumor showed only minor changes in perfusion upon irradiation.

3800	Computer 9	Lonidamine-induced selective acidification and deenergization of prostate cancer xenografts: Enhanced tumor response to radiation therapy
		Kavindra Nath[1], Jeffrey Roman[1], David Nelson[1], Mary Putt[1], Stepan Orlovskiy[1], Ewere Azagidi[1], Violet Tu[1], Dennis Leeper[2], and Jerry Glickson[1]
		[1]University of Pennsylvania, Philadelphia, PA, United States, [2]Thomas Jefferson University, Philadelphia, PA, United States
		Prostate cancer, when treated with external beam radiotherapy (RT) in the range of 78 Gy, is frequently associated with gastrointestinal (GI) & genitourinary (GU) toxicities. We hypothesize that tumor sensitization by lonidamine (LND) will enable the use of lower RT doses reducing the risk of side effects. LND effects detected *in vivo* by ^{31}P and ^{1}H MRS in androgen-independent (PC3) prostate cancer xenografts produced a sustained and tumor-selective decrease in intracellular pH, bioenergetics (βNTP/Pi), oxygen consumption rate and increase in lactate. Selective tumor acidification, deenergization and oxygenation induced by LND potentiated the radiation response in the PC3 prostate cancer model.

3801	Computer 10	Comparative Assessment of Geometric Distortion for an MR-Linac Versus Several Diagnostic Scanners
		Jordan Michael Slagowski[1], Yao Ding[2], Clifton David Fuller[2,3], Caroline Chung[2], Mo Kadbi[4], Zhifei Wen[1], and Jihong Wang[1,3]
		[1]Radiation Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Radiation Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [3]The University of Texas Graduate School of Biomedical Sciences at Houston, Houston, TX, United States, [4]MR Therapy, Philips HealthTech, Cleveland, OH, United States

		The integration of a MR scanner with a linear accelerator (MR-Linac) may improve image guidance in radiation therapy (RT). Spatial fidelity is an important consideration in RT and should be evaluated for MR-Linac imaging. This work presents a phantom and software developed in-house to measure geometric distortion across a large MR imaging field-of-view. A comparative assessment of geometric distortion within a 1.5T MR scanner integrated with a 7 MV linear accelerator is performed versus several commercial scanners with field strengths ranging from 1.5T-3.0T. The geometric distortion within the MR-Linac was comparable or less than that measured with the diagnostic scanners.

3802	Computer 11	Reduction of susceptibility artifacts in MR of permanent prostate gold seed for radiotherapy
		Abby Y Ding[1], Leon Ho[1], K.T Chan[2], Jing Yuan[1], Kin Yin Cheung[1], and Siu Ki Yu[1]
		[1]Medical Physics & Research Department, Hong Kong Sanatorium & Hospital, Hong Kong, China, [2]Department of Radiotherapy, Hong Kong Sanatorium & Hospital, Hong Kong, China
		Stereotactic body radiation therapy for prostate cancer is a highly precise radiotherapy. Post-implant MR is important for target localization, contouring and treatment planning. A phantom was designed to investigate the susceptibility caused by gold seeds in different orientations relative to B_0 field. 2D and 3D acquisition scheme at various resolution, bandwidth and frequency-encoding directions were examined. Our results show that for reduction of susceptibility artifacts and excessive local signal loss, resolution of higher than 0.5mm is recommended, increasing bandwidth with sufficient resolution is more practical than changing frequency-encoding directions. 3D is comparable to 2D sequence in susceptibility artifacts.

3803	Computer 12	Longitudinal diffusion MRI for predicting response to radiotherapy in sarcoma patients
		Yu Gao[1,2], Chunming Gu[3], Joong-hoon Kim[4], Minsong Cao[2,4], Anusha Kalbasi[4], Dan Ruan[2,4], Daniel A Low[2,4], Peng Hu[1,2], and Yingli Yang[2,4]
		[1]Department of Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Physics and Biology in Medicine IDP, University of California, Los Angeles, Los Angeles, CA, United States, [3]Xi'an Jiaotong University, Xi'an, China, [4]Department of Radiation Oncology, University of California, Los Angeles, Los Angeles, CA, United States
		In this work, we sought to predict the necrosis score, a surrogate of radiotherapy treatment outcome for sarcoma patients, using the longitudinal diffusion MRI data. Over three hundred features were extracted from the longitudinal diffusion data on twenty sarcoma patients. Minimum redundancy maximum relevance method with cross-validation was used to select the most relevant and stable features. Logistic regression, support vector machine and adaptive boosting were implemented to predict the necrosis score. AUC of 0.76 was achieved when using SVM with features from all three imaging time points. Features from before the treatment time point had better predictive power than data in the middle or after the treatment.

3804	Computer 13	Assessment Geometric Distortion in MRI for Gynaecological Brachytherapy Planning at 3T Maria A Schmidt[1], Eva Kousi[1], Georgina Hopkinson[2], Anne Gasnier[3], Kate Roberts[3], Alexandra Taylor[3], and Susan Lalondrelle[3] *[1]CR-UK and EPSRC Cancer Imaging Centre, Royal Marsden NHS Foundation Trust & Institute of Cancer Research, Sutton, United Kingdom, [2]Radiology, Royal Marsden NHS Foundation Trust, London, United Kingdom, [3]Radiotherapy, Royal Marsden NHS Foundation Trust, London, United Kingdom* MRI is increasingly used in radiotherapy treatment planning due to its superior soft tissue contrast. The growing interest in 3T MRI relates to the potential of higher signal-to-noise ratio and spatial resolution. However, geometric distortions associated with magnetic field inhomogeneity increase with field strength and may compromise geometric accuracy. We quantify the geometric distortion in MRI examinations for high dose rate brachytherapy planning for gynaecological cancer at 3T, and consider its clinical impact, taking into account the brachytherapy applicators, the subject's susceptibility distribution and hardware-related distortions. We found localised areas of field inhomogeneity, and displacements of less than 1mm.

3805	Computer 14	Practical Aspects of MRI-based Gel Dosimetry in RT Quality Assurance Evanthia Kousi[1], Filipa Costa[1], Rollo Moore[2], Evangelos Pappas[3], Anne Gasnier[2], Emma Wells[2], and Maria A Schmidt[1] *[1]CR-UK and EPSRC Cancer Imaging Centre, Royal Marsden NHS Foundation Trust & Institute of Cancer Research, Sutton, Surrey, United Kingdom, [2]Radiotherapy, Royal Marsden NHS Foundation Trust, London, United Kingdom, [3]Technological Educational Institute of Athens, Department of Radiology-Radiotherapy, Athens, Greece* MRI-based gel dosimetry has been proposed as a part of a Radiotherapy QA programme and is of interest to Stereotactic Ablative Radiotherapy and Stereotactic Radiosurgery. MRI-related sources of error that may compromise the dosimetric accuracy need to be considered. R2 measurement variations associated with measurement timing after irradiation and SAR limitations were investigated using an anthropomorphic head phantom. Our results demonstrate gradual gel deformation and R2 variations that could have an impact on relative and absolute dose measurements.

3806	Computer 15	Use of a Rigidity Penalty to Improve MR-CT Image Registration Elizabeth MaryAnn McKenzie[1], Dan Ruan[2], Percy Lee[2], and Ke Sheng[2] *[1]Physics and Biology in Medicine, University of California Los Angeles, LOS ANGELES, CA, United States, [2]Radiation Oncology, University of California Los Angeles, Los Angeles, CA, United States*

		Attenuation coefficients of tissue must be known to accurately model dose in radiation therapy. MR-guided radiation therapy better visualizes soft tissue, but it does not inherently contain attenuation information in the same way as CT images. CT and MR images can be registered to pool information, but the bones can become severely distorted. This work applies a rigidity penalty to bones segmented in CT, such that the soft tissue is allowed to deform while the bones remain rigid during CT to MRI registration. We show that this technique improves the registration, making the deformations more anatomically feasible.

3807	Computer 16	4D-MRI in radiotherapy: motion phantom study and automatic sorting based on internal surrogate for motion management during free breathing
		Soleakhena Ken[1], Oliver Bieri[2], Zarko Celicanin[2], Philippe Cattin[3], and Laure Parent[1]
		[1]Department of Engineering and Medical Physics, Institut Universitaire du Cancer de Toulouse - Oncopole, Toulouse, France, [2]Department of Medical Physics, University of Basel, Basel, Switzerland, [3]Department of Biomedical Engineering, University of Basel, Basel, Switzerland
		4D-MRI sequence for radiotherapy (RT) application is validated in this study on a motion phantom and on healthy volunteers. 4D-MR imaging of a moving spherical target with different signal waveforms gave similar results as for classical 4D-CT used in RT planning. During free breathing 4D-MRI acquisitions, the internal surrogates, defined as the mean intensity inside a region of interest are relevant to detect the different respiratory phases for consistent retrospective automatic image sorting. Feasibility of integration into treatment planning system was also demonstrated, allowing picturing the dynamic behavior of the moving organ for treatment planning.

3808	Computer 17	Comparative evaluation of DTI and FLAIR images in assessment of whole pathological region in GBM patients for RT planning; a semi-automatic segmentation approach
		Manijeh Beigi[1], Mojtaba Safari[1], Ahmad Ameri[2], Mohsen ShojaeeMoghadam[3], and Hamidreza SalighehRad[1]
		[1]Quantitative MR Imaging and Spectroscopy Group, Research Center for Cellular and Molecular Imaging, Institute for Advanced Medical Imaging, Tehran University of Medical Sciences, Tehran, Iran (Islamic Republic of), [2]Clinical Oncology, Shahid Beheshti University of Medical Science, Tehran, Iran (Islamic Republic of), [3]Payambaran Imaging Center, Tehran, Iran (Islamic Republic of)
		Accurate determination of whole pathological region is still a challenging task and necessary prerequisite step in radiotherapy planning in GBM. This study attempted to propose semi-automatic segmentation method that can extract whole pathogenic tumor on T_2-*FLAIR* and isotropic component (*p*-map) of diffusion tensor imaging(DTI) with over 90 % sensitivity, specificity and dice score. In addition, the extension of pathological region was compared. Results show that there is significant difference between segmented region on T_2-*FLAIR* and *p* map. Beyond usual segmentation method for T_2-*FLAIR*, we have highlighted DTI parametric maps because of its information on tumor infiltration.

3809	Computer 18	A Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) compatible anthropomorphic pelvic phantom for MRI-guided radiotherapy. Kamal Singhrao[1], Yingli Yang[1], Thomas Wong[1], Geraldine Chee[1], Jie Fu[1], Daniel Low[1], and John H Lewis[1] *[1]Radiation Oncology, University of California Los Angeles, Los Angeles, CA, United States* We present an anthropomorphic pelvic phantom for MR-guided radiotherapy. Materials were selected to mimic bone, fat and muscle and produce tissue-like contrast with T1, T2 and T2* weighted MRI sequences and CT. MR and CT tissue quantification results are presented. A comparison between the phantom and patient images acquired using standard prostate radiotherapy MR sequences is presented. The study concludes with an example application of the phantom where we compare the visibility of an implanted gold fiducial marker in phantom and in vivo.

3810	Computer 19	Repeatability of Quantitative Imaging on the MR-Linac for Treatment Response Monitoring Ernst S. Kooreman[1], Petra J. van Houdt[1], Marlies E. Nowee[1], Vivian van Pelt[1], Folkert Koetsveld[1], Leon C. ter Beek[1], Johannes M. Peeters[2], and Uulke A. van der Heide[1] *[1]Department of Radiation Oncology, The Netherlands Cancer Institute, Amsterdam, Netherlands, [2]MR Clinical Science, Philips, Best, Netherlands* The MR-Linac opens the possibility for accurate daily treatment response monitoring. Quantitative MR imaging is a promising tool to quantify day-to-day changes. Therefore the performance of quantitative imaging of the MR-Linac needs to be assessed. In this study, we investigated the repeatability of T2 and ADC mapping using test-retest data of patients with prostate cancer. We calculated the within-patient coefficient of variation (wCV) and compare this to data from a conventional diagnostic 3T scanner. The MR-Linac performs similar to the diagnostic scanner regarding T2 mapping as wCV values are comparable. However, the repeatability for ADC mapping is lower on the MR-Linac.

3811	Computer 20	Susceptibility-based positive contrast for visualization and localization of implanted brachytherapy seeds in realistic prostate phantoms Reyhaneh Nosrati[1,2], Matt Wronski[3,4], Ananth Ravi[1,2,3,4], Ana Pejović-Milić[1], Gerard Morton[5,6], and Greg Stanisz[1,3,4] *[1]Medical Physics, Ryerson University, Toronto, ON, Canada, [2]Sunnybrook Research Institute, Toronto, ON, Canada, [3]Medical Physics, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [4]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [5]Odette Cancer Centre, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [6]Radiation oncology, University of Toronto, Toronto, ON, Canada*

		Employing susceptibility-based positive contrast for depiction and localization of closely implanted elongated paramagnetic objects (i.e. brachytherapy seeds) is very challenging due to the orientation dependence and/or size overestimation of reconstructed object. In this study, 321 brachytherapy seeds were implanted in four realistic prostate phantoms; all phantoms were scanned at three different angles on a 1.5T MR scanner. A novel susceptibility-based workflow was proposed for visualization and localization of the seeds. For all scanning angles the reconstructed seed shapes, centroids and orientations were identical and no significant difference was found between the proposed method and the current clinically used CT-based method.

3812	Computer 21	Response Assessment in Carbon-Ion Radiotherapy of Recurrent High Grade Glioma through Characterization of Tumor Vascularization and Perfusion using DCE MRI
		Charlotte Debus[1,2,3,4], Maximilian Knoll[1,2,3,4], Ralf Floca[3,5], Sebastian Adeberg[3,4], Jürgen Debus[1,2,3,4], and Amir Abdollahi[1,2,3,4]
		[1]German Cancer Consortium (DKTK), Heidelberg, Germany, [2]Translational Radiation Oncology, National Center for Tumor Diseases (NCT), German Cancer Research Center (DKFZ), Heidelberg, Germany, [3]Division of Molecular and Translational Radiation Oncology, Heidelberg Institute of Radiation Oncology (HIRO), National Center for Radiation Research in Oncology (NCRO), Heidelberg, Germany, [4]Heidelberg Ion-Beam Therapy Center (HIT), Department of Radiation Oncology, Heidelberg University Hospital, Heidelberg, Germany, [5]Division of Medical Image Computing, German Cancer Resarch Center, Heidelberg, Germany
		Carbon-ion radiotherapy holds great potential for treatment of recurrent high-grade glioma, where re-irradiation is difficult due to prior dose burden. We investigated effects of carbon RT on tumor micro-vascularization and micro-circulation, by evaluating semi-quantitative parameters derived from DCE MRI before and after irradiation. Results show augmented perfusion parameters AUC, maximum enhancement and wash-out after therapy compared to pre-RT scans, and lower AUC, wash-in, wash-out and final uptake for responders to therapy compared to non-responders. Additionally, significantly lower values for AUC, wash-out, maximum enhancement and final uptake could be observed for progressed tumor volumes compared to irradiated tumor volumes.

3813	Computer 22	Changes in Apparent Diffusion Coefficient (ADC) of the Dominant Tumor during Dose-Painted Radiotherapy and High Dose Rate (HDR) Brachytherapy for Prostate Cancer
		Sangjune Lee[1], Jenny Lee[1], Tim Craig[1], Alejandro Berlin[1], Peter Chung[1], Cynthia Ménard[2], and Warren Foltz[1]
		[1]Radiation Oncology, Princess Margaret Cancer Centre, University Health Network, Toronto, ON, Canada, [2]Radiation Oncology, University of Montreal, Montreal, ON, Canada

		PIRADS-2 compliant Apparent Diffusion Coefficient mapping (ADC) and T2-weighted imaging was performed at baseline and week 6 of radiotherapy in 57 patients with localized prostate cancer. 101 radiomics features were calculated across the gross tumor volume (GTV) and whole prostate (WP). GTV ADC histogram metrics (10 percentile, median, mean) increased (p<1e-06) at equivalent maximum ADC values. High percentile WP ADC histogram metrics (90 percentile, maximum) decreased (p<2e-05) at equivalent 10 percentile/median/mean values. Between 44 (for GTV ADC) and 65 (for WP applied to T2w-weighted images) radiomics features were significantly different and will be explored as potential early predictive biomarkers of response.

3814	Computer 23	Quantification of MRI visibility and artefacts at 3T of liquid fiducial marker in a pancreas tissue mimicking phantom
		Sergej Schneider[1,2], Rasmus Irming Jølck[3,4], Esther Gera Cornelia Troost[1,2,5,6,7], and Aswin Louis Hoffmann[1,2,5]
		[1]Institute of Radiooncology-OncoRay, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany, [2]OncoRay – National Center for Radiation Research in Oncology, Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany, [3]Nanovi Radiotherapy A/S, Kgs. Lyngby, Denmark, [4]Department of Micro- and Nanotechnology, Center for Nanomedicine and Theranostics, Technical University of Denmark, Kgs. Lyngby, Denmark, [5]Department of Radiotherapy and Radiation Oncology, Faculty of Medicine and University Hospital Carl Gustav Carus, Technische Universität Dresden, Dresden, Germany, [6]German Cancer Consortium (DKTK), partner site Dresden, and German Cancer Research Center (DKFZ), Heidelberg, Germany, [7]National Center for Tumor Diseases (NCT), partner site Dresden, Dresden, Germany
		In image-guided radiotherapy (IGRT) of patients with pancreatic ductal adenocarcinoma (PDAC), implanted fiducial gold markers are used for position verification and for registration of computed tomography (CT) and MRI scans used for delineation purposes. Recently, a liquid biodegradable carbohydrate based injectable soft tissue marker, compatible with CT and MRI, has been developed. Our aim was to quantitatively evaluate the tradeoff between visibility and artifacts of this marker on MRI and compare this with two solid fiducial gold markers commonly used in IGRT of PDAC.

3815	Computer 24	Respiratory-Resolved Single-Shot Fast Spin Echo with Improved Volume Consistency
		Anne Menini[1], Daniel V Litwiller[2], Yuji Iwadate[3], and Ersin Bayram[4]
		[1]Global MR Applications & Workflow, GE Healthcare, Menlo Park, CA, United States, [2]Global MR Applications & Workflow, GE Healthcare, New York, NY, United States, [3]Global MR Applications & Workflow, GE Healthcare, Hino, Japan, [4]Global MR Applications & Workflow, GE Healthcare, Houston, TX, United States

		We present a motion-correction-based method for improving through-slice volume consistency for respiratory-resolved single-shot fast spin echo for the purposes of image-guided radiation therapy planning.

Electronic Poster

Endogenous Contrast Mechanisms in Cancer Imaging

Exhibition Hall	Tuesday 8:15 - 9:15

3816	Computer 25	Anisotropy of Anomalous Diffusion Helps in Grading of Gliomas
		Boyan Xu[1], Lu Su[2], Zhenxiong Wang[3], Yang Fan[4], Bing Wu[4], Gaolang Gong[5], Wenzhen Zhu[3], Peiyi Gao[2], and Jia-Hong Gao[1]
		[1]Center for MRI Research, Peking University, Beijing, China, [2]Department of Radiology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China, [3]Department of Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [4]MR Research China, GE Healthcare, Beijing, China, [5]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China
		Anomalous diffusion model has been introduced and shown to be beneficial in clinical applications, compared with conventional diffusion models. However, the anisotropy of anomalous diffusion was neglected and its clinical feasibility remains uncertain. In this study, the use of anisotropy of anomalous diffusion is investigated for differentiating low- and high-grade cerebral gliomas. Based on the results, it is shown that the anisotropy of anomalous diffusion offers advantages compared to that of conventional diffusion models, indicating its potential to facilitate future studies of neuropathological changes in clinical populations.

3817	Computer 26	The Restricted Diffusion Model for Differentiation of Tumor from Normal Tissue in Glioblastoma
		Yuan Li[1,2], Michelle Kim[3], Theodore Lawrence[2], Parmar Hemant[3], and Yue Cao[1,2,3]
		[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Radiation Oncology, University of Michigan, Ann Arbor, MI, United States, [3]Radiology, University of Michigan, Ann Arbor, MI, United States

		It is a challenge to differentiate non-enhanced solid tumor from edema in glioblastoma. This study applied the restricted diffusion model to high b-value diffusion weighted images to characterize glioblastoma. The formation of the restricted diffusion model was derived for bi-polar diffusion gradients. The parameters fitted by the restricted diffusion model can differentiate solid tumor from edema and normal-appearing white matter and grey matter, better than the conventional apparent diffusion coefficient and the bi-exponential model without accounting for diffusion restriction of intra-cellular water.

3818	Computer 27	Intravoxel incoherent motion (IVIM) provides reliable measures of blood volume in patients with metastases to the brain
		Line Brennhaug Nilsen[1], Knut Håkon Hole[2], Ingrid Digernes[1], Endre Grøvik[3], Oliver Geier[1], Edmund Reitan[2], Cathrine Saxhaug[4], Åslaug Helland[4], Kari Dolven Jacobsen[4], Birger Breivik[5], Dag Ottar Sætre[6], and Kyrre Eeg Emblem[1]
		[1]Diagnostic Physics, Oslo University Hospital, Oslo, Norway, [2]Radiology and Nuclear Medicine, Oslo University Hospital, Oslo, Norway, [3]Diagnostic Physic, Oslo University Hospital, Oslo, Norway, [4]Oslo University Hospital, Oslo, Norway, [5]Hospital of Southern Norway, Kristiansand, Norway, [6]The Hospital Østfold Kalnes, Kalnes, Norway
		In this study, we aimed to assess the potential of using intravoxel incoherent motion (IVIM) for measuring cerebral blood volume (CBV) in brain metastases and normal brain tissue. DWI was acquired with b=0, 200, 300 and 1000s/mm^2 in nineteen patients with 23 brain metastases from lung cancer. Asymptotic IVIM fitting yielded an estimation of the perfusion fraction, and subsequent estimation of CBV. CBV_{DWI} in brain metastases and gray matter correlated significantly with CBV obtained from conventional DSC MRI. Our results suggest that IVIM may serve as an independent and reliable surrogate marker of blood volume in well perfused brain tissue.

3819	Computer 28	In Vivo Assessment of Lauren Classification for Gastric Cancer Using Diffusion MRI with a Fractional Order Calculus Model
		Muge Karaman[1], Lei Tang[2], Ziyu Li[3], Yu Sun[4], Jia Fu Ji[3], and Xiaohong Joe Zhou[1,5]
		[1]Center for Magnetic Resonance Research, University of Illinois at Chicago, Chicago, IL, United States, [2]Department of Radiology, Peking University Cancer Hospital and Institute, Beijing, China, [3]Department of Gastrointestinal Surgery, Peking University Cancer Hospital and Institute, Beijing, China, [4]Department of Pathology, Peking University Cancer Hospital and Institute, Beijing, China, [5]Departments of Radiology, Neurosurgery, and Bioengineering, University of Illinois at Chicago, Chicago, IL, United States

		Gastric cancer (GC) is the second most common cause of cancer-related mortality globally. Histological assessment of GC has been based on Lauren classification which categorizes the tumor according to its morphological features. In respond to the need for probing biological tissue complexity, a growing number of diffusion-weighted imaging studies have focused on revealing tissue microstructures by measuring non-Gaussian diffusion behaviors. One of these techniques is the fractional order calculus (FROC) model. In this study, we have used the FROC model to investigate non-invasive imaging-based assessment of GC, providing an alternative to histopathology-based Lauren classification.

3820	Computer 29	Whole Body Magnetic Resonance Imaging in Paediatric Hodgkin's Lymphoma; The Application of Quantitative Parameters for Nodal Staging
		Arash Latifoltojar[1], Paul D Humphries [1], Athar Haroon [2], Leon Menezes[2], and Shonit Punwani[1]
		[1]Centre for Medical Imaging, University College London, London, United Kingdom, [2]Institute of Nuclear Medicine, University College London Hospital, London, United Kingdom
		Nodal disease on whole-body MRI (WB-MRI) is mainly assessed using size criteria that could misclassify sub-centimeter lymphomatous nodes. In this study we investigated the comparative performance of anatomical WB-MRI derived nodal-size and signal-intensity; and whole-body diffusion-weighted-imaging (WB-DWI) nodal-size and apparent-diffusion-coefficient (ADC) measurements for determination of nodal-disease status. We showed that diseased nodes had significantly lower ADCs than benign nodes. We also noticed that for nodes deemed negative for disease based on size criteria (measuring 5-9 mm) ADC was significantly lower for FDG PET-CT -positive compared to FDG PET-CT -negative nodes. We also note that the performance of ADC was not greater than simple size measurement and concluded that there were no added advantage for quantitative measurements to simple size criteria on WB-MRI.

3821	Computer 30	Whole body 3.0 T MRI for Staging Lymphomas: An Assessment of Multiple Sequences Compared to Reference Standard Imaging
		Arash Latifoltojar[1], Mark Duncan[2], Maria Klusmann[2], Alan Bainbridge[3], Deena Neriman[4], Francesco Fraioli[4], Jonathan Lambert[5], Kirit Ardeshna[5], and Shonit Punwani[1]
		[1]Centre for Medical Imaging, University College London, London, United Kingdom, [2]Department of Radiology, University College London Hospital, London, United Kingdom, [3]Department of Medical Physics and Biomedical Engineering, University College London Hospital, London, United Kingdom, [4]Institute of Nucear Medicine, University College London Hospital, London, United Kingdom, [5]Department of Haemato-oncology, University College London Hospital, London, United Kingdom

		In lymphomas, whole-body MRI (WB-MRI), integrating structural / functional MRI sequences, offers an alternative radiation-free imaging method to standard radiological techniques. In this work, we evaluated multiple MRI sequences as part of a WB-MRI protocol for staging of 22 newly-diagnosed Hodgkin's lymphoma and diffuse large B-cell lymphoma patients compared to reference-standard 18F-FDG PET-CT. We found that the performance of WB-MRI for nodal / extra-nodal disease detection and Ann-Arbor staging were at best when the entire protocol was reviewed. We observed an inferior diagnostic performance of WB-MRI using diffusion-weighted-imaging and an improved diagnostic performance when T2-weighted / post-contrast WB-MRI were reviewed.

3822	Computer 31	The effect of flow suppression on BOLD MRI of lung tumor
		Heling Zhou[1], Olivier Belzile[2], Zhang Zhang[3], Jo Wagner[1], Chul Ahn[4], James Richardson[5], Debabrata Saha[3], Rolf A Brekken[6], and Ralph P Mason[1]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Hamon Center for Therapeutic Oncology Research, UT Southwestern Medical Center, Dallas, TX, United States, [3]Radiation Oncology, UT Southwestern Medical Center, Dallas, TX, United States, [4]Clinical Science, UT Southwestern Medical Center, Dallas, TX, United States, [5]Pathology, UT Southwestern Medical Center, Dallas, TX, United States, [6]Surgery, UT Southwestern Medical Center, Dallas, TX, United States
		Blood oxygen level dependent (BOLD) MRI is used to provide information on tumor oxygenation. However, the measurements are susceptible to blood flow changes, which often occur during hyperoxic gas challenge. This study investigated the extent of flow sensitivity by comparing BOLD measurements with and without flow suppression using two orthotopic lung xenograft tumor models. Flow suppression was found to affect multiple measurements including ΔSI(%) and R_2*. The range of discrepancy was smaller in R_2* than the ΔSI(%). High similarity was found in spatial patterns. ROI and spatial pattern analysis showed higher sensitivity to flow in A549 tumors than H460 tumors.

3823	Computer 32	High b value (2000 s/mm2) Diffusion-weighted Imaging in Prostate Cancer Detection: Comparison between Zoomed Field of View (iZOOM) with a Two Dimensional Radiofrequency Pulse (2D-RF) Echo Planar Imaging (EPI) Sequence and Conventional ss-EPI DWI at 3.0 T
		Shuai Ma[1], Kangjie Xu[1], Huihui Wang[1], Huihui Xie[1], Hongxia Sun[1], Juan Wei[2], Xiaodong Zhang[1], and Xiaoying Wang[1]
		[1]Department of Radiology, Peking University First Hospital, Beijing, China, [2]Integrated solution center, Philips (China) Investment Co., Ltd, Shanghai, China

		This study aims to evaluate diagnostic efficacy of high b value (2000s/mm2) zoomed field of view (iZOOM) with a 2D-RF EPI sequence, compared with conventional ss-EPI (CONV) diffusion-weighted imaging (DWI) for peripheral zone (PZ) prostate cancer (PCa) detection at 3.0 T. Prostate Imaging Reporting and Data System version 2 (PI-RADS v2) were used as evaluation tool and the TRUS-guided systematic plus targeted biopsies was considered as reference standard. It demonstrated iZOOM could provide excellent visual conspicuity as well as a better diagnostic performance compared with CONV DWI in PZ, especially in the small lesions and the lesions abutting the capsule.

3824	Computer 33	Differentiation of Normal and Radioresistant DU145 Tumour Xenografts in Mice Using CEST MRI
		Wilfred W Lam[1], Wendy Oakden[1], Leedan Murray[1], William Chu[1,2,3], Stanley K Liu[1,2,3], and Greg J Stanisz[1,2,4]
		[1]Sunnybrook Research Institute, Toronto, ON, Canada, [2]University of Toronto, Toronto, ON, Canada, [3]Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [4]Medical University of Lublin, Lublin, Poland
		The differentiation of normal and radioresistant tumour potentially allows the tailoring of cancer treatment to the patient. DU145 prostate cancer cells from normal and radioresistant cell lines were injected in mouse hind limb and allowed to grow into tumours. The tumours were imaged within 48 h before and after x-ray therapy using CEST. The magnetization transfer ratio (MTR) was compared between tumours grown from each cell line and at both time points. The MTR was significantly different at a frequency offset of –3.3 ppm at both time points. T_1 and T_2 values were not found to be significantly different.

3825	Computer 34	Diffusion weighted MRI simplifies therapy monitoring in TRAMP mice
		Jana Kim[1], Caroline K Søgaard[2,3], Eugene Kim[4], Tone F Bathen[1,5], Marit Otterlei[2,3], Siver A Moestue[1,6], and Deborah K Hill[1]
		[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway, [2]Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway, [3]Clinic of Surgery, St. Olavs Hospital, Trondheim, Norway, [4]Department of Neuroimaging, King's College London, London, United Kingdom, [5]Department of Radiology, Department of Radiology, Trondheim, Norway, [6]Department of Laboratory Medicine, Women's and Children's Health, Norwegian University of Science and Technology, Trondheim, Norway
		Transgenic mouse models of prostate cancer have advantages over xenograft tumor models as the cancer arises spontaneously and can be studied in immunocompetent mice, thus being highly biologically relevant. However, in vivo monitoring of cancer progression and treatment response is challenging and most studies rely on prostate volume measurements. Here we show that diffusion weighted imaging is a helpful tool for assessing response to chemotherapy in transgenic adenocarcinoma of the mouse prostate (TRAMP) mice.

3826	Computer 35	Standard Diffusion-Weighted, Diffusion Kurtosis and Intravoxel Incoherent Motion MR Imaging of Sinonasal Malignancies: Correlations with Ki-67 Proliferation Status
		Zebin Xiao[1], Zuohua Tang[1], Jinwei Qiang[2], Yufeng Zhong[2], Rong Wang[1], and Zhongshuai Zhang[3]
		[1]Radiology, Eye & ENT Hospital of Fudan University, Shanghai, China, [2]Jinshan Hospital of Fudan University, Shanghai, China, [3]Siemens Healthcare Ltd., Shanghai, China
		This study aimed to explore the correlations between parameters derived from standard diffusion-weighted imaging (DWI), diffusion kurtosis imaging (DKI) and intravoxel incoherent motion (IVIM) with the Ki-67 proliferation status. Our preliminary study shows that DWI-derived parameters from different models are capable of providing different pathophysiological information. DWI, DKI and IVIM parameters are associated with Ki-67 proliferation status. Kmax derived from DKI is the strongest independent factor for the prediction of Ki-67 proliferation status.

3827	Computer 36	Intravoxel Incoherent Motion MR Imaging in the Differentiation between Benign and Malignant Sinonasal Lesions: Comparison with Conventional Diffusion-Weighted MR Imaging
		Zebin Xiao[1], Zuohua Tang[1], Jinwei Qiang[2], Yufeng Zhong[2], Rong Wang[1], and Zhongshuai Zhang[3]
		[1]Radiology, Eye & ENT Hospital of Fudan University, Shanghai, China, [2]Jinshan Hospital of Fudan University, Shanghai, China, [3]Siemens Healthcare Ltd., Shanghai, China
		This study aimed to evaluate the value of intravoxel incoherent motion (IVIM) in the differentiation between benign and malignant sinonasal lesions and to compare the diagnostic performance of IVIM with conventional diffusion-weighted imaging (DWI). Our preliminary study shows that ADC, D and f values may be considered as discriminating markers for identifying benign and malignant sinonasal lesions. The combination of D and f values demonstrates significantly higher sensitivity, specificity and accuracy than the ADC value, revealing that IVIM appears to be a more valuable tool than conventional DWI for distinguishing benign from malignant sinonasal lesions.

3828	Computer 37	ADC histogram analysis of rectal cancer patients for early detection of therapeutic efficacy of neoadjuvant radio-chemotherapy: initial results.
		Martin Buechert[1] and Oliver Schäfer[2]
		[1]Department of Radiology - Medical Physics, University Medical Center, Freiburg, Germany, [2]Klinik für Radiologie, Klinikum St. Georg, Leipzig, Germany

		Successful monitoring of neoadjuvant radiochemo therapy will allow early selection of responder and non-responder. Beside conventional morphological MRI additional functional MRI in combination with advanced analysis strategies like histogram analysis of ADC values are promising. Initial results of an ongoing clinical study are presented.

3829	Computer 38	Intravoxel incoherent motion (IVIM) imaging for differential diagnosing hepatocellular carcinoma (HCC), hepatic hemangioma(HHA) and hepatic metastasis(HM).
		Ye Ju[1], Ailian Liu[1], Meiyu Sun[1], Lihua Chen[1], and Lizhi Xie[2]
		[1]Radiology Department, The First Affiliated Hospital of Dalian Medical University, Dalian, China, [2]GE Healthcare China, Beijing, China
		The diffusion property of tumor tissues largely depends on cell density, which may also be predictive features of malignancy in some types of tumors. Intravoxel incoherent motion (IVIM) imaging is an extension of diffusion weighted imaging (DWI) that can be used to investigate both diffusion and perfusion changes in tissues. Comparing the IVIM parameters between carcinoma (HCC), hepatic hemangioma and hepatic metastasis, we found that IVIM can facilitates understanding of tumor tissue characteristics of perfusion and diffusion, and it may provide more useful information to distinguish hemangiomas from other two malignant tumors.

3830	Computer 39	Visualization of Peritumoral Fasciae by Dual-band Long-T2 Saturation UTE at 7T MRI
		Yupeng Cao[1,2], Xiaohan Zhou[1,2], Yang Fan[3], Yuqing Wang[1], Wentao Liu[1], and Dong Han[1,2]
		[1]CAS Center for Excellence in Nanoscience, National Center for Nanoscience and Technology, Chinese Academy of Sciences, Beijing, China, [2]School of Future Technology, University of Chinese Academy of Sciences, Beijing, China, [3]MR Research China, GE Healthcare, Beijing, China
		Fasciae are related with the tumor invasion. To investigate the alteration of peritumoral fasciae during tumor invasion, a novel dual-bandlong-T2saturation UTE sequence was proposed in this study. This sequence was applied to suppress the signal from long-T2 tissue components, consequently directly providing short-T2 contrast. Tumor-bearing Balb/c mouse was scanned on a 7T MRI scanner with the proposed sequence and standard FLASH to compare the quality of fasciae imaging. The results showed that the long-T2 signal was effectively suppressed and the peritumoral fasciae was visualized with this novel technique. This technique will give potential clinical feasibility of the fascia-related diseases.

3831	Computer 40	Detecting Glioblastoma invasion using Multi-parametric MRI and Quantitative Assessment with in-plane Histology

		Haitham Farooq Al-Mubarak[1], Antoine Vallatos[1], Jim Birch[1], Lindsay Gallagher[1], Joanna Birch[2], Lesley Glmour[2], John Foster[3], William Holmes[1], and Anthony Chalmers[2]
		[1]Glasgow Experimental MRI center, University of Glasgow, Glasgow, United Kingdom, [2]Institute of Cancer Sciences, University of Glasgow, Glasgow, United Kingdom, [3]MRI and clinical physics, Glasgow, United Kingdom
		We evaluate the ability of a range of MRI techniques to probe glioblastoma invasion in a mouse model by comparison with in-plane stacked histology, enabling a direct voxel-to-voxel comparison between MRI and histology (HLA stain). We used the G7 mouse model which exhibits highly invasive tumour margins and scanned using T1 weighted, T2 weighted, T2map, Diffusion Tensor Imagining (DTI) and Perfusion Weighting Imaging (PWI). Registration of MRI datasets with stacked in-plane histology allows direct quantitative validation using DICE and ROC analysis, showing that PWI gave the best indication of tumour cell invasion.

3832	Computer 41	Non-linear Mechanics Allows Non-invasive Quantification of Interstitial Fluid Pressure
		Daniel Fovargue[1], Jack Lee[1], Marco Fiorito[1], Adela Capilnasiu[1], Sweta Sethi[2], Stefan Hoelzl[1], Jurgen Henk Runge[1], Jose de Arcos[1], Arnie Purushotham[3], Khesthra Satchithananda[3], David Nordsletten[1], and Ralph Sinkus[1]
		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Department of Research Oncology, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, [3]Division of Cancer Studies, King's College London, London, United Kingdom
		Established tumour treatments include drugs and the emerging class of cell-based therapies. Individual tumours can counteract the delivery of the therapy, for example, they can feature high internal pressures (IFP) caused by blood vessels that are different from normal tissues. Furthermore, a drop in IFP is a well-established marker for successful therapy. Here we demonstrate in simulations, phantom experiments, fatty breast tissue, and a benign breast lesion that tissue biomechanics as quantified via MR-Elastography (MRE) allows in combination with non-linear mechanics to estimate IFP in absolute units non-invasively.

3833	Computer 42	Pilot Study of Rapid MR Pancreas Screening for Patients with BRCA Mutation
		Giuseppe Corrias[1], Andrea Agostini[1], Gabriella Carollo[2], Luca Saba[3], and Lorenzo Mannelli[1]
		[1]Radiology, MSKCC, New York, NY, United States, [2]St. John's University, Jamaica, NY, United States, [3]Radiology, Università degli studi di Cagliari, CAGLIARI, Italy

		Patients with BRCA mutations are offered breast MRI because of their increased risk of breast cancer, but no screening strategy is available for other BRCA-associated malignancies including pancreatic ductal adenocarcinoma. In this protocol, we optimize the use of several recent developments in body MRI for a rapid pancreatic screening in BRCA mutation carriers: first, rapid relatively motion insensitive T2-weighted imaging (T2WI) and navigator triggering (NT), where real-time tracking of the diaphragm position is performed. Secondly advances in diffusion-weighted-imaging (DWI). These techniques have changed our ability to screen for malignancies, in specific organs, such as the pancreas.

3834	Computer 43	Monitoring the Growth of Individual Tumours in the Mouse Lung using Cardio-Respiratory Synchronised bSSFP MRI
		Ana L. Gomes[1], Paul Kinchesh[1], Danny Allen[1], Veerle Kersemans[1], Stuart Gilchrist[1], Luiza Madia-Lourenco[2], Anderson Ryan[2], and Sean C. Smart[1]
		[1]CRUK and MRC Oxford Institute for Radiation Oncology, Department of Oncology, University of Oxford, Oxford, United Kingdom, [2]Department of Oncology, University of Oxford, Oxford, United Kingdom
		bSSFP imaging is used in-vivo to image small tumours in the mouse lung, at an isotropic resolution of 200μm in under 10 minutes per scan. Cardio-respiratory synchronisation using prospective gating control is used to minimise motion artefacts efficiently, and a 4 step RF phase cycle is used to eliminate banding artefact. Growth of individual tumours in multi-focal lung cancer can be measured with a throughput of >4 mice per hour.

3835	Computer 44	Towards an ultra-high field virtual biopsy for hepatic cancers using phospholipid metabolism
		Deb Rivera[1,2,3], IML van Kalleveen[3], Catalina Arteaga de Castro[4], Hanneke Laarhoven[3], Dennis Klomp[1,4], Wybe van der Kemp[4], Jaap Stoker[3], and Aart Nederveen[3]
		[1]MR Coils BV, Zaltbommel, Netherlands, [2]Spinoza Centre, Amsterdam, Netherlands, [3]Academic Medical Center, Amsterdam (AMC), Amsterdam, Netherlands, [4]University Medical Center Utrecht (UMCU), Utrecht, Netherlands
		At 7T 31P spectroscopy becomes possible on clinically relevant scales. Here we tackle the greatest challenge in multi-parametric imaging at high-field – creating localizers and radiological-grade images in the body in the absence of a bore body coil. By using antennas rather than loop coils, we image the full extent of the liver (n=10). Combining antennas with parallel transmit, allows radiological-grade images. Although technically feasible, it is not yet possible to obtain multi-nuclear spectra and parallel transmit images within the same scan session. We combine the methods by rebooting the scanner mid-exam, and demonstrate the method can be used for imaging patients.

3836	Computer 45	CEST MRI to contrast chondrosarcoma tumors: two contrasts in one acquisition.

		Leslie Mazuel[1,2], Aurélien Voissière[1], Valérie Weber[1], Yvain Gérard[1], Sophie Besse[1], Jean-Marie Bonny[2], Elisabeth Miot-Noirault[1], Caroline Peyrode[1], and Guilhem Pagès[2]
		[1]Université Clermont Auvergne, INSERM, U1240 Imagerie Moléculaire et Stratégies Théranostiques, Clermont-ferrand, France, [2]AgroResonance - UR370 QuaPA, Saint Genès Champanelle, France
		This study aims to develop a non-invasive CEST MRI method to evaluate simultaneously pH and glycoaminoglycans (GAG) as a new imaging method for assessing hypoxic and chondrogenic status in chondrosarcoma *in vivo*.

3837	Computer 46	Multi-exponential T2* mapping distinguishes benign/malignant lymph nodes in rectal cancer patients: an ex-vivo and in-vivo experiment
		Inês Santiago[1], João Santinha[2], Andrada Ianus[3,4], Nickolas Papanikolaou[2], Celso Matos[1], and Noam Shemesh[3]
		[1]Radiology Department, Champalimaud Research, Champalimaud Centre for the Unkown, Lisbon, Portugal, [2]Computational Clinical Imaging Group, Champalimaud Research, Champalimaud Centre for the Unkown, Lisbon, Portugal, [3]Neuroplasticity and Neural Activity Lab, Champalimaud Research, Champalimaud Centre for the Unkown, Lisbon, Portugal, [4]Centre for Medical Imaging Computing, Department of Computer Science, University College London, London, United Kingdom
		In rectal cancer patient management, quality-of-life compromise due to unnecessary neoadjuvant chemoradiation is a major concern and may be driven by false positive lymph node(LN) staging. We sought to distinguish benign LNs from LNs with different patterns of malignant infiltration by investigating multi-exponential decay in multi-gradient-echo(MGE) MRI ex-vivo, at 16.4T. The experiment was translated to the clinic and performed at 1.5T during rectal cancer staging. We found that the 2-compartment model of T2* decay allows malignant and benign LNs to be distinguished in clinical images with a higher specificity than that of conventional criteria, namely short-axis>5mm, border irregularity and mixed signal intensity.

3838	Computer 47	Levels of choline-containing compounds are not increased in human liver metastases of colorectal cancer: an assessment by 1H MR spectroscopy
		Edwin E.G.W. ter Voert[1,2], Linda Heijmen [2], Jack J.A. van Asten [2], Alan J. Wright [3], Iris D. Nagtegaal [4], Cornelis J.A. Punt [5], Johannes H.W. de Wilt[6], Hanneke W.M. van Laarhoven [5,7], and Arend Heerschap [2]
		[1]Nuclear Medicine, University Hospital Zurich, Zurich, Switzerland, [2]Radiology and Nuclear Medicine, Radboud University Medical Center, Nijmegen, Netherlands, [3]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [4]Pathology, Radboud University Medical Center, Nijmegen, Netherlands, [5]Medical Oncology, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands, [6]Surgery, Radboud University Medical Center, Nijmegen, Netherlands, [7]Medical Oncology, Radboud University Medical Center, Nijmegen, Netherlands

		The commonly observed relative signal increase of choline-containing compounds (tCho) in ^{1}H MR spectra of tumors may serve as a diagnostic biomarker. Here we evaluate the potential of this tCho signal in ^{1}H MR spectra of the human liver to assess metastases of colorectal cancers. An increased tCho signal was not observed for these metastases. With increasing tumor volumes, the tissue levels of tCho decreased. The likely reason is a larger necrotic voxel fraction as it correlated with more higher ADC values assessed by diffusion weighted imaging. A Bland-Altman analysis revealed average repeatability in normal livers and poor repeatability in tumors.

3839	Computer 48	Relationship of apparent diffusion coefficient on diffusion-weighted imaging and tumour burden in ovarian cancer
		He An[1], Elaine Lee[1], and Queenie Chan[2]
		[1]The University of Hong Kong, Hong Kong, Hong Kong, [2]Philips Healthcare, Hong Kong, Hong Kong
		To investigate the relationship of apparent diffusion coefficient (ADC) on diffusion-weighted imaging (DWI) and tumour burden in ovarian cancer. The ADC of primary ovarian tumour (ADCpri), peritoneal carcinomatosis (ADCmet), and the ratio of ADCmet/ADCpri (ADCratio) were correlated with the total tumour volume (TV) contoured on T2WI as representation of tumour burden in ovarian cancer. Significant correlations were found between ADCmet and TV, and between ADCratio and TV. Our study suggested that the analysis of ADC might provide important information on tumour burden in OC.

Electronic Poster

Non-Edited MRS/MRSI

Exhibition Hall	Tuesday 8:15 - 9:15

3840	Computer 49	Over-discretized SENSE reconstruction and B0 correction for accelerated non-lipid suppressed 1H FID MRSI of the human brain at 9.4T
		Sahar Nassirpour[1,2], Paul Chang[1,2], and Anke Henning[1,3]
		[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience, Eberhard-Karls University of Tuebingen, Tuebingen, Germany, [3]Institute of Physics, Ernst-Moritz-Arndt University Greifswald, Greifswald, Germany

		In this study the acquisition of high resolution (64x64) metabolite maps at 9.4T using a non-lipid suppressed ultra-short TR and TE ^{1}H FID MRSI sequence is accelerated using an improved over-discretized SENSE reconstruction and B_0 correction method. The improved reconstruction is compared to conventional SENSE and GRAPPA reconstruction, and reproducible metabolite maps are acquired using this technique.

3841	Computer 50	SNR Requirements for Successful Application of Compressed Sensing Acceleration to Non-lipid suppressed 1H MRSI at Ultra-High Fields
		Sahar Nassirpour[1,2], Paul Chang[1,2], Nikolai Avdievitch[1,3], and Anke Henning[1,3]
		[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience, Eberhard-Karls University of Tuebingen, Tuebingen, Germany, [3]Institute of Physics, Ernst-Moritz-Arndt University Greifswald, Greifswald, Germany
		In this work we systematically investigate the requirements for successful application of compressed sensing for highly accelerating the acquisition of non-lipid suppressed ^{1}H FID MRSI data at ultra-high fields. It is shown that with a combination of parallel imaging and sparse reconstruction, and an RF coil with an even distribution of receive sensitivity, highly accelerated and high resolution metabolite maps can be acquired at 9.4T through compressed sensing.

3842	Computer 51	Arbitrary Variable Density (AVD)-GRAPPA Enabled EPSI of Short-echo 3D H1-MRSI
		Maryam Vareth[1,2], Yan Li[1], Misung Han[1], Marram P. Olson[1], Jason Crane[1], Sarah J. Nelson[1,3], and Janine M. Lupo[1,3]
		[1]Surbeck Laboratory of Advanced Imaging, Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Berkeley Institude of Data Science, Univeristy of Califonia, Berkeley, Berkeley, CA, United States, [3]UCSF/UCBerkeley Joint Graduate Group in Bioengineering, San Francisco, CA, United States
		This work investigates the feasibility of using arbitrary sampling patterns and GRAPPA-EPSI reconstruction to shorten the acquisition time and increase the spatial resolution of short-echo 3D-MRSI for routine clinical purposes. Fully sampled data were retrospectively under-sampled to achieve effective acceleration rates of 2, 3 and 4 using a variety of sampling patterns. The modified GRAPPA algorithm: 1) took advantage of the FID time points, 2) handled arbitrary sampling patterns, and 3) used a fast, high-resolution external calibration acquisition to estimate sensitivity maps.

3843	Computer 52	Comparison of Compressed Sensing Reconstruction for 3D Echo Planar Spectroscopic Imaging data using Total Variation and Statistically Optimized Perona-Malik Non-linear Diffusion

Andres Saucedo[1], Ajin Joy[2], Eric S. Daar[3], Mario Guerrero[3], Joseph Suresh Paul[2], Manoj K. Sarma[1], and M. Albert Thomas[1]

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Conventional magnetic resonance spectroscopic imaging requires long acquisition times. Echo planar spectroscopic imaging (EPSI) significantly reduces the scan time but is limited by conventional phase encoding. Non-uniform sampling and compressed sensing (CS) reconstruction can further accelerated 3D EPSI. We applied a Perona-Malik (PM) non-linear diffusion algorithm for CS reconstruction of 3D EPSI data in both retrospectively and prospectively undersampled phantom and in-vivo data sets, and compared results with those using Total Variation (TV). Our pilot findings demonstrate that PM produces improved reconstruction results compared to TV. Furthermore, PM eliminates the need for parameter tuning, giving it a great advantage over TV.

3844 Computer 53

Fast Irregular MRSI spiral acquisition for sparse spectra. Application to 31P MRSI in muscles.

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Magnetic resonance spectroscopic imaging (MRSI) has multiple interests in clinical practice but it faces quite long acquisition time in practice which limits its use in a clinical environment. In this work, a new fast Magnetic Resonance Spectroscopic image acquisition method, inspired by Compressed Sensing using the a priori known sparse support of the metabolites chemical shift, is introduced and evaluated based on a k-t space spiral sampling. In the proposed method, the spatial and temporal interleaves are both taken in consideration during the implementation, in order to reach an even faster acquisition. This method has been evaluated using real *in vivo* 31P data.

3845 Computer 54

Residual water signal removal in MR spectroscopic imaging with L2 regularization

Liangjie Lin[1,2], Michal Považan[1], Adam Berrington[1], Zhong Chen[2], and Peter B. Barker[1,3]

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		Residual water signals in MRSI data may hinder the quantification of metabolite signals and thus affect the quality of final metabolite maps. A L2 regularization based post-processing method is proposed here for efficient removal of residual water signals especially in MRSI data. Using a water-basis matrix, the proposed method aims to find spectra that match the original metabolite signals, but at the same time imposes a constraint of reduced water signals. Results show that the L2 regularization based method can be a highly effective way for removing residual water signals from MRSI data of human brain.

3846	Computer 55	High Resolution Semi-LASER Localized Echo Planar Spectroscopic Imaging at Ultra High Field
		Eduardo Coello[1,2], Ralph Noeske[3], Brian L. Burns[4], Jeremy W. Gordon[5], Angela Jakary[5], Bjoern Menze[1], Axel Haase[1], Peder E.Z. Larson[5], Yan Li[5], and Rolf F. Schulte[2]
		[1]Technische Universität München, Munich, Germany, [2]GE Healthcare, Munich, Germany, [3]MR Applied Science Lab Europe, GE Healthcare, Berlin, Germany, [4]MR Applied Science Lab, GE Healthcare, Menlo Park, CA, United States, [5]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States
		This work presents a robust framework for fast high-resolution ^{1}H MRSI at 7 Tesla using semi-localized by adiabatic selective refocusing (semi-LASER) and high-bandwidth symmetric echo planar spectroscopic imaging (EPSI). Inconsistencies in the symmetric EPSI trajectory are corrected using a single shot water reference scan, effectively removing spectral ghosting. With the proposed methodology, high-resolution metabolite ratio maps that show correlation with anatomical structures were obtained under 5-minutes.

3847	Computer 56	Whole Brain 5mm-isotropic 3D 1H-FID-MRSI accelerated with Compressed-Sensing SENSE
		Antoine Klauser[1], Sebastien Courvoisier[1], Michel Kocher[1], Dimitri Van De Ville[1,2], and Francois Lazeyras[1]
		[1]Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [2]Institute of Bioengineering, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
		Proton FID-MRSI sequence was implemented in 3D to measure metabolite distributions over whole brain up to 5mm-isotropic resolution. MRSI dataset was reconstructed through a Low-Rank-TGV model enabling Compressed-sensing SENSE acceleration. Acceleration performance was assessed quantitatively on a-posteriori 6.6mm-isotropic dataset showing good agreement up to a factor 2. As proof of concept, metabolite images of a 5mm-isotropic dataset accelerated by a factor 2 were acquired and reconstructed.

3848	Computer 57	Effect of the phase variation induced by eddy currents on localized spectroscopy fatty acid composition quantification and its correction

Angéline Nemeth[1], Benjamin Leporq[1], Amandine Coum[2,3], Giulio Gambarota[2,3], Kévin Seyssel[4], Bérénice Segrestin[5], Pierre-Jean Valette[6], Martine Laville[5], Olivier Beuf[1], and Hélène Ratiney[1]

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Monte Carlo simulations and in vivo measurements on human abdominal adipose tissue were used to analyze the effect of the phase variation induced by eddy currents on localized spectroscopy fatty acid composition quantification (proportion of polyunsaturated, monounsaturated and saturated fatty acid). Monte Carlo simulations showed that base line distortions were able to strongly impact estimation of fatty acid composition. So we proposed a simple method to correct the base line using a second signal acquired with a longer TE. Test-retest variability of quantitative results was reduced using this correction.

3849 Computer 58

IceVespa: Automated Inline MR Spectral Processing and Fitting on the Clinical Platform

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The IceVespa module is a flexible add-in functor for the Siemens IceProgramF ICE pipeline for MRS data. Raw MRS data is sent to a Python-based Vespa-Analysis spectral processing node via an XML-RPC client/server. Graphical and tabular spectral analysis fitting results are returned to the ICE pipeline and saved in the standard DICOM workflow. Analysis executes in its own process. XML-RPC was chosen for inter-process communication for its simplicity and flexibility for relocating the processing node using standard HTTP protocols. Combining Python-based IceVespa inline with standard C++ ICE processing increases processing algorithm choice while maintaining clinical access to quantitative MRS measures.

3850 Computer 59

Analysis Methods for Human Hyperpolarized 13C-pyruvate Studies

Peder Eric Zufall Larson[1], Hsin-Yu Chen[1], Jeremy W. Gordon[1], John Maidens[2], Daniele Mammoli[1], Mark Van Criekinge[1], Robert Bok[1], Rahul Aggarwal[3], Marcus Ferrone[4], James B. Slater[1], John Kurhanewicz[1], and Daniel B. Vigneron[1]

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		A major challenge for human Hyperpolarized 13C metabolic MRI is to develop informative, accurate and robust methods for measuring metabolic conversion, while accounting for a broad range of experimental characteristics and without gold-standard experiments for evaluating accuracy and precision. We present a simulation framework to evaluate analysis strategies and show that an “input-less” kPL fitting method is a promising approach for accurate and robust measurements of metabolism in human hyperpolarized 13C-pyruvate MRI. We evaluate this method in human prostate cancer studies, where we observed variability of ±5-10s in the bolus delivery that can lead to errors in other analysis methods.

3851	Computer 60	MRSI Brain Temperature Mapping Using Machine Learning
		Dhritiman Das[1,2,3,4], Michael J Thrippleton[3], Scott IK Semple[5], Rolf F Schulte[4], Mike E Davies[2], Bjoern H Menze[1], and Ian Marshall[3]
		[1]Department of Computer Science, Technical University of Munich, Munich, Germany, [2]Institute for Digital Communications, University of Edinburgh, Edinburgh, Scotland, [3]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, Scotland, [4]GE Healthcare, Munich, Germany, [5]Centre for Cardiovascular Sciences, University of Edinburgh, Edinburgh, Scotland
		We propose a machine-learning framework for brain temperature estimation in MRSI using human in-vivo data from 1.5T and 3T scanners. We consider the chemical-shift based method as our benchmark and compare our results against it. Our framework, based on random-forest regression, performs a K-fold cross validation on the MRSI dataset which includes (1) learning the spectral features (including the chemical-shift) from the subjects; (2) obtaining brain temperature estimates and computing the error over the corresponding jMRUI-fitted chemical-shift based estimates. Compared to jMRUI, our method, after training, gives a low estimation error and a 30-fold improvement in estimation speed per patient.

3852	Computer 61	Direct Estimation of Model Parameters in MR Spectroscopic Imaging using Deep Neural Networks
		Dhritiman Das[1,2], Eduardo Coello[2,3], Anjany Sekuboyina[1,4], Rolf F Schulte[2], and Bjoern H Menze[1]
		[1]Department of Computer Science, Technical University of Munich, Munich, Germany, [2]GE Healthcare, Munich, Germany, [3]Department of Physics, Technical University of Munich, Munich, Germany, [4]Klinikum rechts der Isar, Munich, Germany

		We introduce a deep neural-network framework based on a multilayer perceptron for estimation of the output parameters of a model-based analysis of MR spectroscopy data. Our proposed framework: (1) learns the spectral features from a training set comprising of different variations of synthetic spectra; (2) uses this learning and performs non-linear regression for the subsequent metabolite quantification. Experiments involve training and testing on simulated and in-vivo human brain spectra. We estimate parameters such as metabolite-concentration ratios and compare our results with that from the LCModel.

3853	Computer 62	Spatially localized pure shift 1H MRS for biological tissues at 7 T
		Yuqing Huang[1], Weinan Lai[1], and Zhong Chen[1]
		[1]Department of Electronic Science, Xiamen University, Xiamen, China
		Proton magnetic resonance spectroscopy (^{1}H MRS) presents an effective tool for *in vivo* studies on biological tissues by the non-invasive detection manner. However, due to limited proton chemical shift range and extensive *J* coupling splittings, spectral congestions or even overlapping are generally encountered in resulting 1D ^{1}H MRS acquired by routine STimulated Echo Acquisition Mode (STEAM) and Point resolved spectroscopy (PRESS) experiments. In this report, we presents a previously-unreported MAS approach to obtain spatially localized 1D pure shift spectra with spectral simplification, potentially useful for studies on biological samples.

3854	Computer 63	HOPE (Half-intensity with macrOmolecule-suPprEssion): Ultra-short TE MRS without macromolecules on 3 T, 4 T and 9.4 T
		Xi Chen[1], Yihong Yang[2], Dost Ongur[1], and Fei Du[1]
		[1]McLean Hospital; Harvard Medical School, Belmont, MA, United States, [2]National Institute on Drug Abuse, Baltimore, MD, United States
		The strong and overlapping macromolecule (MM) signals remains as one of the major technical challenges for metabolites quantification using ultra-short TE MRS. HOPE (Half-intensity with macrOmolecule-suPprEssion), a simple but effective MM suppression MRS method based on SPECIAL, was proposed and tested on human 3T, 4T and animal 9.4T. HOPE has no additional pulse or cycling compared to SPECIAL but with the same short TE. With the similar SNR level as STEAM, HOPE achieves additional benefit with substantial suppression of MM signals and more accurate quantifications of MM overlapped metabolites such as lactate and GABA.

3855	Computer 64	Intra- and inter-site reproducibility of single voxel MRS at 3T in the human brain
		Carina Graf[1,2], Erin L MacMillan[3,4,5], Eric Fu[6], Irene M Vavasour[7], Trudy Harris[7], Burkhard Mädler[8], Anthony Traboulsee[9], David KB Li[7,9], Alex MacKay[1,7], and Cornelia Laule[1,2,7,10]

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We investigated the intra- and inter-site reproducibility of 1H-MRS with short-TE PRESS at 3T acquired on a single manufacturer at 6 different sites. Metabolite concentrations were robust to small inconsistencies in voxel placement (mean alignment=86%), highlighting that site was not the driving factor for differences in metabolite concentrations. Between-subject differences drove the concentration variability for creatine, choline and myoinositol (42-65% of the variance). The mean intra-site coefficient of variation for the metabolites was between 2.5% and 5.3%. The results support the use of a large single voxel 1H-MRS acquisition from a single manufacturer for multi-site clinical trials.

3856 | Computer 65

Eddy current evaluation and minimization for PRESS localized diffusion tensor spectroscopy.

Chris Hanstock[1] and Christian Beaulieu[1]

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Gradients used for diffusion spectroscopy require minimization of the eddy currents. Eddy currents impact phase alignment, spectral distortion, and signal amplitude, contributing to error in estimating diffusion coefficients. Strategies have been employed to minimize their effects, including using bipolar gradient pulses around the MRS volume selective pulses. This concept has been further refined to allow multiple eddy current time constants to be minimized by using asymmetric bipolar gradient pairs. An additional oscillatory eddy current may arise as the result of vibration and acoustic noise. We present a simple method for assessing and minimizing the oscillatory eddy currents.

3857 | Computer 66

Evaluation of accuracy and reproducibility of 1H MRS measurements of lactate at 7 T

Masoumeh Dehghani[1], Kim Q. Do [1], Pierre Magistretti[1,2], and Lijing Xin[3]

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		Lactate is known as an end-product of aerobic glycolysis, and it has been considered as a potential biomarker of metabolic abnormalities occurred in different cerebral pathological states. However, the ^{1}H MRS detection of lactate is hampered by the presence of co-resonant lipid and macromolecule resonances. The aim of this study was to evaluate the performance of different ^{1}H MRS protocols applied in semi-adiabatic spin-echo full-intensity acquired localized spectroscopy sequence, I) TE=16 ms, no inversion, II) TE=16 ms, TI= 300 ms, and III) TE=110 ms, no inversion in reliable detection of lactate in the brain using *in vivo* measurement and simulated spectra at different experimental condition. The *in vivo* measurement and simulation analysis suggests that short-TE ^{1}H MRS approach without inversion pulse is likely to be a more reliable method for estimating the absolute concentration of lactate and other metabolites simultaneously from the human brain.

3858	Computer 67	Quantification and Assessment of T2 Relaxation Times of Human Bile Components with In Vivo MR Spectroscopy at 7T
		Martin Gajdošík[1,2], Marek Chmelík[3,4,5], Emina Halilbasic[6], Lorenz Pfleger[2], Michael Trauner[6], Siegfried Trattnig[5,7], and Martin Krššák[2,5,7]
		[1]Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York City, NY, United States, [2]Division of Endocrinology and Metabolism, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria, [3]Faculty of Healthcare, University of Prešov, Prešov, Slovakia, [4]Department of Radiology, General Hospital of Levoča, Levoča, Slovakia, [5]High-field MR Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [6]Division of Gastroenterology and Hepatology, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria, [7]Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria
		In vivo measurements of concentrations of bile components are of high interest for understanding and diagnosis of cholestatic diseases. We measured human bile in the gallbladder in vivo using single-voxel ^{1}H-MR spectroscopy at 7T and assessed T_2 relaxation times of water and eight bile components in healthy volunteers. With precise T_2 correction, all eight bile components could be quantified with ultra-short TE sequence and four with long TE sequence.

3859	Computer 68	A 3 Minute Clinical Protocol for Quantitative High-Speed MR Spectroscopic Imaging in Patients with Brain Tumors
		Troy Hutchins-Delgado[1], Mohammad Omar Chohan[2], Kevin Tagne Fotso[1], Lakshmisree Damodaran[1], Howard Yonas[2], Mona D Chaney[1], and Stefan Posse[3]
		[1]Neurology, University of New Mexico, Albuquerque, NM, United States, [2]Neurosurgery, University of New Mexico, Albuquerque, NM, United States, [3]Neurology, Physics and Astronomy, University of New Mexico, Albuquerque, NM, United States

		We develop a quantitative 3-minute 3D short echo-time (TE) proton-echo-planar-spectroscopic-imaging (PEPSI) protocol. The short scan time is made possible by using partial brain coverage that encompasses the tumor and integration of the water reference (WR) scan into the water suppression module, which enables short repetition time. The method was validated in 5 healthy controls and applied to mapping tumor margins and infiltration in 3 patients with brain tumors. Slab-averaged metabolite/water ratios varied by less than 10% between healthy controls and metabolite concentration values after partial volume and relaxation correction were in the range of our previous study.

3860	Computer 69	Assessment of metabolic heterogeneity in glioblastoma multiforme (GBM) through histogram analysis of whole-brain echo planar spectroscopic imaging
		Gaurav Verma[1], Sanjeev Chawla[2], Suyash Mohan[2], Sumei Wang[2], Rebecca Emily Feldman[1], MacLean Nasrallah[3], Steven Brem[4], Donald O'Rourke[4], Harish Poptani[5], and Priti Balchandani[1]
		[1]Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Neuroradiology, Hospital of the University of Pennsylvania, Philadelphia, PA, United States, [3]Pathology, Hospital of the University of Pennsylvania, Philadelphia, PA, United States, [4]Neurosurgery, Hospital of the University of Pennsylvania, Philadelphia, PA, United States, [5]Cellular and Molecular Physiology, University of Liverpool, Liverpool, United Kingdom
		Glioblastoma multiforme (GBM) is an infiltrating and heterogeneous disease with low median survival and over 70% recurrence rates, though 20-30% of progressive enhancing lesions seen in GBM post-treatment exhibit pseudoprogression rather than true recurrent tumor. Differentiating these could improve speed and accuracy of treatment. A statistical and histogram analysis of segmented high-resolution echo-planar spectroscopic imaging data goes beyond mean metabolite ratios to show distribution of Cho/NAA and Cho/Cr ratios in contrast enhancing regions and the surrounding tissue. Cho/NAA distribution in enhancing region showed greater kurtosis than Cho/Cr, suggesting reduction in NAA may be a driving factor in observed Cho/NAA increases.

3861	Computer 70	Cross-validated full-field of view MRSI using a new spatial lipid extraction technique and HSVD and PG algorithms in the human brain.
		Peter Adany[1], In-Young Choi[1,2,3], and Phil Lee[1,3]
		[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States, [2]Neurology, University of Kansas Medical Center, Kansas City, KS, United States, [3]Department of Molecular & Integrative Physiology, University of Kansas Medical Center, Kansas City, KS, United States

		Reliable 1H MRS measurement in the brain is challenging due to strong lipid signals as high as two orders of magnitude stronger than metabolites. We propose a new spatial-domain post processing technique to extract the lipid signal and compare our method with the HSVD and PG algorithms applied to full field of view (FOV) MRSI data (no lipid nulling, no outer volume suppression). Results of lipid removal were assessed visually and by spectral quantification of MRSI voxels for N=9 subjects. Our method outperformed HSVD and PG and achieved reliable full-FOV MRSI, promising to reach the maximum potential of whole-brain MRSI.

3862	Computer 71	High resolution 3D EPSI Spectroscopic Imaging compared with Spectral Localization by Imaging (SLIM)
		Sean Edmund Ellis[1,2], Peter Adany[1], Phil Lee[1,2,3], and In-Young Choi[1,2,3,4]
		[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States, [2]Department of Bioengineering, University of Kansas, Lawrence, KS, United States, [3]Department of Molecular & Integrative Physiology, University of Kansas Medical Center, Kansas City, KS, United States, [4]Department of Neurology, University of Kansas Medical Center, Kansas City, KS, United States
		Quantitative measurements of metabolites in important structures in the human brain are challenging to acquire using conventional spectroscopic imaging methods. In this study, we compared regional metabolite concentrations obtained from high resolution 3D EPSI MRSI data using two different methods: spatial averaging inside regions of interest using the MIDAS software, and Spectral Localization by Imaging (SLIM)-based MRS. Deep brain structures were studied and compared using the two methods. The quantitative outcomes of 3D EPSI and SLIM were comparable and SLIM could provide metabolite concentrations using shorter scan times by reducing the required number of voxel acquisitions.

3863	Computer 72	MRSI-based characterization of GBM using a novel map: Expected Distance to Tumor (EDT)
		Nuno Pedrosa de Barros[1], Raphael Meier[2], Samuel Stettler[1], Urspeter Knecht[1], Evelyn Herrmann[3], Philippe Schucht[4], Mauricio Reyes[2], Jan Gralla[1], Roland Wiest[1], and Johannes Slotboom[1]
		[1]Institute for Diagnostic and Interventional Neuroradiology, University of Bern, Bern, Switzerland, [2]Institute for Surgical Technology and Biomechanics, University of Bern, Bern, Switzerland, [3]Institute of Radiooncology, University of Bern, Bern, Switzerland, [4]Neurosurgery, University of Bern, Bern, Switzerland
		MRSI can detect regions of brain tumor infiltration beyond the tumor borders visible in structural-MRI (sMRI). However, this is often achieved using only a small fraction of the information provided by MRSI, namely Cho/NAA maps only. Here, we present a new machine-learning-based approach that translates the multidimensional information provided by each spectrum into a single measure: the Expected Distance to solid Tumor volume visible in sMRI. The results show that peritumoral spectra carry information on the distance to solid tumor and that EDT maps may improve the characterization of peritumoral tissue changes invisible with structural MRI.

Electronic Poster

Non-Proton MRS/MRI: Technological Advances

Exhibition Hall	Tuesday 8:15 - 9:15

3864	Computer 73	Assessment of Bound Sodium using Triple Quantum Selection vs. Inversion Recovery at 21.1 T
		Nastaren Abad[1,2], Ghoncheh Amouzandeh[2,3], Jens T. Rosenberg[2], Michael G. Harrington[4], and Samuel Colles Grant[1,2]
		[1]Chemical & Biomedical Engineering, Florida State University, Tallahassee, FL, United States, [2]Center for Interdisciplinary MR, National High Magnetic Field Laboratory, Tallahassee, FL, United States, [3]Physics, Florida State University, Tallahassee, FL, United States, [4]Huntington Medical Research Institutes, Pasadena, CA, United States
		This study evaluates Triple Quantum (TQ) and Inversion Recovery (IR) techniques at 21.1 T with regards to bound sodium quantification. Using both gel phantoms imitating physiological concentrations/bound fractions as well as *in vivo* animal pathological models, the efficiency, SNR and selectivity of ^{23}Na TQ and IR techniques were compared with the ultimate goal of localizing specific sodium changes within intra- and extracellular compartments related to disease progression.

3865	Computer 74	Investigating Bound Sodium Signals using a Novel Chemical Shift Imaging Triple Quantum Technique
		Nastaren Abad[1,2], Ghoncheh Amouzandeh[2,3], Jens T. Rosenberg[2], Michael G. Harrington[4], and Samuel Colles Grant[1,2]
		[1]Chemical & Biomedical Engineering, Florida State University, Tallahassee, FL, United States, [2]Center for Interdisciplinary MR, National High Magnetic Field Laboratory, Tallahassee, FL, United States, [3]Physics, Florida State University, Tallahassee, FL, United States, [4]Huntington Medical Research Institutes, Pasadena, CA, United States
		^{23}Na-based MRI techniques can be used to separate sodium signal originating from the extracellular and intracellular compartments. Triple Quantum (TQ) schemes can select the coherence pathway that evolves in slow moving/restricted regimes, such as in the intracellular compartment. In this study, a novel TQ technique based on a modified chemical shift imaging sequence (CSI-TQ), which yields higher signal-to-noise ratios, is introduced for studies at 21.1 T. The CSI-TQ is compared to a more conventional gradient recalled echo variant (GRE-TQ) with respect to SNR and efficiency.

3866	Computer 75	Simultaneously Acquired Single- and Triple-Quantum Spectroscopic Imaging with Density-Adapted Projection Reconstruction and Time Proportional Phase Increment

		Ruomin Hu[1], Matthias Malzacher[1], Michaela A U Hoesl[1], Dennis Kleimaier[1], and Lothar R Schad[1]
		[1]*Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany*
		Multi-quantum filtered spectroscopic imaging methods utilize the spin-3/2 characteristic of ^{23}Na nuclei to generate multi-quantum coherences reflecting on the binding of $^{23}Na^+$ to macromolecules. In this work, a spectroscopic density-adapted radial imaging modality was developed to simultaneously acquire single-quantum and triple-quantum signal under identical condition using time proportional phase increments. In vivo rat head images with 1 mm resolution were acquired in under an hour. This method may be applied to monitor the single-quantum and triple-quantum signal development in diseases such as stroke and cancer and lead to a deeper understanding of metabolic processes in healthy and diseased tissue.

3867	Computer 76	Sodium imaging with an UTE technique to study the effects of exercise on muscle.
		Benjamin L Prestwich[1], Charlotte E Buchanan[1], Andrew P Hale[1], Andrew M Peters[1], and Susan T Francis[1]
		[1]*Sir Peter Mansfield Magnetic Imaging Centre, University of Nottingham, Nottingham, United Kingdom*
		Sodium (^{23}Na) imaging can provide insight into the effects of exercise on muscle. Here we perform a 3D dual TE UTE scheme with radial FID readout to assess the alterations in sodium tissue concentration in the gastrocnemius and soleus muscles; immediately after exercise performed inside the scanner using a Trispect pedal system. In addition an mDIXON proton scan was acquired for delineation of the muscle groups. Following exercise, the time course of the ^{23}Na signal intensity in the medial gastrocnemius and soleus muscles was found to return to baseline after approximately 30 minutes, with a 10 – 20 % signal change.

3868	Computer 77	Design of a Dual Saddle Coil Setup for High Resolution 1H/23Na MRI of Ex Vivo Rat Tail Intervertebral Discs at 14.1T
		Lance Tyler Williams[1,2], John Edward Clark[3], Lukas Neuberger[4], Gangchea Lee[1], Daniel H. Cortes[2], and Thomas Neuberger[1,5]
		[1]*Biomedical Engineering, The Pennsylvania State University, State College, PA, United States,* [2]*Mechanical and Nuclear Engineering, The Pennsylvania State University, State College, PA, United States,* [3]*Science Dept., Deltona High School, Deltona, FL, United States,* [4]*State College High School, State College, PA, United States,* [5]*Huck Institutes of the Life Sciences, The Pennsylvania State University, State College, PA, United States*

		Rat-tail intervertebral disc puncture is a commonly used model for studying treatment options and the pathology of Degenerative Disc Disease (DDD). However, longitudinal studies are impossible as analysis through biochemistry and histology requires euthanization. High-field MRI provides a possible solution to this problem as initial structural and compositional changes related to disc degeneration are observable. In this work, a dual saddle coil was constructed for 1H/23Na imaging at 14.1T. It was concluded from ex vivo rat-tail proton and sodium images that sodium MRI is feasible, and it could be an effective method for rat-tail intervertebral disc degeneration evaluation.

3869	Computer 78	Effect of B0 and B1 Field Inhomogeneity Correction on Region-of-Interest Analysis on 3T Sodium 23Na-MRI
		Elaine H Lui[1], Vijay Venkatraman[1], Christopher Steward[1], Tie-Qiang Li[2], and Patricia M Desmond[1]
		[1]Department of Medicine and Radiology, University of Melbourne, Royal Melbourne Hospital, Parkville, Australia, [2]Department of Medical Radiation and Nuclear Medicine, Karolinska University Hospital, Stockholm, Sweden
		Evaluation of the effect of B0 and B1 correction on region-of-interest (ROI) analysis in forty-one 3T brain 23Na-MRI scans shows average change from B0, B1 and B0B1 correction of 1.0% (p=0.05), -3.7% (p<0.001) and -4.7% (p<0.001) respectively. Effect is more for B1 than B0 correction, and depending on the anticipated effect size of the neurologic disease of interest, B0 +/- B1 correction may not be required, potentially reducing scan time by 66% and thus encourage quantitative 23Na-MRI research in a clinical environment.

3870	Computer 79	Double quantum filtered 23Na MRI with magic angle excitation in presence of B0-inhomogeneities
		Lena V. Gast[1], Bernhard Hensel[2], Michael Uder[1], and Armin M. Nagel[1]
		[1]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany, [2]Center for Medical Physics and Engineering, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany
		In ^{23}Na MRI it is possible to selectively detect signal from sodium ions bound to anisotropic structures by applying a double quantum filter with magic angle excitation (DQ-MA). In this work, the influence of B_0-inhomogeneities on the DQ-MA filtering capacity was examined both theoretically and experimentally. We found that under practical conditions ($\|\Delta B_0\| \approx 50$ Hz at 3T) a significant amount of unwanted odd rank double quantum coherence signal may pass the filter even in case of perfect magic angle excitation. Therefore, B_0-inhomogeneities may cause an over-estimation of the degree of anisotropy.

3871	Computer 80	Investigating the 23Na Flip-Angle Effect in Cartilage, Skin, and Muscle

		Atefeh Kordzadeh[1], Jade Duchscherer[2], Christian Beaulieu[3], and Robert Stobbe[3]
		[1]Biomedical Engineering, University of Alberta, Edmonton, Canada, [2]University of Victoria, Victoria, Canada, [3]Biomedical Engineering Department, University of Alberta, Edmonton, Canada
		The measurement of sodium concentration in cartilage, skin, and muscle with ^{23}Na MRI requires the knowledge and minimization of spin 3/2-related signal losses. Here, a common B_1 mapping experiment is used here to show that greater than prescribed flip-angles are produced in healthy human cartilage, skin, and muscle and that this effect is increased with longer RF excitation pulses. This points to the presence of residual quadrupole interactions in these tissues. To avoid the concomitant signal loss associated with residual quadrupole interactions, very hard (short) RF excitation pulses may be required.

3872	Computer 81	Improved Encoding Efficiency in Sodium MRI with Zero-Gradient-Excitation Ramped Hybrid Encoding (zGRF-RHE)
		Yasmin Blunck[1,2], Bradford A Moffat[2], Scott C Kolbe[2], Roger J Ordidge[2], Jon O Cleary[2], and Leigh A Johnston[1,2]
		[1]Biomedical Engineering, University of Melbourne, Melbourne, Australia, [2]Melbourne Brain Centre Imaging Unit, University of Melbourne, Melbourne, Australia
		The fast signal decay in sodium MRI makes high quality image acquisition challenging. Here we enhance image quality by improving encoding time (t_{enc}) efficiency using a special case of ramped hybrid encoding , zero-gradient-under-RF-excitation RHE (zG_{RF}-RHE). This provides 1) gradient-free-excitation for high flip angle, non-selective excitation profiles necessitated by low signal in sodium MRI and 2) gradient ramping during deadtime for optimised t_{enc}, to reduce T2 decay influence during acquisition. The performance of zG_{RF}-RHE is demonstrated in simulations, phantom and in vivo experiments and improves image quality (SNR and T2 blurring). It is applicable to any centre-out trajectory design.

3873	Computer 82	Influence of motion and partial volume effects on measured tissue sodium concentration in cardiac $^{23}$Na MRI
		Johanna Lott[1], Jonathan M. Lommen[1], Sebastian C. Niesporek[1], Tanja Platt[1], Nicolas G.R. Behl[1], Mark E. Ladd[1], and Armin M. Nagel[1,2]
		[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany

		Sodium (^{23}Na) ions are involved in many biological processes. The tissue sodium concentration can be determined with ^{23}Na MRI; however, fast relaxation times, breathing and heart motion as well as the high sodium concentration of blood render quantitative determination of the myocardial sodium concentration challenging. We present a method to analyze the tissue sodium concentration within the myocardium by utilizing a partial volume correction as well as correction of motion effects. The presented workflow can reduce the bias by up to 49%.

3874	Computer 83	Voxel localization for sodium NMR triple-quantum signal; sequence design and test in agarose phantoms and in-vivo rat
		Michaela A U Hoesl[1], Dennis Kleimaier[1], Matthias Malzacher[1], Ruomin Hu[1], and Lothar R Schad[1]
		[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany
		The TQTPPI – sequence is a global spectroscopic method, which can be used to study the sodium metabolism of cells in-vitro with the foremost interest in the occurrence of the triple-quantum signal. This spectroscopic analysis could offer precise knowledge of sodium metabolic processes in pathology versus healthy tissue. To address clinical questions, we aim for transferring this method to in-vivo patient acquisitions where the need for a localization arises. Two different localization strategies, which preserve the quantum coherences, were successfully implemented and tested in-vitro and in-vivo on a rat using a 9.4T small-animal scanner.

3875	Computer 84	Can sodium triple-quantum signal separate extra- and intracellular signals? – investigation on HEP G2 liver cells, liposomes and nanoparticles
		Michaela A U Hoesl[1], Dennis Kleimaier[1], Ruomin Hu[1], Matthias Malzacher[1], Eric Gottwald[2], Cordula Nies[2], and Lothar R Schad[1]
		[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany, [2]Institute of Functional Interfaces, Karlsruhe Institute of Technology, Karlsruhe, Germany
		Sodium MRI is increasing in popularity albeit the apparent challenges of low SNR and fast bi-exponential decay. Currently, intra- and extra cellular sodium can only be resolved by introducing a chemical shift reagent which is unusable in human studies due to toxicity. There is discussion on whether triple-quantum signal (TQS) could provide a discriminator for resolving intra- and extracellular signal due to motion restriction of sodium ions within the cell. This work investigates the TQS behavior using a triple quantum sequence with time proportional phase increment (TQTPPI) on liposomes, HEP G2 liver cells and nanoparticles to disentangle the reasons for occurring TQS.

3876	Computer 85	Multi-pulse Sodium Magnetic Resonance Imaging for Multi-compartment Quantification in Brain at 7T

		Martin Gajdošík[1], Alina Gilles[1,2], Ivan Kirov[1], and Guillaume Madelin[1]
		[1]*Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York City, NY, United States,* [2]*Institute of Radiology, Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany*
		We propose a new approach to investigate intra- and extracellular sodium in vivo. In this preliminary study we could differentiate brain compartments and provide an estimate of intracellular and extracellular sodium concentrations as well as intracellular, extracellular and cerebrospinal fluid volume fractions.

3877	Computer 86	Application of 3D-Dictionary Learning Compressed Sensing Reconstruction En Route to Isotropic Submillimeter Spatial Resolution Sodium (23Na) In Vivo MRI of the Human Eye at 7.0 Tesla
		Daniel Wenz[1], Nicolas G.R. Behl[2], Armin M. Nagel[2,3], Mark E. Ladd[2], and Thoralf Niendorf[1,4]
		[1]*Berlin Ultrahigh Field Facility, Max Delbrueck Centrum, Berlin, Germany,* [2]*Division of Medical Physics in Radiology, German Research Centre (DKFZ), Heidelberg, Germany,* [3]*Institute of Radiology, Unviersity Hospital Erlangen, Erlangen, Germany,* [4]*MRI.TOOLS GmbH, Berlin, Germany*
		Sodium ion (Na^+) is a very important factor in the physiology of the human eye. However sodium (^{23}Na) MRI is limited by its low sensitivity. Compressed sensing provides means to overcome this challenge. This work demonstrates the feasibility of high spatial resolution (1mm isotropic) ^{23}Na in vivo MRI of the eye using a dedicated six-channel transceiver array in conjunction with a 3D dictionary learning compressed sensing algorithm. This approach showed distinct noise reduction along with substantial reduction in total acquisition time if benchmarked against conventional reconstruction employing standard gridding.

3878	Computer 87	Simulation of 13C labeling Effects of Glutamate and Glutamine in 1H MR Spectra with different Pulse Sequences at 9.4 T
		Theresia Ziegs[1,2] and Anke Henning[1,3]
		[1]*High-Field Magnetic Resonance, Max-Planck-Institute of Biological Cybernetics, Tübingen, Germany,* [2]*Graduate School of Neural and Behavioural Sciences, Tuebingen, Germany,* [3]*Institute of Physics, Ernst-Moritz-Arndt University Greifswald, Greifswald, Germany*

		Glutamate related metabolism can be measured considering the 13C labeling effects from an administered 13C labeled substrate in pure 1H MRS spectra without a 13C channel. In this work, simulated 1H MRS spectra with FID, semi-Laser, and two PRESS sequences have been compared to optimize spectral resolution for glutamate and glutamine measurements at 9.4 T. Furthermore, spectral changes according to a two-compartment model were analyzed. As a result, this work indicates the fastest possible acquisition can be obtained with an FID sequence, while the best resolution possible can be obtained with a PRESS sequence.

3879	Computer 88	Minimum echo-time PRESS-localized proton observed carbon edited (POCE) magnetic resonance spectroscopy for rat brain imaging using simultaneous editing and localization pulses.
		Chathura Kumaragamage[1], Dan Madularu[2], Axel P Mathieu[3], Derek Lupinsky[3], Robin A de Graaf[4], and Jamie Near[2]
		[1]Biomedical Engineering, McGill University, Montreal, QC, Canada, [2]McGill University, Montreal, QC, Canada, [3]Douglas Hospital Brain Imaging Center, Montreal, QC, Canada, [4]Yale University, New Haven, CT, United States
		Dynamic Carbon-13 (^{13}C) magnetic resonance spectroscopy (MRS) remains to be the only noninvasive method capable of measuring neuroenergetics and neurotransmitter cycling in the brain[1]. Proton observed carbon edited (POCE) MRS[2] is an attractive alternative to direct ^{13}C methods due to improved signal-to-noise-ratio (SNR). This study reports a PRESS localized POCE sequence utilizing simultaneous editing and localization (SEAL-PRESS), which allows the TE to be reduced to a theoretically optimal value of ~1/J_{HC} (8.1ms, in this implementation). The sequence was validated in phantom and in a rat preparation, and demonstrated >17% improvement in ^{13}C labeled metabolites relative to a 12.6-ms PRESS-POCE sequence.

3880	Computer 89	Evaluation of three different broadband ^1H decoupling techniques for 13C-MRS at high field using double-tuned array coils
		Guillaume Donati[1] and Rolf Gruetter[1,2]
		[1]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]Department of Radiology, University of Lausanne, University of Geneva, Lausanne, Geneva, Switzerland
		synopsis

3881	Computer 90	Coil Combination Methods for 16-channel Hyperpolarized ^{13}C Spectroscopic Imaging Studies of Liver Metastases Patients

		Zihan Zhu[1,2], Xucheng Zhu[1,2], Michael Ohliger[1], Peng Cao[1], Shuyu Tang[1,2], Jeremy W Gordon[1], Lucas Carvajal[1], Peter J Shin[1], Rahul Aggarwal[3], Robert Bok[1], John Kurhanewicz[1], Pamela Munster[3], Peder E.Z. Larson[1], and Daniel B Vigneron[1]
		[1]Department of Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States, [2]UC Berkeley - UCSF Graduate Program in Bioengineering, UCSF, San Francisco, CA, United States, [3]Department of Medicine, UCSF, San Francisco, CA, United States
		Effective coil combination methods for human hyperpolarized ^{13}C spectroscopy data remain relatively unexplored. This study implemented several coil combination methods, including sum-of-squares (SOS), singular value decomposition (SVD), and pyruvate map based sensitivity calibration (PyrMap). These methods were evaluated by both simulation and in human cancer studies. Overall, both the SVD and PyrMap methods demonstrated better accuracy and robustness than SOS, and the PyrMap best preserved the phase information.

3882	Computer 91	The effects of iodinated CT contrast agent on phosphorus MRS
		Ladislav Valkovic[1,2], Justin YC Lau[1,3], Ines Abdesselam[1], Oliver Rider[1], Damian J Tyler[1,3], Christopher T Rodgers[1,4], and Jack JJJ Miller[1,3,5]
		[1]Oxford Centre for Clinical MR Research (OCMR), RDM Cardiovascular Medicine, University of Oxford, Oxford, United Kingdom, [2]Department of Imaging Methods, Institute of Measurement Science, Slovak Academy of Sceinces, Bratislava, Slovakia, [3]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, United Kingdom, [4]The Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, United Kingdom, [5]Department of Physics, University of Oxford, Oxford, United Kingdom
		Contrast-enhanced CT examination can influence ^{1}H-MRI measurements performed within 24h after the CT scan, due to a reduction in water T_1 and T_2 caused by the iodinated contrast agents used in CT. We have investigated whether contrast from a previous CT examination would also influence metabolic measurements made using ^{31}P-MRS, by measuring the T_1 of ^{1}H and ^{31}P signals in human blood. We find that iodinated CT contrast agent has no effect on phosphorus T_1s. Therefore, ^{31}P-MRS examinations will not be influenced by prior CT (unlike ^{1}H-MRI scans).

3883	Computer 92	In vivo 31P MRI at 7 Tesla in humans using a 3D spectrally selective SSFP sequence and TPI k-space sampling.
		Arthur Coste[1], Sandro Romanzetti[2], Denis Le Bihan[1], Cécile Rabrait-Lerman[1], and Fawzi Boumezbeur[1]
		[1]DRF-ISVFJ-NeuroSpin, CEA, Paris Saclay University, Gif sur Yvette, France, [2]Neurology Department, RWTH Aachen University Hospital, Aachen, Germany

		Spectrally selective ^{31}P MRI can be of interest for the study of brain energetics for clinical research. Using a 3D SSFP sequence with non-Cartesian Twisted Projection Imaging sampling, we obtained whole-brain images of ATP and PCr in healthy volunteers at 7 Tesla with a higher normalized SNR than with CSI. Local concentration quantification was performed using the phantom replacement approach after accounting for the T_1/T_2-weighting and the transmission and reception profiles of our coil yielding consistent results.

3884	Computer 93	Retrospective frequency correction for fluorine (19F) MRS using an external reference
		Chu-Yu Lee[1], In-Young Choi[1,2,3], Jean C Dinh[4], William M Brooks[1,2], Steven J Leeder[4,5], and Phil Lee[1,3]
		[1]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States, [2]Department of Neurology, University of Kansas Medical Center, Kansas City, KS, United States, [3]Department of Molecular & Integrative Physiology, University of Kansas Medical Center, Kansas City, KS, United States, [4]Division of Clinical Pharmacology, Toxicology, and Therapeutic Innovation, Children's Mercy Hospital, Kansas City, MO, United States, [5]Department of Pediatrics, Children's Mercy Hospital, Kansas City, MO, United States
		Fluorine MR Spectroscopy (^{19}F MRS) allows in vivo quantification of fluorine-containing antipsychotic and antidepressant drug concentrations in the brain. To detect the low concentration of the drugs (~ 5-30 μM) in the brain, it requires multiple repeated acquisitions to increase SNR and the scan time is relatively long. Therefore, it is important to ensure consistent frequency alignment across the repeated acquisitions. However, MR system instability induces drifts of the scanner frequency, particularly following MR scans with a high gradient duty cycle. Previous frequency correction methods for ^{1}H MRS require internal reference signals, such as under- or un-suppressed water, and cannot be applied to ^{19}F MRS, where the SNR of ^{19}F signals is low at each repeated acquisition. The purpose of this study is to investigate the feasibility of using an external reference for retrospective frequency correction in ^{19}F MRS.

3885	Computer 94	Measurement of oxygen consumption in a high density 3D cell culture on chip by 19F spectroscopy
		Dennis Kleimaier[1], Michaela Hoesl[1], Andreas Neubauer[1], Matthias Malzacher[1], Cordula Nies[2], Eric Gottwald[2], and Lothar Schad[1]
		[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany, [2]Institute of Functional Interfaces, Karlsruhe Institute of Technology, Karlsruhe, Germany
		Drug-induced mitochondrial dysfunction is of major clinical interest. An NMR-compatible bioreactor system was used to investigate the oxygen consumption of HepG2 cells by measuring T_1 of perflubron. The oxygen consumption was measured by stopping the perfusion. This resulted in a reduction of the oxygen concentration from (19.29 ± 0.96)% to (11.41 ± 0.92)% in 104.24 min. Our results might allow for detecting a drug-induced mitochondrial dysfunction of cells in a well-controlled environment by using the two compartments of the bioreactor.

3886	Computer 95	Low Intensity Spectral Peaks Reconstruction with Weighted Nuclear Norm Minimization on Low Rank Hankel Matrix
		Di Guo[1], Xiaofeng Du[1], Yu Yang[2], Meijing Lin[3], and Xiaobo Qu[2]
		[1]School of Computer and Information Engineering, Xiamen University of Technology, Xiamen, China, [2]Department of Electronic Science, Xiamen University, Xiamen, China, [3]College of Ocean and Earth Sciences, Xiamen University, Xiamen, China
		To speed up the acquisition time of multi-dimensional magnetic resonance spectroscopy (MRS), one typical way is to sparsely acquire free induction decay (FID) data reconstruct the spectrum from the incomplete observations. Recently, a low rank Hankel matrix (LRHM) approach, that explores the sparse number of spectral peaks, has shown great ability to reconstruct the spectrum. When the data are highly undersampled, however, low intensity spectral peaks are compromised in the reconstruction. In this abstract, a weighted LRHM approach is proposed. A weighted nuclear norm is introduced to better approximate the rank constraint, and a prior signal space is estimated from the pre-reconstruction to reduce the number of unknowns in reconstruction. Results on both synthetic and real MRS data demonstrate that the proposed approach can reconstruct low intensity spectral peaks better than the state-of-the-art LRHM method.

3887	Computer 96	Quintuple tuned coil configuration for multi-nuclear metabolic MRI at 7 tesla
		Tijl van der Velden[1], Anh Pham[2], Carel van Leeuwen[1], Debra Rivera[2], Mark Gosselink[1], and Dennis Klomp[1,2]
		[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]MR Coils, Zaltbommel, Netherlands
		Metabolic and anatomic imaging by combining X-nuclei imaging with ^1H imaging has shown great potential in clinical research. Traditional multi-nuclear coil setups are however limited to 2 or 3 frequencies, and often birdcage for ^1H. In this study we propose a coil array setup tuned for acquiring 5 different nuclei in a single scan session practically without compromising efficiency on any nuclei.

Electronic Poster

MRS Applications

Exhibition Hall	Tuesday 8:15 - 9:15

3888	Computer 97	Probing alterations of cellular metabolism in a mouse model of Huntington’s disease (R6/1) using in vivo MRS and DW-MRS

		Clémence Ligneul[1], Edwin Hernandez-Garzon[1], Marco Palombo[2], Julien Flament[1,3], and Julien Valette[1]
		[1]Molecular Imaging Research Center (MIRCen), Commissariat à l'Energie Atomique (CEA), Fontenay aux Roses, France, [2]UCL, London, United Kingdom, [3]UMS 27, INSERM, Fontenay aux Roses, France
		Huntington's disease is a genetic neurodegenerative disorder caused by the abnormal repetition of the CAG triplet in the gene coding for huntingtin (Htt). R6/1 mouse model, expressing a human form of mutated huntingtin, exhibits a progressive neuronal alteration in the striatum. We use in vivo MRS and diffusion-weighted MRS at various diffusion-weightings and diffusion times to detect changes in cellular metabolic content and structure R6/1 mice striatum. We report massive metabolic remodeling, especially for N-acetyl aspartate (NAA) and Glutamine (Gln), as well as changes in glutamate diffusion properties that we tentatively relate to variations in glutamate cellular compartmentation.

3889	Computer 98	Metabolite concentration changes associated with positive and negative BOLD signal in the human visual cortex: a functional magnetic resonance spectroscopy study at 7T.
		Yohan Boillat[1], Lijing Xin[2], Wietske Van der Zwaag[2,3], and Rolf Gruetter[1,2,4,5]
		[1]LIFMET, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]CIBM, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands, [4]Department of Radiology, University of Geneva, Geneva, Switzerland, [5]Department of Radiology, University of Lausanne, Lausanne, Switzerland
		The metabolite correlates of the negative BOLD signal were investigated using functional MRS and compared to the changes produced by the positive BOLD response. The participants were scanned in a 7-T MRI while passively viewing visual checkerboards. For the positive BOLD response, increases of glutamate and lactate concentrations were observed, while the negative BOLD response in a similar voxel was linked to a decrease of glutamate, lactate and GABA concentrations. This measured decrease of oxidative metabolism during the negative BOLD response suggest a reduction a glutamatergic activity in the visual cortex.

3890	Computer 99	Changes of brain metabolites in response to acupuncture therapy in migraine are correlated with clinical outcomes: Result from a magnetic resonance spectroscopy imaging Study
		Tao Gu[1,2], Min Chen[1], Ryan CN D'Arcy [2], and Xiaowei Song[2]
		[1]Beijing hospital, Beijing, China, [2]ImageTech laboratory, Simon Fraser University, Surrey, BC, Canada

		Migraine is a common neurological disease. Acupuncture has been proven to be effective but the mechanisms remain unclear. A proton magnetic resonance spectroscopy imaging (MRSI) study was used to investigate biochemical changes in brain regions key for the transmission of pain in response to acupuncture treatment. Results showed acupuncture treatment was associated with a significantly increased NAA/Cr in bilateral thalamus in migraine patients. A strong significant correlation between NAA/Cr and headache intensity was found in thalami. Our data provided the first evidence suggesting a brain biochemical change in response to acupuncture therapy in migraine, in correlation with clinical outcomes.

3891	Computer 100	Synergy between probiotics and antibiotics for the treatment of chronic hepatic encephalopathy: a longitudinal in vivo 1H MRS study of brain metabolism.
		Emmanuelle Flatt[1], Cristina Cudalbu[2], Olivier Braissant[3], Stefanita Mitrea[2], Dario Sessa[4], Valérie A. Mc Lin[4], and Rolf Gruetter[5]
		[1]LIFMET, EPFL, Lausanne, Switzerland, [2]CIBM, EPFL, Lausanne, Switzerland, [3]Service of Biomedecine, CHUV, Lausanne, Switzerland, [4]Swiss Center for Liver Disease in Children,Department of Pediatrics, HUG, Geneva, Switzerland, [5]CIBM/LIFMET, EPFL, Lausanne, Switzerland
		Chronic hepatic encephalopathy(HE) is a well-accepted complication of chronic liver disease(CLD), and finding the right treatment to reduce HE episodes before liver transplant remains a challenge. Both rifaximin and probiotics are currently used to reduce HE symptoms, but their precise effect on brain metabolites have never been studied. Our aims were first to assess in vivo and longitudinally the effect of the combination of probiotics and rifaximin on a rat model of chronic HE; and second to compare the results obtained to groups of non-treated/rifaximin-only treated rats. ^{1}H-MRS at high field combined with biochemical and behavioral tests were used.

3892	Computer 101	Shorter apparent T_2 relaxation times of metabolites in the older human brain
		Dinesh K Deelchand[1], J. Riley McCarten[1,2], Laura S Hemmy[1,2], Edward J Auerbach[1], and Małgorzata Marjańska[1]
		[1]University of Minnesota, Minneapolis, MN, United States, [2]Veterans Affairs Health Care System, Minneapolis, MN, United States
		The goal of this study was to compare the apparent transverse relaxation time constants (T_2) of metabolites obtained in young and older subjects in three brain regions (occipital cortex (OCC), posterior cingulate cortex (PCC) and prefrontal cortex (PFC)) using LASER at 3T. A lower apparent T_2s of *N*-acetyl aspartate and tissue water were measured in older adults in all three regions. T_2 for total creatine and *myo*-inositol were also shorter in older adults in OCC and PCC. In conclusion, differences in T_2 values of metabolites during normal brain aging are region-dependent.

3893	Computer 102	Magnetic Resonance Spectroscopy biomarkers predict patient outcome in subacute spinal cord injury
		Patrik O. Wyss[1,2,3], Peter Zweers[2], Anne K. Brust[4], Corinne Funk[4], Markus F. Berger[2], and Anke Henning[1,3,5]
		[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Department of Radiology, Swiss Paraplegic Centre, Nottwil, Switzerland, [3]Max-Planck-Institute for Biological Cybernetics, Tuebingen, Germany, [4]Clinical Trial Unit, Swiss Paraplegic Centre, Nottwil, Switzerland, [5]Ernst-Moritz-Arndt University Greifswald, Greifswald, Germany
		Spinal cord injury (SCI) is a very heterogeneous disease that makes it difficult to identify a single biomarker during rehabilitation therapy in order to predict the future patient status. In this study, we applied Magnetic Resonance Spectroscopy to examine specific metabolic markers in the pons 10 weeks after injury and correlated them with changes of the clinical status obtained twice during early rehabilitation.

3894	Computer 103	Partial Normalization of altered brain acetate metabolism in alcohol-dependent subjects after one month of sobriety
		Lihong Jiang[1], Gustavo A. Angarita[2], Kevin L. Behar[2], Elizabeth Guidone[1], Barbara I. Gulanski[3], Stuart A. Weinzimer[4], Robin A. de Graaf[1], and Graeme F. Mason[1,2]
		[1]Diagnostic Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [2]Psychiatry, Yale University, New Haven, CT, United States, [3]Yale Health, Yale University, New Haven, CT, United States, [4]Pediatrics, Yale University, New Haven, CT, United States
		The purpose of this study is to analyze the adaptation of brain acetate metabolism of AD subjects upon detoxification in order to understand the mechanism of alcohol addiction. Using 13C-magnetic resonance spectroscopy in combination of 2-13C-acetate infusion, and monitor the turn over rates of brain 13C-labeled glutamate/glutamine neurotransmitter, we have found increased brain acetate metabolism after detoxification treatment, suggesting the compromised acetate uptake/metabolism in AD subjects.

3895	Computer 104	Investigation of ethanol stimulation on HepG2 cells in a high density cell culture on chip by correlation spectroscopy
		Dennis Kleimaier[1], Andreas Neubauer[1], Michaela Hoesl[1], Cordula Nies[2], Eric Gottwald[2], and Lothar Schad[1]
		[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany, [2]Institute of Functional Interfaces, Karlsruhe Institute of Technology, Karlsruhe, Germany

		Ethanol-induced toxicity leads to alterations of certain cellular functions such as mitochondrial dysfunction. This study investigated the feasibility to detect changes induced by 2‰ ethanol stimulation on HepG2 cells in an NMR-compatible bioreactor system by double quantum filtered correlation spectroscopy. During ethanol stimulation, the spectra with cells led to an increased SNR of the glucose (15.5±2.1 %) and lactic acid (10.8%) cross peaks. These changes were larger than the SNR reproducibility of (3.94±2.44)%. Our results show that the DQF-COSY sequence can be used for the investigation of ethanol-induced damage on cells in a bioreactor system (worse shim condition).

3896	Computer 105	Response to glutaminase inhibition in patient-derived breast cancer xenograft models
		Maria Tunset Grinde[1], Jana Kim[1], Ida Marie Henriksen[1], Hanna Maja Tunset[1], and Siver Andreas Moestue[2,3]
		[1]Dept. of Circulation and Medical Imaging, NTNU (Norwegian University of Science and Technology), Trondheim, Norway, [2]Dept. of Clinical and Molecular Medicine, NTNU (Norwegian University of Science and Technology), Trondheim, Norway, [3]Dept. of Pharmacy, Nord University, Bodø, Norway
		We used ex vivo 13C HR MAS MRS to determine glutamine consumption and conversion in two patient-derived xenograft models of breast cancer, aiming to identify metabolic differences between a responding (luminal-like) xenograft and a resistant (basal-like) xenograft. CB-839 inhibited tumor growth in luminal-like, but not basal-like, xenograft tumors. Response to treatment was associated with differences in glutamine utilization. Depletion of proline in responding tumors indicate that the effect of glutaminase inhibitors may be associated with metabolic adaption to tumor hypoxia.

3897	Computer 106	Energy Metabolism Differences in Rat Skeletal Muscle Due to Restricted Ambulation Following SCI
		Celine Baligand[1], Fan Ye[2], Sean C Forbes[3], Ravneet S Vohra[1], Jonathon Keener[4], Prodip Bose[4], Floyd Thompson[4], Glenn A Walter[1], and Krista Vandenborne[3]
		[1]Physiology and Functional Genomics, University of Florida, Gainesville, FL, United States, [2]Applied Physiology and Kinesiology, University of Florida, Gainesville, FL, United States, [3]Physical Therapy, University of Florida, Gainesville, FL, United States, [4]Physiological Sciences, University of Florida, Gainesville, FL, United States
		Classic rodent models of SCI can rapidly and spontaneously recover locomotor function, muscle mass, and energy metabolism within weeks after injury. This is attributed to “self training” and does not replicate the conditions experienced by human patients who are often confined to bed rest for an extended period of time. Using ^{31}P-MRS during electrically stimulated exercise to assess mitochondrial oxidative capacity in vivo, we show that restricted activity by cast immobilization delays spontaneous recovery of skeletal muscle metabolism in a rat model of severe SCI.

3898	Computer 107	Noninvasive biomarkers for the early diagnosis and staging of hepatic fibrosis : A real-time in vivo hyperpolarized 13C MR spectroscopy Chung-Man Moon[1], Yong-Yeon Jeong[2], Il-Woo Park[2], and Sang-Soo Shin[2] *[1]Advanced Institute of Aging Science, Chonnam National University, Gwangju, Republic of Korea, [2]Radiology, Chonnam National University Medical School, Gwangju, Republic of Korea* Hepatic fibrosis associated with chronic liver injury can progress to cirrhosis and ultimately hepatocellular carcinoma. To date, liver biopsy has been regarded as the gold standard for detecting hepatic fibrosis but with practical constraints. Therefore, alternative non-invasive diagnostic methods that can precisely evaluate progression of hepatic fibrosis are urgently needed. However, an in vivo study for hepatic fibrosis using hyperpolarized ^{13}C-labeled pyruvate has not yet been attempted until now. The purpose of this study was to investigate the cellular metabolic changes at different stages of hepatic fibrosis for the early diagnosis.

3899	Computer 108	In vivo characterization of glucose metabolism in pancreatic cancer xenografts. Shun Kishimoto[1], Jeffrey Brender[1], Tomohiro Seki[1], Ayano Enomoto[1], Kazutoshi Yamamoto[1], and Murali C Krishna[1] *[1]NCI, Bethesda, MD, United States* Recently, we developed a post processing denoising algorithms that are based on singular value decomposition and its multidimensional analogue Tucker decomposition. These algorithms allow more than 10-fold improvement in signal to noise ratio in dynamic spectroscopy and more than 50-fold in dynamic spectral imaging studies. Using this technique, we successfully characterize the metabolic profiles of two pancreatic ductal adenocarcinoma xenografts, MiaPaca-2 and Hs766t tumors by injecting 50 mg of 13C6 glucose. This imaging is potentially applicable to human subject and provides even more information than PET or 13C DNP MRI alone.

3900	Computer 109	High-Resolution Cardiopulmonary Imaging in Free-Breathing Mice using Hyperpolarized Xenon-129 Luis Loza[1], Mehrdad Pourfathi[2], Stephen Kadlecek[1], Kai Ruppert[1], Hooman Hamedani[1], Sarmad Siddiqui[1], Faraz Amzajerdian[1], Yi Xin[1], Ryan Baron[1], Mary Spencer[1], Tahmina Achekzai[1], Ian Duncan[1], and Rahim R. Rizi[1] *[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]University of Pennsylvania, Philadelphia, PA, United States*

		Hyperpolarized gas MRI is a well-established tool for assessing lung structure and function in both humans and large animals. However, its utility in small animal models has been limited to terminal studies, as proper gas delivery requires an MR-compatible ventilation scheme that has thus far only been achievable using a terminal intubation process. In this study, we developed a method for delivering hyperpolarized xenon-129 gas to free-breathing mice. An array of pulse sequences were used to acquire high-resolution gas- and dissolved-phase images of the heart and lung structure.

3901	Computer 110	Feasibility of the in vivo measurement of acetate metabolism by 1H-[13C] MRS at 14.1T in the mouse hypothalamus
		Blanca Lizarbe[1], Irene Guadilla[2], and Rolf Gruetter[1,3,4]
		[1]Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Féderal de Lausanne, Lausanne, Switzerland, [2]Instituto de Investigaciones Biomedicas "Alberto Sols" CSIC-UAM, Madrid, Spain, [3]University of Lausanne, Lausanne, Switzerland, [4]University of Geneva, Geneva, Switzerland
		Astrocytic metabolism is impaired in many central nervous system diseases, like obesity or diabetes. Using ^{1}H-[^{13}C] MRS together with [2-^{13}C]acetate infusion in a 14.1T magnet, we have measured the incorporation of ^{13}C labeling in the mouse hypothalamus *in vivo*, and calculated its metabolic fluxes using a two-compartment metabolic model that distinguishes between neurons and astrocytes. We think that these results open the possibility of investigating local variations of astrocytic metabolism in the mouse hypothalamus *in vivo*.

3902	Computer 111	Stress Induced bioenergetic perturbations in CMS rat model of Depression – An invivo phosphorousMRS study at 7T.
		Hemanth Kumar B S[1], Dinesh K Deelchand[2], Sushanta Kumar Mishra[1], Sadhana Singh[1,3], and Subash Khushu[1]
		[1]NMR Research Centre, DRDO-INMAS, New Delhi, India, [2]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota Medical School, Minneapolis, MN, United States, [3]Department of Anesthesiology, University of California Los Angeles, Los Angeles, CA, United States
		A chronic mild stress (CMS) animal model for depression was developed and validated using behavioural studies like OFT, FST and SCT. Following anaesthesia, invivo Phosphorous MRS was acquired covering the entire brain using ISIS pulse sequence at field strength of 7T. The spectra thus acquired were processed using LC-model for bioenergy metabolites quantification. The overall study provides new evidence on brain energy related metabolites and redox balance in CMS rats as compared to controls, suggesting that compromised energy metabolism and altered NAD biology observed in CMS rats. The study also revealed changes in High energy phosphate metabolites and membrane phospholipids.

3903	Computer 112	Assessment of gene therapy efficacy by neurochemical profiling
		Ivan Tkac[1], Igor Nastrasil[2], Kanut Laoharawee[3], Kelly M Podetz-Pedersen[3], Kelley F Kitto[4], Carolyn A Fairbanks[5], Walter C Low[6], Karen Kozarsky[7], and R Scott McIvor[3]
		[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Dept. of Pediatrics, University of Minnesota, Minneapolis, MN, United States, [3]Dept. of Genetics and Cell Biology, University of Minnesota, Minneapolis, MN, United States, [4]Dept. of Neuroscience, University of Minnesota, Minneapolis, MN, United States, [5]Dept. of Pharmaceutics, University of Minnesota, Minneapolis, MN, United States, [6]Dept. of Neurosurgery, University of Minnesota, Minneapolis, MN, United States, [7]REGENXBIO Inc., Rockville, MD, United States
		Mucopolysaccharidosis type II (MPS II), also known as Hunter syndrome, is a rare X-linked recessive lysosomal disorder caused by defective iduronate-2-sulfatase (IDS). Enzyme replacement is the only FDA–approved therapy available for MPS II, but it does not improve neurologic outcomes in MPS II patients. The 1H MRS data acquired from the hippocampus and cerebellum of untreated and AAV9-IDS treated MPS II mice and heterozygote controls clearly demonstrate that the direct transfer of the missing IDS gene to the CNS at 12 weeks of age prevented neurochemical alternations typical for MPS II at 9 months of age.

3904	Computer 113	Relationship of longitudinal changes in cerebral metabolite and diffusivity property during the early brain development
		Chun-Xia Li[1], Yuguang Meng[1], Hui Mao[2], Anthony WS Chan[3,4], and Xiaodong Zhang[1,5]
		[1]Yerkes Imaging Center, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States, [2]Department of Radiology and imaging science, Emory University, Atlanta, GA, United States, [3]Department of Human Genetics, Emory University School of Medicine, Emory University, Atlanta, GA, United States, [4]Divisions of Microbiology and Immunology, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States, [5]Division of Neuropharmacology and Neurologic Diseases, Yerkes National Primate, Emory University, Atlanta, GA, United States
		In vivo Magnetic Resonance Spectroscopy (MRS) is widely used to characterize the cerebral metabolic disorders in the developing brains of human and animal models. Prior study has demonstrated the spatial and temporal difference in evolution pattern of each metabolite during early brain maturation. This study is aimed to investigate the relationship of the longitudinal change of each metabolite with the microstructural evolution during early brain development in the cingulate cortex (ACC) of rhesus monkeys. The results demonstrated the heterogeneity of correlation degree of each metabolite with the microstructural maturation, suggesting combined MRS/DTI examination could offer complementary information to characterize early brain maturation and related disorders in pediatric research.

3905	Computer 114	Higher Vitamin C Concentration in Patients with Alzheimer’s Disease
		Malgorzata Marjanska[1], J Riley McCarten[1,2], Laura Hemmy[1,2], and Melissa Terpstra[1]

		[1]University of Minnesota, Minneapolis, MN, United States, [2]VA Health Care System, Minneapolis, MN, United States
		The concentrations of the antioxidants vitamin C (ascorbate, Asc) and glutathione (GSH) were quantified as components of the neurochemical profile using 7 T 1H MRS in patients with Alzheimer's disease (AD) and age-matched controls. Spectra were measured at ultra-short echo time in the posterior cingulate cortex (PCC), which is involved in AD, and the occipital cortex (OCC) as a control region. In patients, the concentrations of Asc and *myo*-inositol were higher in both regions. In the PCC of patients, total choline concentration was also higher.

3906	Computer 115	Differences in steady-state glutamate levels and variability between 'non-task-active' control conditions: Evidence from ¹H fMRS of the prefrontal cortex
		Jonathan D Lynn[1], Eric A Woodcock[2,3], Chaitali Anand[1], Dalal Khatib[4], and Jeffrey A Stanley[5]
		[1]Psychiatry and Behavioral Neurosciences, Wayne State University, Detroit, MI, United States, [2]Yale University, New Haven, CT, United States, [3]Wayne State University, Detroit, MI, United States, [4]Department of Psychiatry and Behavioral Neurosciences, Wayne State University, Detroit, MI, United States, [5]Psychiatry and Behavavioral Neurosciences, Wayne State University, Detroit, MI, United States
		Proton functional magnetic resonance spectroscopy (1H fMRS) is capable of detecting dynamic changes in brain glutamate related to task engagement compared to a "non-task-active" control condition. The selection of an appropriate control condition is critical, which may confound the magnitude change in glutamate modulation. The purpose of this 1H fMRS study was to compare the steady-state levels of glutamate and its variability in the left dorsolateral prefrontal cortex during four different putative control conditions. Results show significant differences in the glutamate level and variability between conditions, emphasizing the importance of the control condition for the detection of task-evoked glutamate modulation.

3907	Computer 116	Metabolic basis of (de)activation fMRI paradigms: J-edited lactate and diffusion-weighted water 1H-MRS
		Yury Koush[1], Robin A. de Graaf[1], Ron Kupers[2], Laurence Dricot[3], Douglas L. Rothman[1], and Fahmeed Hyder[1]
		[1]MRRC, Yale University, New Haven, CT, United States, [2]Department of Clinical Neurophysiology, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark, [3]Institute of Neuroscience, University of Louvain, Brussels, Belgium

		During task-based versus rest epochs, the BOLD signal increases in a task-positive region (activation paradigm) and decreases in a task-negative region (deactivation paradigm), also known as the default mode network (DMN). We investigated the metabolic basis of (de)activation paradigms using concurrent ^{1}H-MRS acquisitions of J-edited lactate and diffusion-weighted water. Using (de)activation paradigms, we detected associated increase of water (i.e., BOLD signal) and lactate in visual cortex (non-DMN area), whereas in posterior cingulate cortex (DMN area) water decreased but lactate did not change. These results suggest similar degrees of aerobic glycolysis in both DMN and non-DMN areas.

3908	Computer 117	Neurochemical profiling in the rat model of Tourette's Syndrome @ 11.7T
		Alireza Abaei[1], Francesca Rizzo[2,3], Dinesh K Deelchand[4], Tobias M. Böckers[2], and Volker Rasche[1]
		[1]Core Facility Small Animal Imaging, Ulm University, Ulm, Germany, [2]Institute of Anatomy and Cell Biology, Ulm University, Ulm, Germany, [3]Department of Child and Adolescent Psychiatry, Ulm University, Ulm, Germany, [4]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States
		Tourette's syndrome (TS) is a neurodevelopmental disorder characterized primarily by motor tics probably due to dysfunctions of the cortico-striato-thalamic-cortical loop (CSTC) but the underlying molecular reason why tic occur is not yet known. In this study, a dedicated optimized STEAM sequence with single-shot phase and frequency correction, and image-based shimming was applied to uncover the metabolic "signature" of a tic using *in vivo* ^{1}H-MRS at 11.7T. Despite a clear ticking phenotype observed in our animal model, the unaltered striatal neurochemical profile suggest questions on the role of the striatum within the supposed dysfunctional cortical-striatal-thalamic-cortico circuitry in TS.

3909	Computer 118	Correlations Between Brain Structural Volumes and Brain Metabolite Concentrations in Alzheimer's Disease: Preliminary Results from the NeuroMet Project
		Ariane Fillmer[1], Theresa Köbe[2], Semiha Aydin[1], Laura Goeschel[2], Agnes Flöel[2,3], Florian Schubert[1], and Bernd Ittermann[1]
		[1]Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany, [2]Department of Neurology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]Department of Neurology, University Medicine Greifswald, Greifswald, Germany
		The NeuroMet project aims to identify new biomarkers for Alzheimer's disease (AD) and to reduce measurement uncertainties for known biomarkers for AD. This work presents first NeuroMet results with a focus on ultra-high field MR imaging and MR spectroscopy. Significant correlations were found between volumes of cortical and subcortical gray matter structures and concentrations of NAA, glutamate and GABA.

3910	Computer 119	Brain lithium and myo-inositol levels in lithium treated and non-lithium treated bipolar disorder patients Fiona Elizabeth Smith[1], Peter Edward Thelwall[1], Carly Jay Flowers[2], Matthew George Birkbeck[1], Joe Necus[2], Andrew Matthew Blamire[1], and David Andrew Cousins[2] *[1]Institute of Cellular Medicine, Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, United Kingdom, [2]Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom* The action of lithium in bipolar disorder (BD) is incompletely defined but the inositol depletion hypothesis[1] states that lithium inhibits IMPase to deplete *myo*-inositol, confirmed in vivo using proton magnetic resonance spectroscopy (^{1}H-MRS) following acute treatment[2,3] Chronic treatment may upregulate IMPase, with trend-level increases in grey matter *myo*-inositol reported.[4] This ^{1}H-MRS study compares frontal white matter *myo*-inositol/creatine levels (8cm^3 voxel) in BD subjects (lithium-treated versus BD controls taking other medication), supplemented by measuring brain lithium signal intensity using 3D ^{7}Li-MRI. *Myo*-Ino/Cr levels were significantly lower in the lithium-treated group, but their levels did not correlate with ^{7}Li-MRI signal intensity.

3911	Computer 120	MR-Spectroscopic Imaging in the Spotlight of the 2016 WHO Classification Elie Diamandis[1], Carl Philipp Simon Gabriel[2], Horst Urbach[3], Irina Mader[1], and Dieter Henrik Heiland[4] *[1]Department of Neuroradiology, Medical Center Freiburg, Freiburg, Germany, [2]Department of Neuroradiology, Medical Center Freiburg, Freibrug, Germany, [3]Department of Neuroradiology, Medical Center Freiburg, Frieburg, Germany, [4]Department of Neurosurgery, Medical Center Freiburg, Freiburg, Germany* The purpose of this study is to map spatial metabolite differences across the three molecular subgroups of glial tumors, defined by the IDH1/2 mutation and 1p19q-co-deletion, using chemical shift imaging. The classification was based on a radiomic approach to the spectroscopic data.

Electronic Poster

Predictive Cancer Imaging

Exhibition Hall	Tuesday 9:15 - 10:15

3912	Computer 1	Synthetic MRI of bone metastases in castration-resistant prostate cancer: detection of tumor activity and calcifications.

		Yuki Arita[1,2], Taro Takahara[3], Soichiro Yoshida[4], Thomas C Kwee[5], Tatsuaki Kobayashi[6], Chikako Ishii[7], Jun Kurasawa[7], Kazuya Sugimoto[3], Nobuya Higuchi[1,2], and Yasuhisa Fujii[4]
		[1]Department of Radiology, National Hospital Organization Tokyo Medical Center, Tokyo, Japan, [2]Department of Diagnostic Radiology, Keio University School of Medicine, Tokyo, Japan, [3]Department of Biomedical Engineering, Tokai University School of Engineering, Kanagawa, Japan, [4]Department of Urology, Tokyo Medical and Dental University Graduate School, Tokyo, Japan, [5]Department of Radiology, UMC Groningen, Groningen, Netherlands, [6]Visionary Imaging Services, Inc., Yokohama, Japan, [7]Department of Radiology, Advanced Imaging Center Yaesu Clinic, Tokyo, Japan
		We quantified T1, T2, and proton density (PD) of bone metastases in castration-resistant prostate cancer with synthetic MRI (SyMRI). Bone foci of interest were classified into four groups; active disease, red bone marrow (RBM), inactive disease without calcification (Inactive C(-)), and inactive disease with calcification (Inactive C(+)). Active disease group showed very high PD, and Inactive C(+) group showed very low PD. Both Inactive C(-) and RBM showed medium values. Significant differences were noted among these three divisions. SyMRI thus shows clinical potential to differentiate active/inactive lesions, calcifications, and red bone marrow in castration-resistant prostate cancer.

3913	Computer 2	Hyperpolarized [1-^{13}C]Pyruvate Imaging Predicts Survival in Rat C6 Glioma Model
		Keshav Datta[1], Mette H. Lauritzen[1], Milton Merchant[2], Taichang Jang[2], Shie-Chau Liu[1], Ronald D. Watkins [1], Ralph E. Hurd[1], Lawrence Recht[2], and Daniel M. Spielman[1]
		[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Neurology, Stanford University, Stanford, CA, United States
		The [1-^{13}C]Lactate/[1-^{13}C]Bicarbonate ratio at 48 hrs post-treatment, as measured in a hyperpolarized [1-^{13}C]Pyruvate experiment, was found to accurately predict the survival in rat C6 glioma model treated with a single dose of the anti-VEGF drug Bevacizumab.

3914	Computer 3	Radiomics: a novel MRI-based method of predicting recurrence in chordoma
		Wei Wei[1,2,3], Ke Wang[4], Kaibing Tian[4], Zhenyu Liu[1], Liang Wang[4], Junting Zhang[4], Zhen Wu[4], and Jie Tian[1]
		[1]Key Laboratory of Molecular Imaging, Chinese Academy of Science, Beijing, China, [2]School of Life Sciences and Technology, Xidian University, Xi'an, China, [3]Department of Electronics and Information, Xi'an Polytechnic University, Xi'an, China, [4]Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

		In order to find the relationship between MRI image and the postoperative recurrence of chordoma, we used a novel radiomics method for quantitative analysis of MRI image. Finally successfully predicted the probability of postoperative recurrence of chordoma.

3915	Computer 4	Low nodal plasma volume is associated with poor treatment response in head and neck cancer treated with induction chemotherapy.
		Rafal Panek[1,2], Kee H. Wong[3,4], Liam Welsh[3,4], Alex Dunlop[3], Dualta Mcquaid[3], Angela M. Riddell[3], Dow-Mu Koh[3,4], Martin O. Leach[3,4], Shreerang A. Bhide[3,4], Kevin J. Harrington[3,4], Christopher M. Nutting[3], Kate L. Newbold[3], and Maria Schmidt[3,4]
		[1]Nottingham University Hospitals, Nottingham, United Kingdom, [2]University of Nottingham, Nottingham, United Kingdom, [3]The Royal Marsden NHS Foundation, London, United Kingdom, [4]The Institute of Cancer Research, London, United Kingdom
		Impaired tumour perfusion results in decreased efficacy of cancer treatment. In this work we investigated the optimal timing and predictive value of early chemotherapy induced changes, measured by dynamic contrast enhanced (DCE) and longitudinal intrinsic susceptibility (IS) MRI. We observed lower plasma volume in metastatic nodes responding poorly to the treatment. We found that for HNSCC patients treated with induction chemotherapy, combining DCE and IS-MRI methods improves early predictive value. This methodology could be used to aid patient stratification and subsequent radiotherapy treatment planning.

3916	Computer 5	Oxygen-Enhanced MRI for the Detection of Hypoxia in Patients with Head and Neck Cancer
		Rafal Panek[1,2], Kee H. Wong[3,4], Liam Welsh[3,4], Angela M. Riddell[3], Dow-Mu Koh[3,4], Veronica Morgan[3], Shreerang A. Bhide[3,4], Kevin J. Harrington[3,4], Christopher M. Nutting[3], Maria Schmidt[3,4], Martin O. Leach[3,4], James P.B. O'Connor[5,6], Kate L. Newbold[3], and Simon P. Robinson[4]
		[1]Nottingham University Hospitals, Nottingham, United Kingdom, [2]University of Nottingham, Nottingham, United Kingdom, [3]The Royal Marsden NHS Foundation, London, United Kingdom, [4]The Institute of Cancer Research, London, United Kingdom, [5]The University of Manchester, Manchester, United Kingdom, [6]Christie NHS Foundation Trust, Manchester, United Kingdom
		Tumour hypoxia is a recognized cause of treatment failure. Noninvasive methods to quantify distribution and extent of hypoxia remain an unmet clinical need. Quantitation of the longitudinal relaxation rate, R_1, using oxygen-enhanced MRI (OE-MRI), can be used to monitor differences in levels of paramagnetic molecular oxygen in plasma. In this study, we report a significantly reduced hyperoxia-induced ΔR_1 response in HNSCC in comparison to the healthy lymph nodes, revealed by OE-MRI. Such a reduction can be attributed to regions of impaired tumour vasculature and hypoxia, the presence of which may be linked to a poorer outcome.

3917	Computer 6	Correlation of CD31-Based Microvessel Density and Percent Area Measurements against 13C-tert-butanol MRI Perfusion Mapping in a Sunitinib-Resistant RCC Xenograft Patricia Coutinho de Souza[1], Aaron Grant[1], Xiaoen Wang[1], Rupal Bhatt[2], Gopal Varma[1], David Alsop[1], and Leo Tsai[1] *[1]Department of Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States, [2]Department of Medicine, Beth Israel Deaconess Medical Center, Boston, MA, United States* Tumor heterogeneity is deeply associated with regional perfusion. Improved evaluation of local perfusion, by imaging or histology, can be useful for tracking tumor progression and treatment. Here we use h13C-tert-butanol, a high-SNR quantitative MRI perfusion marker, to map perfusion in untreated (UT) and sunitinib-resistant (SR) renal cell carcinoma (RCC) xenografts. This study investigates the correlation between these perfusion maps with histologic measures of vascularity using CD31-labeled sections.

3918	Computer 7	Hydrogen magnetic resonance spectroscopy: a technique for predicting clinical outcome in patients with head & neck squamous cell cancer with locally advanced cervical nodal disease Sola Adeleke[1], Marianthi-Vasiliki Papoutsaki[2], Harbir Sidhu[2], Alan Bainbridge[3], David Price[3], Dawn Carnell[4], Martin Forster[5], Ruheena Mendes[4], and Shonit Punwani[1] *[1]Centre for medical imaging, University College London(UCL), London, United Kingdom, [2]Centre for medical imaging, University College London, London, United Kingdom, [3]Dept of medical physics and biomechanical engineering, University college london hospitals, London, United Kingdom, [4]Dept of oncology, University college london hospitals, London, United Kingdom, [5]Research department of oncology, University college london, London, United Kingdom* Hydrogen magnetic resonance spectroscopy (1H-MRS) is a technically challenging modality. It has the potential to provide specific metabolic information that could guide clinical decision making. In this study we assess feasibility of performing 1H MRS in patients with head and neck squamous cell carcinoma (HNSCC) prior to treatment and explore its correlation with post-treatment outcomes.

3919	Computer 8	Noninvasive prediction of tumor-fibrosis using texture analysis of multiparametric MRI in pancreatic cancer model Dae Chul Jung[1], Ravneet Vohra[2], Seon Young Lee[3], Kyunghwa Han[1], Helen Hong[3], and Donghoon Lee[2] *[1]Radiology, Yonsei University, Seoul, Republic of Korea, [2]Radiology, University of Washington, Seattle, WA, United States, [3]Software Convergence, Seoul Women's University, Seoul, Republic of Korea*

		Authors want to evaluate the correlations between texture features of tumor on multi-parametric MRI (mp-MRI) and tumor-fibrosis in animal model of pancreatic cancer. mp-MRI was performed in a genetically engineered mice model of human pancreatic cancer. Texture features of tumors were extracted from each parametric map using texture analysis. Linear regression with LASSO method was used to evaluate the correlations between the texture features and percentage of fibrosis on histologic slides. Several texture features were correlated with tumor fibrosis. Statistical learning showed preliminary prediction model. Texture analysis of mp-MRI is helpful for predicting and monitoring tumor-fibrosis in pancreatic cancer model.

3920	Computer 9	Prediction of pathological complete response of rectal tumor by radiomics method based on diffusion kurtosis imaging results before neoadjuvant chemoradiotherapy
		Xiaoyan Zhang[1], Haitao Zhu[1], Xiaoting Li[1], Yanjie Shi[1], Yingshi Sun[1], Aijun Zhang[2], and Haoyu Li[2]
		[1]Peking University Cancer Hospital, Beijing, China, [2]The University of Hong Kong, Hong Kong, Hong Kong
		Neoadjuvant chemoradiotherapy is the standard treatment for locally advanced rectal cancer. Patients with pathological complete response (pCR) after NCRT (15~21% of the total) could benefit from either less invasive surgery or a “wait-and-see” strategy. A radiomics model is proposed in this work based on diffusion kurtosis imaging (DKI) result before NCRT is used to predict pCR of rectal cancer.

3921	Computer 10	Development of a Patient-specific Tumor Mold using MRI and 3D Printing Technology for Targeted Tissue Procurement and Radiomics Analysis of Renal Masses
		Durgesh Kumar Dwivedi[1], Yonatan Chatzinoff[1], Qing Yuan[1], Jeffrey A. Cadeddu[1,2], Payal Kapur[2,3], and Ivan Pedrosa[1,2,4]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Urology, UT Southwestern Medical Center, Dallas, TX, United States, [3]Pathology, UT Southwestern Medical Center, Dallas, TX, United States, [4]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States
		To implement a platform for co-localization of *in vivo* quantitative multi-parametric magnetic resonance imaging (mpMRI) features with *ex vivo* surgical specimens of patients with renal masses using patient-specific 3D-printed tumor molds, which may aid in targeted tissue procurement and radiomics/radiogenomic analyses. Volumetric segmentation of 6 renal masses was performed with 3D Slicer (http://www.slicer.org) to create a three-dimensional (3D) tumor model. All patients successfully underwent partial nephrectomy and adequate fitting of the tumor specimens within the 3D mold was achieved in all tumors. Distinct *in vivo* MRI features corresponded to unique pathologic characteristics in the same tumor.

3922	Computer 11	Rectal cancer: multi-parametric MRI 3-dimensional assessment of intra-tumour heterogeneity and chemoradiotherapy response prediction Trang Thanh Pham[1,2,3,4,5], Gary Liney[1,3,4], Karen Wong[1,3,4], Christopher Henderson[3,5,6], Robba Rai[1,3], Petra L Graham[7], Malcolm Hudson[7,8], Nira Borok[9], Minh Xuan Truong[9], Mark Lee[1,3], Joo-Shik Shin[6], and Michael B. Barton [1,3,4] *[1]Radiation Oncology, Liverpool Cancer Therapy Centre, Liverpool Hospital, Sydney, Australia, [2]Sydney West Radiation Oncology Network, Westmead, Blacktown and Nepean Hospitals, Sydney, Australia, [3]Faculty of Medicine, University of New South Wales, Sydney, Australia, [4]Ingham Institute for Applied Medical Research, Sydney, Australia, [5]School of Medicine, Western Sydney University, Sydney, Australia, [6]Anatomical Pathology, Liverpool Hospital, Sydney, Australia, [7]Department of Statistics, Macquarie University, Sydney, Australia, [8]NHMRC Clinical Trials Centre, Sydney, Australia, [9]Radiology, Liverpool Hospital, Sydney, Australia* This study investigated 3D quantitative histogram assessment of diffusion weighted imaging (DWI) and dynamic contrast enhanced (DCE) MRI in the prediction of chemoradiotherapy (CRT) response in locally advanced rectal cancer. Histopathologic response assessment was centralised and defined according to AJCC tumour regression grade. A whole tumour histogram analysis and combined multiparametric scatterplots of ADC and Ktrans were used to assess tumour heterogeneity and prediction of CRT response. Post-CRT ADC 75th and 90th histogram quantiles were the most promising parameters for prediction of CRT response. However, DCE-MRI and multi-parametric scatterplots combining ADC and Ktrans did not add value in predicting response.

3923	Computer 12	Early Prediction of Soft Tissue Sarcoma Response to Preoperative Therapy Using DCE-MRI Texture Features Tristan Xiao[1], Archana Machireddy[2], Xubo Song[2], Alina Tudorica[2], Aneela Afzal[2], May Mishal[2], Brooke Beckett[2], Megan Holtorf[2], Torrie Aston[2], Christopher Ryan[2], Wei Huang[2], and Guillaume Thibault[2] *[1]Saratoga High School, Saratoga, CA, United States, [2]OHSU, Portland, OR, United States* 23 patients with soft tissue sarcoma (STS) (25 tumors) underwent DCE-MRI before and after one cycle of preoperative chemoradiotherapy. Extended Tofts model (ETM) and Shutter-Speed model (SSM) were used for pharmacokinetic (PK) analysis of DCE-MRI data and generating voxel based PK parametric maps, from which texture features were extracted using different statistical matrix methods. Changes in SZM and RLM features consistently provided good early prediction of therapy response, while more features from the SSM PK maps were good predictors of response than the ETM maps.

3924	Computer 13	MRS measurement of succinate in vivo as a biomarker in succinate dehydrogenase deficient tumours

		Mary A McLean[1], Ruth T Casey[2,3], Benjamin G Challis[3], Rogier ten Hoopen[4], Thomas Roberts[5], Graeme R Clark[2], Deborah Pittfield[3], Helen L Simpson[6], Venkata R Bulusu[7], Kieran Allinson[8], Lisa Happerfield[9], Soo-Mi Park[2], Alison Marker[8], Olivier Giger[4], Basetti Madhu[1], Eamonn R Maher[2], and Ferdia A Gallagher[10]
		[1]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [2]Medical Genetics, University of Cambridge, Cambridge, United Kingdom, [3]Endocrinology, Cambridge University NHS Foundation Trust, Cambridge, United Kingdom, [4]Pathology, University of Cambridge, Cambridge, United Kingdom, [5]Haematology Oncology, University of Cambridge, Cambridge, United Kingdom, [6]Diabetes and Endocrinology, UCLH NHS Foundation Trust, London, United Kingdom, [7]Medical Oncology, Cambridge University NHS Foundation Trust, Cambridge, United Kingdom, [8]Histopathology, Cambridge University NHS Foundation Trust, Cambridge, United Kingdom, [9]Immunohistochemistry, Cambridge University NHS Foundation Trust, Cambridge, United Kingdom, [10]Radiology, University of Cambridge, Cambridge, United Kingdom
		We performed respiratory-gated single-voxel ^{1}H-MRS (TE = 144ms; voxel size 2.2-100ml; 96-512 averages) at 3T in tumours with suspected mutations in the mitochondrial enzyme succinate dehydrogenase (SDH) in 15 patients, analysed using LCModel. A germline mutation or epimutation in one of the SDH genes was identified in 11/15 subjects, with concordant MRS findings in 9 subjects, data rejection as technical failure in 4, and equivocal results in 2. Referencing succinate peaks to choline was an important quality control for discrimination of true from false negatives. MRS may provide a useful biomarker of SDH activity in this patient group.

3925	Computer 14	Assessment of Tumor Microenvironment to Determine the Most Suitable Therapeutic Window in an Ovarian Cancer Model
		Sarah Belderbos[1], Kristof Govaerts[1], Anca Croitor Sava[1], Jens Wouters[1], Bella B. Manshian[1], Christophe M. Deroose[1,2], Sabine Van Huffel[3,4], Stefaan J. Soenen[1], Willy Gsell[1], and Uwe Himmelreich[1]
		[1]Imaging and Pathology, KU Leuven, Leuven, Belgium, [2]UZ Leuven, Leuven, Belgium, [3]ESAT - STADIUS, Stadius Centre for Dynamical Systems, Signal Processing and Data Analytics, KU Leuven, Leuven, Belgium, [4]Imec, Leuven, Belgium
		Multimodal imaging, *i.e.* combining (simultaneous) positron emission tomography (PET)-magnetic resonance imaging (MRI) and bioluminescence imaging (BLI) allows in-depth assessment of changes in tumor microenvironment over time. In this study, the development of human ovarian xenografts in mice was longitudinally monitored using BLI and PET-MRI to identify the most suitable time window to test nanomaterial-based therapies. Under these conditions, xenografts are viable, vascularized and metabolically active tumor masses with leaky blood vessels after four weeks, indicating a suitable time point for nanomaterial administration. This suggests that a combination of PET, MRI and BLI allows the identification of potential therapeutic windows.

3926	Computer 15	Spatial comparison of *in vivo* MRI with digital histology validates R_2* as a biomarker of vascular hemodynamics in the Th-*MYCN* model of neuroblastoma
		Konstantinos Zormpas-Petridis[1], Matthew D. Blackledge[1], Louis Chesler[2], Yinyin Yuan[3], Simon P. Robinson[1], and Yann Jamin[1]
		[1]Division of Radiotherapy and Imaging, Institute of Cancer Research, London, United Kingdom, [2]Division of Clinical Studies, Institute of Cancer Research, London, United Kingdom, [3]Division of Molecular Pathology, Institute of Cancer Research, London, United Kingdom
		This study explores the use of automated image analysis pipelines and kernel density estimation (KDE) analysis for hotspot mapping as a generic methodology to spatially evaluate MRI biomarkers with corresponding high-resolution whole-slide digital histology, used here to validate the transverse relaxation R_2* as a biomarker of vascular hemodynamics in the Th-*MYCN* transgenic mouse model of childhood neuroblastoma.

3927	Computer 16	Imaging immunotherapy resistance in melanoma in vivo and in vitro employing magnetic resonance
		Shivanand Pudakalakatti[1], Ashvin Jaiswal[2], Prasanta Dutta[1], Michael Curran[2], and Pratip Bhattacharya[1]
		[1]Cancer Systems Imaging, University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Immunology, University of Texas MD Anderson Cancer Center, Houston, TX, United States
		Identifying immunotherapy resistance and underlying molecular mechanisms of resistance will help in stratifying immunotherapy treatment effectively. However, identifying immunotherapy resistance and its causative mechanisms are elusive. Here we have developed mouse models of immunotherapy resistance and identified molecular mechanisms indicating immunotherapy resistance employing magnetic resonance. *In vitro* studies showed adaptations in metabolic pathways of glycolysis, fatty acid and purine synthesis in resistant cell lines. *In vivo* experiments with 1-^{13}C hyperpolarized pyruvate revealed higher pyruvate to lactate conversion in immunotherapy resistant mice compared to responding ones. Hence, pyruvate to lactate ratio can be a potential biomarker to identify immunotherapy resistance *in vivo*.

3928	Computer 17	Multi-Resolution Fractal Analysis of DCE-MRI Parametric Maps for Early Prediction of Breast Cancer Therapy Response
		Archana Machireddy[1], Guillaume Thibault[1], Alina Tudorica[1], Aneela Afzal[1], May Mishal[1], Kathleen Kemmer[1], Arpana Naik[1], Megan Troxell[1], Eric Goranson[1], Karen Oh[1], Nicole Roy[1], Neda Jafarian[1], Megan Holtorf[1], Wei Huang[1], and Xubo Song[1]
		[1]Oregon Health and Science University, Portland, OR, United States

		DCE-MRI data from 54 breast cancer patients collected before and after one cycle of neoadjuvant chemotherapy were subjected to Shutter-Speed pharmacokinetic analysis. A new texture feature, multi-resolution fractal dimension (FD), was extracted from DCE-MRI parametric maps and compared with single-resolution FD for early prediction of therapy response. The multi-resolution approach appears to provide a richer description of the underlying tumor heterogeneity in perfusion/permeability than the single-resolution FD method, and has higher accuracy in early discrimination of pathologic complete response (pCR) from non-pCR.

3929	Computer 18	PERFUSION MRI AS A MARKER OF GLIOBLASTOMA INFILTRATION INTO HEALTHY TISSUE
		Antoine Vallatos[1,2], Haitham F. I. Al-Mubarak[2], Joanna L. Birch[3], Lindsay Gallagher[2], James Mullin[2], Lesley Gilmour[3], William M. Holmes[2], and Anthony J. Chalmers[3]
		[1]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom, [2]Glasgow experimental MRI centre (GEMRIC), Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom, [3]Wolfson Wohl Translational Cancer Research Centre, Institute of Cancer Sciences, University of Glasgow, Glasgow, United Kingdom
		We investigate the ability of perfusion MRI to probe glioblastoma infiltration into healthy brain tissue, on a patient-derived mouse model presenting infiltrative tumour margins. Using a high SNR Arterial Spin Labelling sequence and a multiple slice in-plane histology method, we show that perfusion imaging can probe lower tumour cell density regions than conventional MRI. Voxel-to-voxel comparison between perfusion and tumour cell density images, allows identifying a negative relation between tumour cell burden and perfusion at the invasion margins. This relation, related to vascular co-option mechanisms, could be used as a marker of tumour cell infiltration into healthy tissue.

3930	Computer 19	Diffusion-Weighted MRI Apparent Diffusion Coefficient (ADC) Histogram Changes In Primary Rectal Cancer Treated With Chemotherapy + Anti-Angiogenic Therapy Versus Neoadjuvant Chemoradiation
		N. Jane Taylor[1], Davide Prezzi[2], J. James Stirling[1], James A d'Arcy[3], Rob Glynne-Jones[4], and Vicky J Goh[2]
		[1]Paul Strickland Scanner Centre, Mount Vernon Hospital, Northwood, United Kingdom, [2]Cancer Imaging, School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom, [3]CRUK-EPSRC Cancer Imaging Centre, Institute of Cancer Research & Royal Marsden Hospital, Sutton, United Kingdom, [4]Mount Vernon Hospital, Northwood, United Kingdom
		Changes in the apparent diffusion co-efficient (ADC) histogram parameters in primary rectal cancers treated with neoadjuvant chemotherapy + anti-angiogenic therapy (NAC) differ substantially to those treated with chemoradiation (CRT), reflecting the differing mechanisms of action of these therapies. Higher diffusivity and lower variance post-CRT compared to NAC in responders likely reflects radiotherapy-related inflammation.

3931	Computer 20	Multi-parametric imaging based differentiation of primary CNS lymphoma from Glioblastoma using T1-Perfusion, Diffusion and Susceptibility-weighted MR Imaging Pradeep Kumar Gupta[1], Jitender Saini[2], Ashish Awasthi[3], Chandra M Pandey [4], Shreelekha Mohapatra[1], Anup Singh[5], Rana Patir[6], Sunita Ahlawat[7], Manish Beniwal[8], Anita Mahadevan [9], and Rakesh Kumar Gupta[1] *[1]Department of Radiology and Imaging, Fortis Memorial Research Institute, Gurgaon, India, [2]Department of Neuroimaging & Interventional Radiology, National Institute of Mental Health and Neurosciences, Bangalore, India, [3]Indian Institute of Public Health, Gandhinagar, India, [4]Biostatistics, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India, [5]Center for Biomedical Engineering, Indian Institute of Technology Delhi, Delhi, India, [6]Department of Neurosurgery, Fortis Memorial Research Institute, Gurgaon, India, [7]SRL Diagnostics, Fortis Memorial Research Institute, Gurgaon, India, [8]Department of Neurosurgery, National Institute of Mental Health and Neurosciences, Bangalore, India, [9]Neuropathology, National Institute of Mental Health and Neurosciences, Bangalore, India* Glioblastoma and primary CNS lymphoma (PCNSL) need differentiation on pre operative imaging as management strategies for these two pathologies are diverse. Due to the presence of atypical imaging findings in a significant number of cases, it becomes difficult to differentiate these two pathologies on conventional MRI. We utilized multi-parametric imaging methods (T1-perfusion, DWI, and SWI) for possible differentiation of these two entities. In linear discriminant analysis using various imaging parameters we achieved 84% accuracy with AUC 90.14%. We conclude that multi-parametric imaging may prove to be useful in accurate preoperative discrimination of these two pathologies.

3932	Computer 21	Towards quantitative multiparametric evaluation of response to treatment following loco-regional treatment for HCC- pilot study. Sonal Krishan[1] and Amit Mehndiratta[2] *[1]Radiology, Medanta Hospital, Gurgaon, India, [2]IIT Delhi, Delhi, India* The aim of the present study was to explore the feasibility and utility of quantitative volumetric change in ADC, tumor volume and percentage differential enhancement in the various phases in being able to predict response to treatment following loco-regional therapy (LRT).This IRB approved pilot study included 40 consecutive patients following LRT for HCC .Patients with baseline imaging, 1,3 and 6 months follow up dynamic contrast-enhanced MRI were included in our study. Percentage change in arterial, portal venous and hepatic-venous differential enhancement, as well as change in ADC and tumor volume at 1 and 3 months, was calculated for all values. There was global reduction in the percentage of mean volume and differential enhancement is seen in all phases in completely treated study group.In patients with residual tumor, there is paradoxical decrease in ADC and increase in hepatic venous enhancement at 1 month.Our pilot study has shown that volumetric quantitative evaluation of differential enhancement of the treated lesion in various phases combined with ADC and change in tumour volume are feasible. This has potential to act as surrogate markers for evaluating response to treatment

3933	Computer 22	Functional diffusion maps to assess treatment response in head and neck tumors using SPLICE. Boris Peltenburg[1], Tim Schakel[1], Chris H.J. Terhaard[1], Remco de Bree[2], and Marielle E.P. Philippens[1] *[1]Radiotherapy, Universtiy Medical Center Utrecht, Utrecht, Netherlands, [2]Cancer Center, Universtiy Medical Center Utrecht, Utrecht, Netherlands* ADC changes during chmoradiation treatment might be of prognostic value in patients with head and neck squamous cell carcinoma (HNSCC) and allow for treatment modification. To overcome decrease in tumor visibility and increase in delineation variation by observers, functional diffusion maps provide an objective measure to follow response on DW-MRI during treatment provided a good geometric accuracy as is offered by the SPLICE technique.

3934	Computer 23	Multiparametric MRI as a biomarker of response to neoadjuvant second-generation hormone therapy for localized prostate cancer- a pilot study Fiona Fennessy[1,2], Andriy Fedorov[1], Mark Vangel[3], Robert Mulkern[4], Rosina Lis[5], Maria Tretiakova[6], Clare Tempany[1], and Mary Ellen Taplin[7] *[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States, [2]Dana Farber Cancer Institute, Boston, MA, United States, [3]Radiology, Massachusetts General Hospital, Boston, MA, United States, [4]Radiology, Children's Hospital Boston, Boston, MA, United States, [5]Pathology, Dana Farber Cancer Institute, Boston, MA, United States, [6]Pathology, University of Washington, Seattle, WA, United States, [7]Oncology, Dana Farber Cancer Institute, Boston, MA, United States* Advanced prostate cancer (PCa) is driven by androgen receptor (AR) signaling, and as such the AR is an important therapeutic target to prevent PCa progression. The aim of this pilot study was to explore a role for prostate multiparametric MRI (mpMRI) as a biomarker for treatment response of localized prostate cancer to neoadjuvant treatment with the second-generation AR inhibitor enzalutamide. We demonstrate that quantitative mpMRI may play an important role as a biomarker of response to neoadjuvant treatment of localized PCa, and MRI-based tumor volumetrics may act as a surrogate for RCB at prostatectomy. These findings are worthy of investigation in a larger clinical setting.

3935	Computer 24	MEMRI-guided preclinical trial of an experimental TAM-targeted therapy in mouse medulloblastoma Hari Rallapalli[1], I-Li Tan[2], Alexandre Wojcinski[2], Alexandra L Joyner[2], and Daniel H Turnbull[1] *[1]New York University School of Medicine, New York, NY, United States, [2]Sloan Kettering Institute, New York, NY, United States* Using our high-throughput MEMRI pipeline, presented previously, we tested an experimental anticancer drug in mouse models of sporadic medulloblastoma.

Electronic Poster

Exogenous Contrast Mechanisms in Cancer Imaging

Exhibition Hall	Tuesday 9:15 - 10:15

3936	Computer 25	Evaluation of Pharmacokinetic Models for Perfusion Imaging with Dynamic Contrast-Enhanced Magnetic Resonance Imaging in Skeletal Muscle Using Low-Molecular-Weight Contrast Agents Stefan Hindel[1], Giorgos Papanastasiou[2], Peter Wust[3], Marc Maaß[4], Anika Söhner[1], and Lutz Lüdemann[1] *[1]Klinik und Poliklinik für Strahlentherapie, Universitätsklinikum Essen, Essen, Germany, [2]Centre for Cardiovascular Science, Clinical Research Imaging Centre, University of Edinburgh, Edinburgh, United Kingdom, [3]Department of Radiation Oncology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [4]Department of General and Visceral Surgery, Protestant Hospital Wesel, Wesel, Germany* Pharmacokinetic models for perfusion quantification with DCE-MRI using a low-molecular-weight contrast agent (LMCA) in skeletal muscle of pigs were validated. This in vivo study included compartmental and distributed parameter models which allow estimation of the functional and structural composition of heterogeneously perfused tissues. The different tracer kinetic models, which measure transport parameters in physically meaningful units in heterogeneous tissue, were compared to identify a method that allows reliable quantitative determination of physiological parameters. Double-contrast agent DCE-MRI using LMCA and intravascular CA in combination with the 2-compartment exchange model extended by a nonnutritive arteriolar compartment yields the most reliable results.

3937	Computer 26	Locally constrained registration of dynamic contrast enhanced MRI time series improves tracer kinetic model voxel-wise fit repeatability in liver tumours Michael Berks[1], Ross A Little[1], Yvonne Watson[1], Sue Cheung[1], Gordon C Jayson[2], James P B O'Connor[2,3], and Geoff J M Parker[1] *[1]Division of Informatics, Imaging & Data Sciences, University of Manchester, Manchester, United Kingdom, [2]Division of Cancer Sciences, University of Manchester, Manchester, United Kingdom, [3]CRUK & EPSRC Cancer Imaging Centre in Cambridge and Manchester, Cambridge and Manchester, United Kingdom* DCE-MRI enables the estimation of clinically useful parameters of tissue microvasculature, and is frequently used in trials of anti-angiogenic drugs. However tissue movement can lead to inaccurate parameter estimation. Rapidly changing contrast and limited spatial structure within tumours makes DCE-registration a challenging task. We present a novel algorithm that estimates a model of local tumour motion from the most stable part of the time-series and uses this to constrain registration of the whole series. We demonstrate statistically significant improved extended Kety-model fits and improved parameter repeatability for a set of 59 liver tumours in 40 patients, at two baseline scans.

3938	Computer 27	Monitoring theragnostic drug delivery in tumors using Fe(III) metal crosslinked-micelles at 7T William Dominguez-Viqueira[1], Tara L Costich[1], Epifanio Ruiz[1], Kevin N Sill[2], Suzanne J Bakewell[2], and Gary Martinez[1] *[1]Moffitt Cancer Center, Tampa, FL, United States, [2]Intezyne Technologies, Tampa, FL, United States* Stabilized micelles have shown prolonged blood circulation and targeting to solid tumors through enhanced permeability and retention (EPR) effect. It has been demonstrated that Intezyne's Versatile Encapsulation and Crosslinking Technology (IVECT™) has the advantage of allowing the micelles to be crosslinked via a pH-sensitive Fe(III) metal coordination reaction that permeates xenografted tumors and clears from circulation without retention in the kidneys or liver. In this work we developed a theragnostic method to study drug delivery over time of IVECT by T1-weighted image histogram and image intensity in the tumor, kidneys, liver and muscle in a HCT116 Xenograft Model.

3939	Computer 28	In Search of Repeatable and Useful Prostate DCE Sharon Peled[1], Michael Schwier[1], Mark Vangel[1], Clare Tempany[1], Ron Kikinis[1], Andrey Fedorov[1], and Fiona Fennessy[1] *[1]Brigham and Women's Hospital, Boston, MA, United States* This work aims to improve the practical utility of DCE derived quantitative biomarkers by comparing the repeatability of DCE calculated parameters across analysis methods, and across AIF choices. The data consists of two scans each from a set of 15 patients with suspected prostate cancer, repeated within 14 days without intervening therapy.

3940	Computer 29	Tumorigenesis in glioblastoma multiforme: Longitudinal mapping of glioma growth and extracellular pH John J Walsh[1], Lucas C Adam[2], Maxime J Parent[2], Daniel Coman[2], Samuel K Maritim[1], and Fahmeed Hyder[1,2] *[1]Department of Biomedical Engineering, Yale University, New Haven, CT, United States, [2]Department of Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States*

		Tumorigenesis in glioblastoma multiforme (GBM) is complex and depends on interactions of tumor cells with the tumor microenvironment. A limiting factor in translating preclinical GBM treatment studies is being able to longitudinally and non-invasively map the tumor microenvironment in the same tumor over days and weeks. Here we describe a multi-modal MRI study of glioma growth and metabolism in human-derived models of GBM that differ in levels of hypoxia, angiogenesis, and necrosis. We demonstrate successful longitudinal mapping of tumor growth and extracellular pH in the same U87 and U251 gliomas. We find that despite significant tumor growth, acidosis plateaus early.

3941	Computer 30	MRI for vitrectomized eyes
		Jan-Willem Beenakker[1,2]
		[1]C.J. Gorter Center for High-Field MRI, Leiden University Medical Center, Leiden, Netherlands, [2]Department of Ophthalmology, Leiden University Medical Center, Leiden, Netherlands
		Retinal detachment is a common complication of ocular tumours and is treated by replacing the original vitreous liquid with a silicon oil (SiOil). This SiOil hinders regular ophthalmic imaging, preventing follow-up after radiotherapy. MRI could offer the necessary imaging, but the strong off-resonance of SiOil impedes normal scan protocols. We determined the MR-characteristics of SiOil and developed a corresponding MR-imaging protocol. This protocol was evaluated on an eye tumour patient, who also suffered from retinal detachment. The protocol resulted in high quality MR-images of the eye, allowed a diagnosis of the multiple ocular lesions and averted surgical removal of the eye.

3942	Computer 31	DCE-MRI with a targeted contrast agent for characterizing prostate cancer aggressiveness
		Zheng-Rong Lu[1] and Zheng Han[1]
		[1]Case Western Reserve University, Cleveland, OH, United States
		Conventional dynamic contrast-enhanced MRI (DCE-MRI) has been used for tumor characterization based on tumor vascularity and permeability using non-targeted small molecular contrast agents. In this study, we investigate the effectiveness of DEC-MRI with a targeted MRI contrast agent for characterization of prostate cancer of different aggressiveness in comparison with a clinical agent. Distinctive Ktrans and Ve values were obtained between the high-risk PC3 and low-risk LNCaP tumors using the targeted agent, but not for the clinical agent, Gd(HP-DO3A). DCE-MRI with this targeted contrast agent could increase accuracy in characterizing prostate cancer aggressiveness.

3943	Computer 32	PET/MR in tumor differentiation of head and neck squamous cell carcinoma: a Preliminary Study of Multi-modality Imaging including PET, DWI, DCE and the combination
		Haodan Dang[1], Yu Chen[1], Bo Hou[1], Huadan Xue[1], and Zhengyu Jin[1]

		[1]*Peking Union Medical College Hospital, Beijing, China*
		The purpose of our study was to evaluate the diagnostic efficiency of multiple parameters and the combination with PET/MR in tumor differentiation of HNSCC. The patients with clinical suspicion or diagnosis of HNSCC were included and had the PET/MR examination with 18F-FDG PET and multiple MR sequences. The results showed that there was no significant correlation among different parameters. The differences among groups of tumor differentiation were obvious with ADCmean and SUVmean. Finally, our study suggested that the multiple parameters of PET / MR could be complementary in diagnosis of tumor differentiation and the combination can further improve the performance.

3944	Computer 33	Population variation in tumour microvascular characteristics
		Ross A Little[1], Hervé Barjat[2], Jennifer I Hare[3], Mary Jenner[2], Yvonne Watson[1], Susan Cheung[1], Katherine Holliday[1], Weijuan Zhang[1], James PB O'Connor[1], Simon T Barry[3], Sanyogitta Puri[4], Geoff JM Parker[1], and John C Waterton[1]
		[1]*University of Manchester, Manchester, United Kingdom,* [2]*formerly AstraZeneca, Alderley Park, United Kingdom,* [3]*AstraZeneca, Cambridge, United Kingdom,* [4]*AstraZeneca, Alderley Park, United Kingdom*
		It is unclear from the literature whether microvascular characteristics vary according to primary tumour type, although this is important for e.g. patient selection in drug development. DCE-MRI data were obtained covering 342 tumours and 13 tumour types. Median K^{trans} for non-glioma tumours had geometric mean (95% CI) of 0.15 min^{-1} (0.05 min^{-1}, 0.45 min^{-1}). There was insufficient separation between posterior densities to predict tumour K^{trans} given primary tumour type. This demonstrates that where microvascular characteristics are relevant for inclusion in a clinical trial or for beginning a specific treatment, it is not generally possible to select on tumour type alone.

3945	Computer 34	The effect of sunitinib on human melanoma xenografts assessed with MRI and intravital microscopy
		Jon-Vidar Gaustad[1], Trude G Simonsen[1], and Einar K Rofstad[1]
		[1]*Oslo University Hospital, Oslo, Norway*
		We evaluated the effect of sunitinib on melanoma xenografts with dynamic contrast-enhanced MRI (DCE-MRI), diffusion weighted MRI (DW-MRI), intravital microscopy, and immunohistochemistry. An MR-compatible dorsal window chamber was used to compare parametric MR images with high resolution intravital microscopy images of the tumor vasculature. Sunitinib treatment reduced vessel density, increased the hypoxic tumor fraction, and induced necrosis, and DCE-MRI and DW-MRI were sensitive to these microenvironmental effects. The MR-compatible window chamber allowed daily assessment of both the morphology and function of tumor vasculature and may be a valuable tool to verify treatment-induced effects observed in parametric MR images.

3946	Computer 35	CEST MRI of 3-O-Methyl-D-Glucose uptake and accumulation in brain tumors Akansha Ashvani Sehgal[1,2], Yuguo Li[1,2], Bachchu Lal[3], Nirbhay N Yadav[1,2], Xiang Xu[1,2], Jiadi Xu[1,2], John Laterra[3], and Peter C. M van Zijl[1,2] *[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Neurology, Oncology, and Neuroscience, The Johns Hopkins Medicine, and The Hugo W. Moser Research Institute at Kennedy Krieger, Baltimore, MD, United States* Glucose weighted chemical exchange saturation transfer (CEST) imaging has garnered a lot of interest in the past few years as it can be a safe alternative to gadolinium contrast based MRI for tumor diagnosis. 3-O-methyl glucose (3-OMG) is a structural analog of glucose which, because of its apparent non-toxicity and its property to not get metabolized, has been shown to be another promising CEST contrast agent. Here we explore its application as a CEST contrast agent for assessing brain tumors.

3947	Computer 36	Bio-orthogonal MR imaging – A novel method proposed for metastatic cancer detection Tanner Ravsten[1], William Pitt[1], Neal Bangerter[2], Randy Hartley[2], Forrest Howell[2], and Jessica Doud[2] *[1]Chemical Engineering, Brigham Young University, Provo, UT, United States, [2]Electrical Engineering, Brigham Young University, Provo, UT, United States* Metastatic tumors (METs) cause 90% of cancer deaths since their small size makes detection difficult. A bio-orthogonal method is demonstrated where two distinct detection molecules and mechanisms are employed with minimal interference. Gadolinium (Gd) and Iron-Oxide-Particles (IOP) with respective MRI T1 and T2* scans were hypothesized to produce orthogonality in the resulting images. In vitro experiments showed respective minimum detectability limits of Gd and IOP at 1μL, 0.25μM and 0.5μL, 6μM. Ex vivo experiments demonstrated Gd and IOP detection at 0.313-0.625mM. Thus the plausibility of bio-orthogonal MET detection to reduce the likelihood of false positive and negative diagnoses is very high.

3948	Computer 37	A 3D Spiral/Radial sequence for both anatomical and DCE imaging of pulmonary metastases in mice Emeline Julie RIBOT[1], Charles Castets[1], Wilfried Souleyreau[2], Lin Cooley[2], Andreas Bikfalvi[2], Aurélien Trotier[1], and Sylvain Miraux[1] *[1]CRMSB UMR5536, CNRS-Univ.Bordeaux, Bordeaux, France, [2]LAMC U1029, INSERM, Talence, France*

		In order to detect and characterize pulmonary metastases in small animals, a 3D UTE sequence using a hybrid radial/spiral encoding, was employed while free breathing. Due to the high contrast and the high spatial resolution (125µm isotropic), early-growing metastases (representing less than 10 voxels) were detected in mice in only 12min. In parallel, through the acceleration of the acquisition by 4, the same sequence was used to perform, for the 1st time, DCE-MRI on pulmonary metastases in mice. The new pulmonary-dedicated sequence enables to obtain either anatomical or DCE-MRI information in mice.

3949	Computer 38	Correlation of Native Liver T1 mapping to post contrast T1 mapping, Apparent Diffusion Coefficient (ADC) and Dynamic Contrast Enhancement (DCE) Maps in a Rabbit Model for Liver Cancer
		Dana C Peters[1], Daniel Coman[1], Julius Chapiro[1], John Walsh[1], Fahmeed Hyder[1], Tsa Shelton[2], Johanna van Breugel[1], Tabea Borde[1], Lynn Savic[1], MingDe Lin[1,3], Albert J Sinusas[2], Jean-Francois Geschwind[4], Douglas Rothman[1], R. Todd Constable[1], James S Duncan[1], and Steffen Huber[1]
		[1]Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [2]Medicine, Yale University, New Haven, CT, United States, [3]U/S Imaging and Interventions, Philips Research North America, Cambridge, MA, United States, [4]PreScience Labs, Westport, CT, United States
		We investigated native T1 mapping for detection of liver tumors in comparison to multi-parametric MRI. In 13 rabbits with implanted 2 week VX2 tumor, 9 of which underwent transarterial chemoembolization (TACE), native T1 mapping showed a similar spatial pattern compared to dynamic contrast enhanced (DCE) imaging, apparent diffusion coefficient maps (ADC), and post-contrast T1 maps. Native T1 is highest in central necrosis, intermediate in viable hypervascular tumor, and lowest in normal liver.

3950	Computer 39	Feature decomposition based examining tumor heterogenity on dynamic susceptibility contrast enhansed MRI data
		Bing Ji[1], Silun Wang[1], Liya Wang[1,2], Xiaofeng Yang[3], and Hui Mao[1]
		[1]Department of Radiology and Imaging Sciences, Emory University School of Medicine, Emory University, Atlanta, GA, United States, [2]Long Hua Hospital, Guangdong, China, [3]Department of Radiation Oncology, Emory University School of Medicine, Emory University, Atlanta, GA, United States
		Dynamic susceptibility contrast-enhanced magnetic resonance imaging (DSC MRI) is widely used for studying blood perfusion in brain tumors. We report use of a model free approach combining with a feature extraction strategy to interrogate time course data from DSC MRI of brain tumor patients. The results reveal the spatial and temporal heterogenity of brain tumors based on features of time course profiles. The number of features/patterns in DSC data indicating the heterogenity of the tumor is associated with the tumor grade. The new method can potentially extract more tumor physiology information from DSC MRI comparing to the traditional model-based analysis.

3951	Computer 40	Magnetic targeting and imaging of super-paramagnetic iron-oxide nanoparticles to subcutaneous tumour models Mohammad Mohseni[1], John Connell[1], Stephen Patrick[1], Chris Payne[1], Yichao Yu[1], May Zaw-Thin[1], Tom Roberts[2], Bernard Siow[1], Tammy Kalber[1], Quentin Pankhurst[1], and Mark Lythgoe[1] *[1]UCL, london, United Kingdom, [2]Kings College, london, United Kingdom* Magnetic targeting of iron-oxide nanoparticles using a MRI system could play an important role for future advances in delivery and non-invasive monitoring of therapeutic interventions. Currently, there is limited information on the effect of magnetic field gradients on the distribution of particle accumulation in the target region. This study shows that the delivery of individual 100nm particles can be enhanced in tumours using an external magnetic field after intravenous injection in vivo. Using quantitative non-invasive imaging we found that the distribution of nanoparticles within the tumour depends on the shape of the magnetic field gradient applied across the tumour.

3952	Computer 41	Androgen receptor signaling in castration resistant prostate cancer tumor alters real-time lactate flux and lactate levels in vivo Niki Zacharias[1,2], Jaehyuk Lee[3], Sumankalai Ramachandran[4], Sriram Shanmugavelandy[3], James McHenry [3], Sankar Maity [4], Mark Titus [4], and Pratip Bhattacharya[3] *[1]Urology, University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Bioengineering, Rice University, Houston, TX, United States, [3]Cancer Systems Imaging, University of Texas MD Anderson Cancer Center, Houston, TX, United States, [4]Genitourinary Medical Oncology, University of Texas MD Anderson Cancer Center, Houston, TX, United States* Non-invasive imaging of castration resistant prostate cancer (CRPC) subtypes remains a challenge in the clinic. CRPC can be subdivided grossly into two phenotypes 1) a morphologically small cell, chemosensitive, and androgen receptor (AR) negative subtype and 2) AR-dependent CRPC characterized by dysregulation of AR signaling. Employing hyperpolarized pyruvate conversion to lactate *in vivo* as well as lactate measurements *ex vivo*, we determined the difference in glycolysis between patient derived xenograft (PDX) animal models of these two CRPC subtypes. We have found increased pyruvate to lactate conversion (P <0.04) and higher lactate levels in AR-dependent compared to AR negative PDX models.

3953	Computer 42	Comparison of 2D and 3D dynamic contrast enhanced perfusion magnetic resonance imaging in patients with colorectal cancer Tanja Uhrig*[1], Christina Korth*[1], Sonja Sudarski[2], Lothar R. Schad[1], and Frank G. Zöllner[1]

		[1]*Computer Assisted Clinical Medicine, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany,* [2]*Institute of Clinical Radiology and Nuclear Medicine, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany*
		This study investigated the influence of quantitative 3D volume dynamic contrast enhanced-MRI in rectal cancer on perfusion parameters compared to the data obtained by a selecting a single tumor slice as typically performed in clinical routine. Data analysis of five patients showed deviations of up to 28 % for Plasma Flow, 28 % for Plasma Volume and 36 % for Mean Transit Time. An examination of the entire tumor volume is therefore advisable in order to additionally guarantee intra-observer reproducibility.

3954	Computer 43	In vivo monitoring of oxygen levels in the brain tumor between fractionated radiotherapy using oxygen-enhanced MR imaging
		Junchao Qian[1], Xiang Yu[1], Suhong Wu[1], and Hongzhi Wang[1]
		[1]*Department of Medical Imaging, Hefei Cancer Hospital of Chinese Academy of Sciences, Hefei, China*
		Response of tumor cells to radiation is closely related to oxygen level and fractionated radiotherapy allows reoxygenation of hypoxic tumor cells. Dynamic monitoring of tissue oxygenation is important for precise radiotherapy. Oxygen-enhanced MRI may directly reflect tissue oxygenation, has shown promising applications in the measurement of hypoxia. Therefore, in this study we explored the possibility to monitor oxygen level in the brain between fractionated radiotherapy using oxygen-enhanced MRI. The results showed ΔR_1 increased in tumor 30 minutes after first fractionated radiation compared to pre-radiation levels. Thus, oxygen-enhanced MRI can noninvasively monitor oxygen levels in brain tumor between fractionated radiotherapy.

3955	Computer 44	Variation-guided supervoxels for subregional tumour analysis in DCE-MRI
		Jola Mirecka[1], Benjamin Irving[1], Danny Allen[2], Paul Kinchesh[2], Stuart Gilchrist[2], Ana Gomes[2], Veerle Kersemans[2], Sean Smart[2], Michael Chappell[1], Julia Schnabel[3], and Mark Jenkinson[4]
		[1]*Institute of Biomedical Engineering, Department of Engineering Science, University of Oxford, Oxford, United Kingdom,* [2]*Department of Oncology, University of Oxford, Oxford, United Kingdom,* [3]*School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom,* [4]*Oxford Centre for Functional MRI of the Brain (FMRIB), Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom*

		In nature and real life application domains it is common to encounter varied or textured areas, therefore in many cases it is of greater interest to partition the image into similarly varied, as opposed to similarly homogeneous subregions. We propose a novel, variation-guided approach to SLIC clustering, that has a potential to provide a useful alternative to standard supervoxels due to it's ability to retain local variation information. We evaluate the method on a longitudinal DCE-MRI dataset of 10 mice scanned over 10 days. The method was able to produce contiguous segmentations, while significantly reducing computational complexity.

3956	Computer 45	Hypoxia in Rat Prostate Tumors: Correlation of BOLD/TOLD MRI with [18F]FMISO PET
		Heling Zhou[1], Srinivas Chiguru[1], Rami Hallac[1,2], Donghan M Yang[1], Guiyang Hao[1], Peter Peschke[3], and Ralph P Mason[1]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]AIM Center, Children's Health, Dallas, TX, United States, [3]Clinical Cooperation, German Cancer Research Center, Heidelberg, Germany
		^{18}F-fluoromisonidazole ([^{18}F]FMISO) has been exploited in positron emission tomography (PET) as an imaging radiotracer for tumor hypoxia. The accumulation of [^{18}F]FMISO must depend on both hypoxia and perfusion. In this study, we investigated [^{18}F]FMISO activity in the AT1 tumor rat model and found that [^{18}F]FMISO produced conflicting results in the poorly perfused hypoxic tumors. The preliminary results indicate that BOLD and TOLD MRI can provide complimentary information for interpretation of the [^{18}F]FMISO results.

3957	Computer 46	Assessment of tumors aggressiveness in papillary thyroid cancer (PTC) using DCE-MRI
		Ramesh Paudyal[1], Yonggang Lu[2], Vaios Hatzoglou[3], David Aramburu Nunez[1], Andre Moreira[4], Yousef Mazaheri[1,3], Mithat Gonen[5], Joseph O. Deasy[1], Ashok Shaha[6], R. Michael Tuttle[7], and Amita Shukla-Dave[1,3]
		[1]Medical Physcis, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]Pathology, NYU Langone Medical Center, New York, NY, United States, [5]Epidemiology and Biostatistics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [6]Surgery, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [7]Medicine, Memorial Sloan Kettering Cancer Center, New York, NY, United States

		In this study, pretreatment dynamic contrast enhanced (DCE-MRI) data was analyzed using the Tofts model (TM), extended Tofts model (ETM), and two compartment exchange model (2CXM) to quantify perfusion-related quantitaive imaging metrics in papillary thyroid cancer (PTC) patients. The histopathological features of aggressiveness were used as the standard of reference. The results indicated that the ETM provided better fit among the models. The ETM Ktrans values were able to distinguish between aggressive and non-aggressive tumors. The study concludes that pretreatment perfusion-related metric can be useful biomarkers for stratifying tumor aggressiveness in PTC patients.

3958	Computer 47	Iron Oxide-Based T2-weighted MRI and NMR Metabolomics of Radiation and Chemotherapy Induced Inflammation in Glioma Models
		Heather Caulkins[1], Paul Hong[2], Ksenia Serdukova[3], Kendra Huber[1], Denise Davis[1], Jenna Steiner[1], and Natalie Julie Serkova[1]
		[1]Anesthesiology, University of Colorado Denver, Aurora, CO, United States, [2]Penn State Health, Hershey, PA, United States, [3]University of Colorado Boulder, Boulder, CO, United States
		Radio- and chemotherapy for gliomas cause a macrophage-driven inflammation called pseudoprogression (PsP) which appears as abnormal MRI enhancement mimicking treatment response. Our quantitative NMR metabolomics in murine glioma models show a significant increase in amino acid uptake and metabolism (glutamine, glycine, methionine, and tyrosine), lactate and phospholipids in actively proliferating untreated gliomas. Iron oxide is taken up uniquely by inflammatory macrophages, as shown by decreased T2-MRI contrast and an increase in the F4/80 macrophages during treatment-induced PsP. This imaging platform may provide a promising discernment of PsP (iron oxide qT2MRI) and true progression (amino acid PET) for gliomas.

Electronic Poster

J-Difference-Edited MRS/MRSI

Exhibition Hall	Tuesday 9:15 - 10:15

3959	Computer 49	Simultaneous Measurement of Glutamate, Glutamine, GABA, and Glutathione by Spectral Editing Without Subtraction
		Li An[1] and Jun Shen[1]
		[1]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States

		A novel spectral editing approach was proposed to simultaneously measure glutamate, glutamine, GABA, and glutathione at 7 T. By using a single editing pulse, a relatively short echo time of 56 ms was achieved. The main targets of the signal detection were the H2 and H4 protons of GABA and the H4 protons of glutamate, glutamine, and the glutamyl moiety of glutathione. No motion-sensitive data subtraction was required.

3960	Computer 50	High-Speed Density Matrix Simulation of PRESS with A Single Editing Pulse
		Li An[1] and Jun Shen[1]
		[1]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States
		A single spectral editing pulse incorporated into the PRESS sequence produces large Bloch-Siegert shift. The lack of a general method to quantify these shifts for spectral editing experiments has made it necessary to use a second identical editing pulse to cancel the shift. Here we describe a high-speed density matrix simulation method to accurately simulate a PRESS sequence with a single editing pulse for simultaneous detection of glutamate, glutamine, GABA, and glutathione at TE = 56 ms and 7 Tesla. To facilitate *in vivo* quantification, the frequency dependent Bloch-Siegert shift is accurately calculated and removed from the spectra.

3961	Computer 51	Simultaneous edited MR spectroscopy of glutathione and macromolecule-suppressed GABA
		Georg Oeltzschner[1,2], Kimberly L. Chan[1,2,3], Muhammad G. Saleh[1,2], Mark Mikkelsen[1,2], Nicolaas A. J. Puts[1,2], and Richard A. E. Edden[1,2]
		[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Biomedical Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States
		γ-aminobutyric acid (GABA) and glutathione (GSH) can be simultaneously measured in the human brain *in vivo* at 3T using Hadamard encoding and reconstruction of MEGA-edited spectroscopy (HERMES). A drawback of conventional HERMES of GABA/GSH is the contamination of the edited GABA peak with co-edited macromolecular signals (MM), reducing the specificity of the method. We propose the addition of symmetrical suppression into the HERMES framework, and demonstrate the successful implementation of this approach in ten healthy subjects.

3962	Computer 52	Editing everything with HERCULES: Hadamard-encoded editing of seven low-concentration metabolites
		Georg Oeltzschner[1,2], Daniel Rimbault[3], Mark Mikkelsen[1,2], Muhammad G. Saleh[1,2], Nicolaas A. J. Puts[1,2], and Richard A. E. Edden[1,2]

		[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Division of Biomedical Engineering, Department of Human Biology, University of Cape Town, Cape Town, South Africa
		Low-concentration metabolites can be detected at 3T with *J*-difference-edited MR spectroscopy. However, long acquisition times (~10 min per metabolite) make edited studies of many metabolites unfeasible. Multiplexed editing experiments have increased the time efficiency of editing while maintaining its specificity. Here, we introduce HERCULES (Hadamard Editing Resolves Chemicals Using Linear-combination Estimation of Spectra), an advanced multiplexed approach to differentiate the evolution of eight editable spin systems (GABA, GSH, Asp, Asc, NAA, NAAG, Lac and 2-HG) within a single experiment. HERCULES quantifies a total number of 13 metabolites, providing a 7T-like neurochemical profile of neurotransmitters, antioxidants, and metabolic markers at 3T.

3963	Computer 53	Bilateral functional MRS of GABA with real-time frequency and motion correction at 7T
		Anouk Marsman[1], Vincent Oltman Boer[1], Mads Andersen[2], and Esben Thade Petersen[1,3]
		[1]Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark, [2]Philips, Copenhagen, Denmark, [3]Center for Magnetic Resonance, Dept. Electrical Engineering, Technical University of Denmark, Lyngby, Denmark
		Brain function is largely controlled by inhibitory processes steered by main inhibitory neurotransmitter GABA. In this role, GABA is essential in brain development and plasticity as well as neuropsychiatric and neurodegenerative diseases. In order to accurately measure GABA responsiveness, we designed a bilateral edited fMRS sequence including real-time frequency and motion correction, as the relatively weak GABA signal is highly susceptible to frequency drift and motion. As acquisition of the macromolecule-uncontaminated GABA signal is challenging at lower field strengths, experiments were performed at 7T.

3964	Computer 54	Test-retest reproducibility of quantitative proton MRS using short-TE STEAM and semi-LASER sequences in young adult volunteer brains at 7T.
		Tomohisa Okada[1], Hideto Kuribayashi[2], Lana G Kaiser[2], Yuta Urushibata[2], Nouha Salibi[3], Ravi Teja Seethamraju[3], Sinyeob Ahn[3], Tadashi Isa[1], and Koji Fujimoto[1]
		[1]Kyoto University, Kyoto, Japan, [2]Siemens Healthcare K.K., Tokyo, Japan, [3]Siemens Healthcare, USA, Malvern, PA, United States

		Recently, 7T-MR system has been approved for clinical use in Europe and USA; however, its clinical configuration is limited to single-channel transmit so B1+ shimming is not feasible. This study investigated reproducibility of single-voxel MRS using short-TE STEAM and semi-LASER using a single-transmit & 32-receiver head coil at 7T. Fifteen healthy young volunteers were scanned twice at the posterior cingulate. SNR was higher in semi-LASER, but coefficients of variation were comparable ranging mainly from 5-10% and better in short-TE STEAM in low-concentration J-coupled peaks. Even with clinical setups, 7T shows high reliability and will contribute to MRS investigation.

3965	Computer 55	Impact of sub-echo timings of PRESS on quantitative glutamate/glutamine level using LCModel at 7T
		Tzu-Jung Fei[1], Cheng-Wen Ko[1], Moritz Braig[2], and Jochen Leupold[2]
		[1]Dept. of Computer Science and Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan, [2]Medical Physics,Department of Radiology, University Medical Center Freiburg, Freiburg, Germany
		In this study, we investigated the signal variation of Glu and Gln along sub-echo timings (TE1, TE2) in PRESS acquisitions on a preclinical 7T system. Our results show that the choice of sub-echo timings (TE1, TE2) for PRESS may alter the quantitative outcome remarkably for strongly coupled metabolites, e.g. Glu, Gln. The basis-sets used for LCModel analysis has to be carefully simulated and take the sub-echo timings into account since J-evolution of strongly coupled resonances may vary with TE1/TE2 at high fields. Quantitative comparison on these metabolites with mismatched sub-echo timings (TE1, TE2) can result in invalid conclusion.

3966	Computer 56	Non-water Suppressed GABA Edited Magnetic Resonance Spectroscopic Imaging using Density Weighted Concentric Rings k-space Trajectory
		Uzay E Emir[1], Pingyu Xia[1], Xiaopeng Zhou[1], Mark Chiew[2], Adam Steel[3,4], M Albert Thomas[5], and Ulrike Dydak[1,6]
		[1]School of Health Sciences, Purdue University, West Lafayette, IN, United States, [2]Wellcome Centre for Integrative Neuroimaging, FMRIB Division, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [3]Nuffield Department of Medicine, University of Oxford, Oxford, United Kingdom, [4]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States, [5]Department of Radiological Sciences, University of California, Los Angeles, CA, United States, [6]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States

		In this study, we have developed and demonstrated a non-water suppressed GABA editing Magnetic Resonance Spectroscopic Imaging technique using density-weighted concentric rings k-space trajectory that performs robustly within a clinically feasible acquisition time at 3T. The method has been validated in a series of phantom experiments and its feasibility assessed in a healthy volunteer with a high in-plane resolution of 7.5 × 7.5 mm^2. Experiments qualitatively demonstrate the advantage of the proposed method in terms of its improved resolution and reduced contamination of spectra from neighboring voxels.

3967	Computer 57	Automated MR Spectrum Registration for In Vivo Mouse MEGA-PRESS Study at 9.4T And the Introduction of MRSMouse2.0
		Jia Guo[1], Douglas L. Rothman[2], and Scott A. Small[3]
		[1]Department of Biomedical Engineering, Columbia University, New York, NY, United States, [2]Biomedical Engineering & Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [3]Departments of Neurology, Radiology or Psychiatry, Columbia University College of Physicians and Surgeons, New York, NY, United States
		The goal of this study was to develop the tailored automated processing and quantification software for Meshcher–Garwood point resolved spectroscopy (MEGA-PRESS) in research of mouse models at 9.4T. The proposed software, MRSMouse, consists of two modules: the data loading module, MRSMouseLoad, which reads the Bruker time-domain raw data and processes it into a frequency-domain GABA-edited spectrum with bandwidth, frequency and phase drift correction through spectrum registration; and the spectral fitting module, MRSMouseFit, which quantifies the metabolite concentrations by modeling the spectra as a linear combination of the simulated basis-set and a smooth-spline in the frequency domain.

3968	Computer 58	Comparison of GABA and Glx Quantification from Edited and Unedited MR Spectra – assessment of age effects
		Akila Weerasekera[1], Diana Sima[2], Ronald Peeters[3], Tom Dresslaers[3], Oron Levin[4], Stephan Swinnen[4], Sabine Van Huffel[2], and Uwe Himmelreich[1]
		[1]Department of Imaging and Pathology, KU Leuven, leuven, Belgium, [2]Department of Electrical Engineering (ESAT), STADIUS Center for Dynamical Systems, Signal Processing and Data Analytics and Imec, KU Leuven, leuven, Belgium, [3]Radiology, Department of Imaging and Pathology, UZ Leuven, leuven, Belgium, [4]Movement Control & Neuroplasticity Research Group, KU Leuven, leuven, Belgium

		1H-MR spectroscopy (MRS) is a well-established tool to provide in vivo measurement of gamma-aminobutyric acid (GABA), glutamine and glutamine (Glx) concentrations for a variety of conditions1. There is an increasing interest in using spectral editing methods to measure GABA and Glx in the human brain. The commonly used GABA-editing sequence MEGA-PRESS provides filtered GABA signals based on the molecule's J-coupling2, 3. Nonetheless, quantitative comparison among presently used acquisition and analysis methods is lacking. Here we compare currently available spectral fitting methods to assess the in vivo concentration values for GABA and Glx derived from edited (MEGA-PRESS) and unedited (MEGA-PRESS-OFF) spectra. We have tested our approach to assess the inter-subject variability in neurotransmitter levels arising from age effects.

3969	Computer 59	Towards repeatable GABA-MRS of the hippocampus: Development of an extended post-processing pipeline
		Yannik Völzke[1], Eberhard D. Pracht[1], Elke Hattingen[2], and Tony Stöcker[1,3]
		[1]German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany, [2]Neuroradiology, Radiology, University Clinic Bonn, Bonn, Germany, [3]Department of Physics and Astronomy, University Bonn, Bonn, Germany
		The low concentration and the overlap with more prominent resonances hamper the GABA quantification via MR spectroscopy. Strong B0 inhomogeneities in the hippocampus further impede reliable spectroscopic measurements. To increase the repeatability of the GABA quantification we developed a post-processing module for MEGA-sLASER measurements.The development of an optimized post-processing module reduces the coefficient of variation of the intra-session GABA/creatine signal ratio to (5-10)%. This is essential for clinical trials.

3970	Computer 60	Simulations of MEGA-PRESS spectra to achieve quality criteria for GABA quantification
		Helge Jörn Zöllner[1,2], Alfons Schnitzler[1], and Hans-Jörg Wittsack[2]
		[1]Institute of Clincial Neuroscience and Medical Psychology, Heinrich Heine University, Düsseldorf, Germany, [2]Department of Diagnostic and Interventional Radiology, Heinrich Heine University, Düsseldorf, Germany

		The purpose of this study was to investigate the influence of diminished spectral quality on GABA quantification by using MEGA-PRESS simulations. Different levels of spectral quality were created by adding artificial noise and line broadening to a simulated spectrum to mimic shimming quality. Initial results revealed that the impact of signal to noise ratio (SNR) is much higher than the impact of line broadening. Furthermore the error of peak fitting does not seem to reflect the real quantification error of the known GABA levels of the simulated spectrum. Further simulations and analyses are needed to assure these initial results.

3971	Computer 61	Spectral simulations of glutathione at 7T: Comparison of two different spin system parameter sets
		Muhammad Gulamabbas Saleh[1,2], Mark Mikkelsen[1,2], Georg Oeltzschner[1,2], Kimberly L. Chan[1,2,3], Adam Berrington[1,2], Peter B. Barker[1,2], and Richard A. E. Edden[1,2]
		[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Biomedical Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States
		Glutathione (GSH) is a redox compound, providing protection against reactive oxygen species. Abnormal variation in GSH concentration has been associated with several neurological diseases. Several studies quantify low-concentration metabolites, such as GSH, using simulated basis sets derived from spin system parameters available in the literature. Through simulations and phantom experiments, we assess the accuracy of two different sets of spin system parameters of GSH-cysteine at 7T. The disagreement between the phantom and simulation GSH-cysteine spectra suggests a need for further refinement of the spin system parameters.

3972	Computer 62	Simultaneous editing of GABA and glutathione at 7T
		Muhammad Gulamabbas Saleh[1,2], Mark Mikkelsen[1,2], Georg Oeltzschner[1,2], Kimberly L. Chan[1,2,3], Adam Berrington[1,2], Peter B. Barker[1,2], and Richard A. E. Edden[1,2]
		[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Biomedical Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States
		HERMES has been shown to simultaneously edit GABA and GSH at 3T. Spectral editing at 7T provides better editing pulse selectivity, e.g. quantifying GABA with less contamination from macromolecules. In this abstract, simulations, phantom and in vivo experiments were performed at 7T using the sLASER sequence for simultaneous editing of GABA and GSH using HERMES. HERMES with sLASER localization at 7T provides uniform localization, doubles the acquisition rate, and provides excellent separation of the metabolites without any loss in spectral quality compared to sequentially acquired measurements of GABA and GSH using MEGA-PRESS.

3973	Computer 63	High Spatial Resolution Simulated Basis Sets for HERMES and MEGA-PRESS Diana Georgiana Rotaru[1] and David John Lythgoe[1] *[1]Neuroimaging, King's College London, London, United Kingdom* Low concentration metabolites with J-coupled peaks are difficult to quantify using MRS, even using MEGA-PRESS or its recently propose HERMES implementation. Using LCModel with simulated basis sets can lead to inaccurate metabolite quantification, since the spatial-dependence of the signal is often not fully accounted for. This can be minimised by increasing the number of spatial positions simulated, at the expense of computation time. We simulated basis sets for MEGA-PRESS and HERMES using the recently introduced approach based on one-dimension projections, as a replacement for the commonly used three-dimensional method, providing more accurate basis sets in shorter computation time.

3974	Computer 64	Multi-Step Frequency-and-Phase Correction for Multiplexed Edited MRS Data Mark Mikkelsen[1,2], Muhammad G. Saleh[1,2], Jamie Near[3], Kimberly L. Chan[1,2,4], Tao Gong[5], Ashley D. Harris[6], Georg Oeltzschner[1,2], Nicolaas A. J. Puts[1,2], Kim M. Cecil[7], Iain D. Wilkinson[8], and Richard A. E. Edden[1,2] *[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Douglas Mental Health University Institute and Department of Psychiatry, McGill University, Montreal, QC, Canada, [4]Department of Biomedical Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [5]Shandong Medical Imaging Research Institute, Shandong University, Jinan, China, [6]Department of Radiology, University of Calgary, Calgary, AB, Canada, [7]Department of Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [8]Academic Unit of Radiology, University of Sheffield, Sheffield, United Kingdom* Multiplexed edited MRS – more than one edited experiment combined in a single acquisition – involves acquiring subspectra with four or more distinct signal profiles. This technique therefore requires a tailored approach for correcting frequency and phase errors associated with participant head motion and scanner instability. Here, we demonstrate a novel alignment algorithm, termed multi-step frequency-and-phase correction (msFPC), designed to deal with the challenges of aligning individual transients in multiplexed edited data. Testing this method on simulated and in vivo datasets, msFPC was found to outperform other previously demonstrated algorithms (spectral registration and spectral registration with post hoc choline-creatine alignment).

3975	Computer 65	Scan Duration, Signal-To-Noise Ratio and Sample Size Considerations in GABA-Edited MRS Studies Mark Mikkelsen[1,2], Rachelle S. Loo[3,4], Nicolaas A. J. Puts[1,2], Richard A. E. Edden[1,2], and Ashley D. Harris[3,4]

		[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Radiology, University of Calgary, Calgary, AB, Canada, [4]CAIR Program, Alberta Children's Hospital Research Institute and Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada
		We investigate the relationships between scan duration, signal-to-noise ratio (SNR) and group-level variance in GABA-edited MRS. Typically, GABA editing takes ~10 min for a 27-mL voxel. GABA+/Cr measurements from five voxels from 18 participants were analyzed by cumulatively binning the averages within each dataset to determine the effects on SNR and group-level variance. Sample size calculations estimated the required sample sizes needed for different predicted effect sizes in GABA-edited MRS studies. We show that the duration of GABA-edited acquisitions can be reduced if taking into account a statistically acceptable amount of group-level variance and the magnitudes of predicted effects.

3976	Computer 66	Optimal phased-array signal combination from separate coil elements for GABA quantification at 7T
		Donghyun Hong[1], Seyedmorteza Rohani Rankouhi[1], Jan-Willem Thielen[1], and David G. Norris[1,2]
		[1]Erwin L. Hahn Institute for MRI, University of Duisburg-Essen, Essen, Germany, [2]Donders Institute for Brain, Cognition and Behavior, Radboud University, Nijmegen, Netherlands
		Hitherto, signal combination strategies from separate coil elements have been evaluated on the basis of spectral SNR improvement. This study compared various combination methods for two representative GABA measurement techniques: GABA editing and short echo time acquisitions, and investigated which signal combination method is optimal in terms of GABA quantification using LCModel.

3977	Computer 67	Feasibility of ultra-short TE MRS with full intensity to detect human brain glutathione, glutamine and GABA on 3 T and 4 T
		Xi Chen[1], Yihong Yang[2], Dost Ongur[1], and Fei Du[1]
		[1]McLean Hospital; Harvard Medical School, Belmont, MA, United States, [2]National Institute on Drug Abuse, Baltimore, MD, United States
		GABA, glutamine (Gln) and Glutathione (GSH) are important metabolites in human brain. However, with regular proton MRS, all of them are subject to J modulations during the moderate TE and hardly reliably observed. This study utilizes SPECIAL, an ultra-short TE MRS with full intensity, on 3T and 4T human scanners to test its feasibility to detect GABA, Gln and GSH. Compared to 3T PRESS, SPECIAL on 3T and 4T observed consistent Gln and GSH concentrations with higher reliabilities. Uniquely, 4T SPECIAL observed GABA+MM signal with significantly lower CRLB compared to 3 T measurements.

3978	Computer 68	Increased Rostral Anterior Cingulate Cortex GABA+ Concentrations in IBS Patients with Anxiety Sofie Tapper[1,2], Adriane Icenhour[2,3], Olga Bednarska[3], Anders Tisell[1,2], Susanna Walter[2,3], and Peter Lundberg[1,2] *[1]Department of Radiation Physics, and Department of Medical and Health Sciences, Linköping University, Linköping, Sweden, [2]Center for Medical Image Science and Visualization, Linköping University, Linköping, Sweden, [3]Institute of Clinical and Experimental Medicine, Division of Gastroenterology, Linköping University, Linköping, Sweden* The aim was to investigate whether Glutamate and GABA concentrations were altered in the rACC in patients with IBS compared to healthy controls, and to investigate if the GABA and Glutamate concentrations were associated with the level of anxiety in IBS patients. We observed higher rACC GABA+ concentrations in IBS patients, whereas Glx concentrations remained unaltered. Moreover, the changes in GABA concentrations were most pronounced in patients with high severity of anxiety. Thus, our findings provide first evidence of dysregulated rACC GABAergic neurotransmission in IBS, and suggest that altered inhibitory neurotransmission may be linked to comorbid anxiety in IBS patients.

3979	Computer 69	Macromolecule Suppressed GABA Editing with Reduced Artifact in Region near Sinuses using Improved MEGA-SPECIAL Sequence Meng Gu[1], Ralph Hurd[1], Laima Baltusis[2], Frederick T. Chin[1], and Daniel M. Spielman[1] *[1]Radiology, Stanford University, Stanford, CA, United States, [2]Center for Cognitive and Neurobiological Imaging, Stanford University, Stanford, CA, United States* B0-inhomogeneity-insensitive GABA editing with MM suppression has been developed using improved MEGA-SPECIAL sequence using highly selective (30 ms) editing pulses allowed by 1D ISIS localization and 1D echo planar gradient in the logical S/I direction. MM suppressed GABA editing was successfully achieved in occipital lobe. However, GABA editing in regions near sinuses, e.g. anterior cingulate cortex (ACC), was compromised from imperfect subtraction in the ISIS localization. To reduce artifact in this region, the ISIS and 1D EP gradient were applied in the logical R/L direction together with a 16-step phase-cycled acquisition. These methods significantly improved edited spectra obtained from ACC.

3980	Computer 70	Frequency-dependent cortical plasticity via GABA modulation Caroline Lea-Carnall[1], Faezeh Sanaei Nezhad[1], Nelson Trujillo-Barreto[1], Marcelo A Montemurro[1], Wael El-Deredy[1,2], and Laura M Parkes[1] *[1]University of Manchester, Manchester, United Kingdom, [2]University of Valparaiso, Chile, Manchester, United Kingdom*

		Gamma-Aminobutyric acid (GABA) is the major inhibitory neurotransmitter in the human brain and is thought to underlie plasticity processes. We tested the effect of repetitive tactile stimulation using two driving frequencies on GABA concentration using functional magnetic resonance spectroscopy (fMRS) and psychophysics testing. We were able to detect changes within a single scan session at 3 Tesla (3T) and relate these to well-established behavioural markers of plastic change demonstrating the utility of fMRS as a novel tool to understand the mechanisms of plasticity and the efficacy of therapeutic treatments.

3981	Computer 71	Effect of DRD4 receptor −616 C/G polymorphism on thalamic GABA levels in pediatric primary nocturnal enuresis patients
		Yi You[1], Zijun Li[1], Xiaoqi Wang[2], and Bing Yu[1]
		[1]Shengjing Hospital of China Medical University, Shenyang, China, [2]Philips Healthcare China, Beijing, China
		The objective of this study is to explore the effect of DRD4 −616 C/G single nucleotide polymorphism (SNP) on thalamic GABA levels in with primary nocturnal enuresis (PNE). Results indicates the DRD4 −616 C allele is associated with increased thalamic GABA levels and higher arousal from sleep (AS) scores in PNE children. This research helps us understand the genetic susceptibility of the DRD4 −616 C allele to PNE.

3982	Computer 72	Baseline GABA Concentration Predicts Treatment Response to Selective Serotonin Reuptake Inhibitors in Major Depressive Disorder
		Xiang He[1], Kenneth T Wengler[2], Greg Perlman[3], Elizabeth Bartlett[2], and Christine DeLorenzo[3]
		[1]Radiology, Stony Brook University Hospital, Stony Brook, NY, United States, [2]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [3]Psychiatry, Stony Brook University Hospital, Stony Brook, NY, United States
		Major depressive disorder (MDD) affects more than 350 million people world-wide. Large heterogeneities in patient symptoms has led to several different treatment courses. Although treatments, such as SSRIs, are generally effective, a large portion of patients (~30%) do not achieve remission. The ability to predict which treatment option will yield the best outcome would be of great use to clinicians and patients. The GABAergic system is implicated in MDD and affected by SSRIs. In this study GABA concentrations were measured with MEGA-PRESS MRS in MDD patients before and after treatment with a SSRI to determine predictive ability and treatment changes.

Electronic Poster

Non-Proton MRS/MRI: Novel Applications

Exhibition Hall	Tuesday 9:15 - 10:15

3983	Computer 73	Relative quantification of the 23Na MRI signal of human intervertebral lumbar discs Stephan Gruber[1], Stefan Zbyn[2], Thomas Stulnig[3], Wolfgang Bogner[1], Siegfried Trattnig[1,4], and Lenka Minarikova[1] *[1]HFMR, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [2]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [3]Clinical Division for Endocrinology and Metabolism, Department of Medicine III, Medical University of Vienna, Vienna, Austria, [4]CD Laboratory for Clinical Molecular MR Imaging, Vienna, Austria* 23Na MRI was applied in five healthy volunteers to determine the feasibility of intervertebral discs sodium signal quantification using the cerebrospinal fluid signal from the spinal column as an internal reference. There were no significant differences between the five measured volunteers, or between the different discs (L1/2 – L5/S1), that were analysed. Therefore, internal referencing using CSF has the potential for sodium content quantification in intervertebral discs, which may be used as an indicator of disc degeneration.

3984	Computer 74	23NA-MRI of the skeletal muscle and skin in patients with adrenal insufficiency Andreas Max Weng[1], Stephanie Burger-Stritt[2], Irina-Oana Chifu[2], Martin Christa[3], Bernhard Petritsch[1], Thorsten Alexander Bley[1], Herbert Köstler[1], and Stefanie Hahner[2] *[1]Department of Diagnostic and Interventional Radiology, University Hospital Würzburg, Würzburg, Germany, [2]Department of Medicine I, University Hospital Würzburg, Würzburg, Germany, [3]Comprehensive Heart Failure Center, University Hospital Würzburg, Würzburg, Germany* Patients with chronic primary adrenal insufficiency require life-long glucocorticoid- and mineralocorticoid-replacement therapy. Monitoring of treatment is mainly based on clinical parameters and additional measurement of electrolyte status and plasma renin levels. However, obtained values often do not correspond to the patients' subjective well-being and thus may not fully reflect optimal treatment. The present study investigated sodium content in the calf muscle and the skin obtained via ^{23}Na-MRI in patients with chronic primary AI and healthy controls. Sodium content assessed by ^{23}Na-MRI correlates with further parameters of mineralocorticoid activity and may serve as an objective method to monitor hormone substitution therapy in patients with adrenal insufficiency.

3985	Computer 75	Electrophysiological stimulation of excised rat muscle elicits a measurable change in tissue sodium concentration using 23Na-MRI

		Frank Riemer[1], Joshua Kaggie[1], Cormac O'Neill[2], Mary McLean[3], James Grist[1], Myfanwy Hill[3], Joe Guy[3], Rolf Schulte[4], Martin Graves[1,2], James Fraser[5], and Ferdia Gallagher[1]
		[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom, [3]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [4]GE Healthcare, Munich, Germany, [5]Department of Physiology, Development and Neuroscience, University of Cambridge, Cambridge, United Kingdom
		Changes in the tissue sodium gradient play an important role in cell signalling such as at the neuromuscular junction and as part of neuronal action potentials. ^{23}Na-MRI has the ability to measure the macroscopic sodium distribution. In this study we investigated the changes in tissue sodium in an electrically stimulated and freshly excised rat leg muscle.

3986	Computer 76	Comparison of quantitative imaging methods of sodium concentration in leg muscle
		Ryan J. Larsen[1], Luis M Perez[2], Kenneth R. Wilund[3], Theodore C. Claiborne[4], and Brad P. Sutton[1,5]
		[1]Beckman Institute, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Division of Nutritional Sciences, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]The Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [4]Center for MR Research, University of Illinois at Chicago, Chicago, IL, United States, [5]Department of Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States
		Quantitative imaging of tissue sodium content requires corrections for coil loading. This can be done by introducing external calibration standards within the scan, or by employing the principle of reciprocity to normalize the signal by the voltage required to obtain a signal maximum. A direct comparison of these two quantification methods shows that they are highly consistent.

3987	Computer 77	Mapping Brain Tissue Sodium Parameters Using Fast 3D Multi-Echo Radial Imaging
		Jinhu Xiong[1], William R Kearney[1], Ankit Parekh[2], Mathews Jacobs[3], Rolf Schulte[4], Baolian Yang[4], and Vincent A Magnotta [1]
		[1]Radiology, Univ. of Iowa, Iowa City, IA, United States, [2]New York University, New York City, NY, United States, [3]lectrical-Computer Engin, Univ. of Iowa, Iowa City, IA, United States, [4]GE Healthcare, Madison, WI, United States
		We have developed 3D Multi-Echo Radial Imaging and Tikhonov reconstruction techniques for mapping brain tissue sodium concentration and R2* relaxation rate. The total acquisition time is about 6 minutes. Intra- and inter-cellular sodium concentrations and R2* relaxation rates were simultaneous estimated. Our long term aim is to develop 23Na imaging techniques for studies of brain function and diseases.

3988	Computer 78	31P MRS of the frontal lobe of human brain at 7T Shizhe Steve Li[1], Li An[1], Jan Willem van der Veen[1], Maria Ferraris Araneta[1], Johnson Christopher[1], Yu Shao[2], Shumin Wang[1], Jun Shen[1], and Jun Shen[1] *[1]National Institutes of Health, Bethesda, MD, United States, [2]Chongqing University of Posts and Telecommunications, Chongqing, China* The majority of neuropsychiatric disorders are thought to be originated in the frontal lobe. Increasing the SNR of frontal lobe ^{31}P MRS using a surface coil can be very important because many MRS manifestations of psychiatric illnesses could be subtle. This study demonstrates the feasibility of high SNR ^{31}P MRS of human frontal lobe using a surface coil and 3D CSI at 7 Tesla. Comparing to the occipital lobe spectra acquired from the same subject it was shown that the sensitivity and spectral resolution of ^{31}P MRS spectra of the frontal lobe can be made comparable to that of the occipital lobe.

3989	Computer 79	Influence of BMI and hepatic lipids on absolute quantification of 31P metabolites at 7T Lorenz Pfleger[1,2], Martin Gajdošík[1,3], Peter Wolf[1], Sabina Smajiš[1], Paul Fellinger[1], Sigfried Trattnig[2,4], Michael Krebs[1], Marek Chmelík[2,5,6], and Martin Krššák[1,2] *[1]Division of Endocrinology and Metabolism, Department of Medicine III, Medical University of Vienna, Vienna, Austria, [2]High-field MR Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [3]Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [4]Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria, [5]Faculty of Healthcare, University of Prešov, Prešov, Slovakia, [6]Department of Radiology, General Hospital of Levoča, Levoča, Slovakia* This study focuses on absolute quantification of hepatic ^{31}P metabolites at ultra-high field (7T) and the possible influence of BMI and hepatocellular content of lipids (HCL) on the calculated metabolite concentrations. Significant differences were found in γ- and α-ATP as well as in P_i content for population groups with normal and high BMI. With the assessment of HCL it is possible to correct for those differences and no significances could be reported after.

3990	Computer 80	Unambiguous detection of cardiac Pi using long TM 31P STEAM Albrecht Ingo Schmid[1,2], Ladislav Valkovic[1,3], Elizabeth M Tunnicliffe[1], and Christopher T Rodgers[1,4] *[1]OCMR, RDM Cardiov. Medicine, University of Oxford, Oxford, United Kingdom, [2]CMPBME, MR Physics, MRCE, Medical University of Vienna, Vienna, Austria, [3]Institute of Measurement Sciences, Department of Imaging Methods, Slovak Academy of Science, Bratislava, Slovakia, [4]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom*

		Inorganic Phosphate is a resonance that holds important information on the metabolic state of tissues. From its resonance frequency, intracellular pH can be derived. The ratio of P_i to PCr or ATP are also important markers. Unlike in other tissues, myocardial P_i is frequently hidden underneath blood 2,3-DPG signals. Using 7 T STEAM's T_M delay to be one cardiac cycle, blood-pool originating signals are gone and the Pi resonance is clearly visible. In 3 subjects, P_i signal was detected and quantified. The signal was around 4.89±0.02ppm, corresponding to a pH of 7.08±0.02. This is a breakthrough for the investigation of cardiac metabolism.

3991	Computer 81	First experiences with a phosphorus 30 channel receiver head array at 7T
		Benjamin C Rowland[1], Ian Driver[1], Mohamed Tachrount[1], Dennis WJ Klomp[2,3], Ria Forner[3], Anh Pham[3], Michel Italiaander[3], and Richard G Wise[1]
		[1]CUBRIC, University of Cardiff, Cardiff, United Kingdom, [2]Radiology, UMC Utrecht, Utrecht, Netherlands, [3]MR Coils, Zaltbommel, Netherlands
		Multi-receiver arrays offer the high sensitivity of surface coils and the extended field of view of volume coils, as long as the individual receivers can be combined correctly. In 31P MRS, the low intrinsic SNR makes determining weighting factors challenging and data quality can suffer. We report on our experiences of working with a custom-built 30 channel head coil, dual-tuned for 1H and 31P at 7T, comparing its performance against a traditional birdcage, in phantom and *in vivo*. Our results are encouraging, with equal SNR in the centre of the brain and significantly enhanced signal in the periphery.

3992	Computer 82	In vivo Phosphorus Metabolite Imaging on a 3T MRI Scanner in a Clinically Feasible Scan Time
		Yunhong Shu[1], Joshua D Trzasko[1], Aiming Lu[1], Joel P Felmlee[1], and John D Port[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		We developed an MRI system (coil, sequence, reconstruction) capable of performing imaging of phosphorus metabolites in a clinically-feasible scan time on a conventional 3T MRI scanner. Each component of the system is explained, and results of a phantom scan and scan of a human thigh are presented.

3993	Computer 83	Functional phosphorus spectroscopy of the human visual cortex at 9.4 T
		Rolf Pohmann[1], Sathiya Raju[1,2], and Klaus Scheffler[1,3]

		[1]*Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*Furtwangen University, Schwenningen, Germany,* [3]*Biomedical Magnetic Resonance, University Tübingen, Tübingen, Germany*
		Functional ^{31}P spectroscopy has been investigated in several studies with greatly varying results, which may be due to the low sensitivity of the ^{31}P nucleus. We have taken advantage of the high SNR at 9.4 T to acquire spectra from the human visual cortex under stimulation. Experiments were performed with different localization volumes, defined by saturation pulses. In spite of the excellent quality of the obtained data, no stimulation-related changes in metabolite concentrations or resonance frequencies could be detected.

3994	Computer 84	T1 values of phosphorus metabolites in the human visual cortex at 9.4 T
		Rolf Pohmann[1], Sathiya Raju[1,2], and Klaus Scheffler[1,3]
		[1]*Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*Furtwangen University, Schwenningen, Germany,* [3]*Biomedical Magnetic Resonance, University Tübingen, Tübingen, Germany*
		Ultra-high field has the potential to improve the quality of ^{31}P spectroscopic applications due to the increased SNR and spectral dispersion. In addition, previous studies have reported a decreasing T_1 with increasing field strength, which would further contribute to an improved quantification quality. In this study, we have measured the longitudinal relaxation time T_1 in the visual cortex of healthy human subjects at 9.4 T, using an inversion-recovery technique. The values obtained were consistently lower than published data at 7 T, confirming observations of a decreasing T_1 with field strength.

3995	Computer 85	Quantification of human cardiac inorganic phosphate content in vivo by ^{31}P-MRSI at 7T
		Ladislav Valkovic[1,2], Albrecht I Schmid[1,3], Lucian AB Purvis[1], Jane Ellis[1], Matthew D Robson[1], Stefan Neubauer[1], and Christopher T Rodgers[1,4]
		[1]*Oxford Centre for Clinical MR Research (OCMR), RDM Cardiovascular Medicine, University of Oxford, Oxford, United Kingdom,* [2]*Department of Imaging Methods, Institute of Measurement Science, Slovak Academy of Sceinces, Bratislava, Slovakia,* [3]*High-Field MR Centre, Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria,* [4]*The Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, United Kingdom*

		Determination of human cardiac Pi using ^{31}P-MRS is challenging as the resonance frequency of Pi is concealed by a close resonating 2,3-DPG signal originating from blood. Long TR acquisition using adiabatic excitation at 7T can compensate for the rapid blood signal replacement in partially-saturated short TR scans. In order to quantify Pi concentration in vivo, knowledge about longitudinal relaxation of Pi is still required. We have measured the T_1 of Pi in 4 healthy volunteers at 7T using dual-TR method and used this value to quantify cardiac Pi concentration in 8 healthy volunteers.

3996	Computer 86	In Vivo Measurement of Cerebral NAD Contends and Redox State in Young Mouse.
		Radek Skupienski[1,2,3], Kim Q Do[1], Roger Marti[3], and Lijing Xin[2]
		[1]Center for Psychiatric Neuroscience, Department of Psychiatry, Lausanne University Hospital (CHUV), Prilly, Switzerland, [2]Center for Biomedical Imaging (CIBM), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]Chemistry, HEIA-FR, Fribourg, Switzerland
		Nicotimamide adenine dinucleotide (NAD^+ and NADH) is a key player of cell energy metabolism. ^{31}P-MRS has been demonstrated for *in vivo* measurement of NAD content and redox state in cat and human brain, however, there is no reports in mouse brain. In this study we established the *in vivo* measurement of NAD^+, NADH and NAD^+/NADH in young (prepubetrtal) mice and compared two different quantification methods (Least square fitting and LCmodel). This study demonstrated the feasibility of *in vivo* measurement of NAD^+, NADH and redox state in mouse brain and it opens the prospect of studying longitudinally the energy metabolism and redox dysfunction in mouse models of brain pathologies.

3997	Computer 87	SNR optimized $^{31}$P fMRS to measure energy metabolism in the visual cortex
		Arjan D. Hendriks[1], Wybe J.M. van der Kemp[1], Natalia Petridou[1], and Dennis W.J. Klomp[1]
		[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands
		Energy metabolism of the human visual cortex was investigated, by performing ^{31}P fMRS. The used setup was optimized for high SNR by using a dedicated ^{31}P RF coil at 7T and a visual stimulus with a large visual angle. Changes in the up-field peak of inorganic phosphate (Pi) are observed, revealing new promising opportunities to measure energy metabolism in the human visual cortex.

3998	Computer 88	Dietary modulation of metabolic enzyme activity assessed by dynamic in vivo 31P-MRS of hepatic fructose metabolism
		Christian T. Farrar[1], Gregory Tesz[2], and Jeremy Wellen[2]

		[1]*Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States,* [2]*Pfizer Worldwide Research & Development, Cambridge, MA, United States*
		In this study, ^{31}P-MRS was applied to monitor hepatic fructose metabolism of rats in response to IV fructose challenge. Animals exposed to 7-days of sucrose-enriched diet experienced enhanced fructose clearance relative to animals on an isocaloric control diet. The finding of more efficient fructose metabolism in the sucrose fed group corresponded with elevated KHK and AldoB gene expression, two key enzymes responsible for fructose clearance. Treatment of animals on sucrose diet with a KHK inhibitor nearly completely blocked fructose metabolism and prevented increased expression of these enzymes, implying that metabolism of fructose elicits the enzyme induction rather than fructose itself.

3999	Computer 89	In vivo $$$^{31}\hspace{0.1 mm}$$$P-MRS of triple negative breast cancer patients
		Erwin Krikken[1], Wybe J.M. van der Kemp[1], Peter R. Luijten[1], Kenneth G.A. Gilhuijs[2], Dennis W.J. Klomp[1], Hanneke W.M. van Laarhoven[3], and Jannie P. Wijnen[1]
		[1]*Radiology, UMC Utrecht, Utrecht, Netherlands,* [2]*Image Science Institute, UMC Utrecht, Utrecht, Netherlands,* [3]*Medical Oncology, Academic Medical Centre Amsterdam, Amsterdam, Netherlands*
		^{31}P-MR spectra of breast cancer tissue have shown very high GPC/PC ratios in xenografts for triple negative (TN) tumors. We set out to investigate if this is also visible in vivo in six TN breast cancer patients. In two of the patients the phosphocholine (PC) peak is missing or approaching zero. To the best of our knowledge, this is the first time that this phenomenon is shown in vivo in breast cancer patients, however, the relation of the presence or absence of PC and TN subtype remains to be investigated.

4000	Computer 90	Detection of 13C glucose metabolism in multiple human brain regions using dynamic 1H MRS
		Steven Zhang[1], Chathura Kumaragamage[2], Pedro Rosa Neto[3], and Jamie Near[1,2,4]
		[1]*Integrative Program of Neuroscience, McGill University, Montreal, QC, Canada,* [2]*Biomedical Engineering, McGill University, Montreal, QC, Canada,* [3]*Neurology & Neurosurgery, Douglas Mental Health University Institute and Department of Psychiatry, McGill University, Montreal, QC, Canada,* [4]*Magnetic Resonance Imaging, Douglas Mental Health University Institute and Department of Psychiatry, McGill University, Montreal, QC, Canada*

In vivo carbon-13 magnetic resonance spectroscopy is a quantitative technique for studying brain metabolism. Here, we demonstrate the use of ^{1}H MRS to indirectly observe the metabolism of ^{13}C labelled glucose, simultaneously in two brain regions in a single healthy volunteer. This was done using only standard proton (^{1}H) MRS sequences and hardware. Our results demonstrate an accumulation of ^{13}C label in glutamate and glutamine that is distinctly observable due to the pronounced effect of heteronuclear scalar coupling. This technique provides insight into neuronal metabolic rates and may provide complimentary information to ^{18}F-FDG PET in the study of neurodegenerative disorders.

4001	Computer 91	Detection of 5-Fluorouracil (5-FU) Tumor Trapping Using Fluorine-19 Chemical Shift Imaging in a Murine Model of Colorectal Cancer
		Yurii Shepelytskyi[1], Karen Davenport[2], Matthew S Fox[3], Tao Li[2], Mitchell Albert[1,2,4], and Eric Davenport[5]
		[1]Chemistry, Lakehead University, Thunder Bay, ON, Canada, [2]Thunder Bay Regional Health Research Institute, Thunder Bay, ON, Canada, [3]Medical Biophysics, University of Western Ontario, London, ON, Canada, [4]Northern Ontario School of Medicine, Thunder Bay, ON, Canada, [5]Thunder Bay Regional Health Science Centre, Thunder Bay, ON, Canada
		Colorectal cancer is an increasing healthcare problem and is the third leading cause of cancer deaths worldwide. Fluorine-19 (^{19}F) chemical shift imaging (CSI) can detect the distribution of 5-fluorouracil (5-FU) and its metabolites within a tumor over time. By measuring the 5-FU trapping, it is possible to determine the tumor response at the earliest stage of treatment (before changes in tumor size are observable). In this work, we present preliminary results of detecting the presence and absence of 5-FU trapping in mice bearing H-508 and HT-29 colorectal tumors, respectively.

4002	Computer 92	Mapping longitudinal changes in brain oxygenation in vascular cognitive impairment using 19F-MRI
		Ahmed A Khalil[1,2,3], Susanne Mueller[1,4], Marco Foddis[1], Janet Lips[1], Ulrich Dirnagl[1], Sebastian Temme[5], Ulrich Floegel[5], and Philipp Boehm-Sturm[1,4]
		[1]Department of Experimental Neurology and Center for Stroke Research Berlin, Charité – Universitätsmedizin Berlin, corporate member of Freie Universität Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Health, Berlin, Germany, [2]Berlin School of Mind and Brain, Humboldt-Universität zu Berlin, Berlin, Germany, [3]Department of Neurology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [4]Cluster of Excellence NeuroCure and Charité Core Facility 7T Experimental MRIs, Charité - Universitätsmedizin Berlin, Berlin, Germany, [5]Institute of Molecular Cardiology, Heinrich-Heine-University of Düsseldorf, Düsseldorf, Germany

		We assessed tissue oxygenation with 19F-MRI using perfluorocarbon emulsions in a mouse model of vascular cognitive impairment. Brain T1 values were measured using a cryogenic 19F/1H coil at multiple timepoints before and after surgery to induce bilateral common carotid artery stenosis and converted to pO_2. T1 values decreased with increasing concentration of inhaled oxygen, and we observed a decrease in tissue pO_2 following surgery which gradually recovered over four weeks. 19F-MRI of perfluorocarbon emulsions can be used for long-term assessment of brain tissue pO_2 in vivo and may be relevant for monitoring endogenous or induced regenerative processes.

4003	Computer 93	3D 7Li Magnetic Resonance Imaging of Brain Lithium Distribution in Bipolar Disorder Fiona Elizabeth Smith[1], Peter Edward Thelwall[1], Carly Jay Flowers[2], Joe Necus[2], Andrew Matthew Blamire[1], and David Andrew Cousins[2] *[1]Institute of Cellular Medicine, Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, United Kingdom, [2]Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom* Lithium is a major treatment for bipolar disorder (BD) and the likelihood of a favourable response may be determined by its distribution in the brain. Lithium can be directly detected by magnetic resonance (MR), but this is challenging compared to proton MRI due to lithium's low therapeutic concentration in brain (<1mM). To overcome this challenge, we implemented a highly efficient balanced steady state free precession (b-SSFP) 7Li-MRI method. We report a 3D 7Li-MRI acquisition with 25mm isotropic resolution, acquired in 8 minutes using a 3T clinical scanner, demonstrating heterogeneity in lithium concentration within the brain in subjects with BD (n=14).

4004	Computer 94	Use of dissolved-phase 129Xe imaging to visualize gas uptake and distribution in the free-breathing mouse Luis Loza[1], Stephen Kadlecek[1], Mehrdad Pourfathi[1], Kai Ruppert[1], Hooman Hamedani[1], Ian Duncan[1], and Rahim R. Rizi[1] *[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States* The lung is an intrinsically difficult organ to image using conventional MRI. Although global structural features and major abnormalities are detectable using conventional MRI, lung structure on the vascular level is prohibitively difficult to image. Hyperpolarized gas MRI provides high enough signal to obtain high-resolution images of lung structure at the acinar level. Furthermore, with the use of hyperpolarized xenon MRI, dynamic images of xenon dissolution are made obtainable given xenon's high solubility in blood and tissue. By applying decreasingly destructive pulses, the uptake and distribution of the gas throughout the body becomes visible.

4005	Computer 95	Effects of Fraction of Inhaled Oxygen on Hyperpolarized 129Xe MR Signals Acquired from the Rat Brain In Vivo Yonni Friedlander[1,2], Marcus Couch[1,2], Andrea Kassner[1,3], and Giles Santyr[1,2] *[1]Translational Medicine, Hospital for Sick Children, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Medical Imaging, University of Toronto, Toronto, ON, Canada* A theoretical model was developed to describe the dependence of the signal strength of ^{129}Xe dissolved in the rat brain on the fraction of inhaled oxygen (F_iO_2). To validate the model, ^{129}Xe MR signals were measured in the rat brain in vivo for four different values of F_iO_2 using a continuous ventilation scheme. The measured ^{129}Xe RBC signal showed a strong dependence on F_iO_2 in good agreement with the trends predicted by the theoretical model. These results underscore the need to optimize and control F_iO_2 when using ^{129}Xe signals to probe brain function.

4006	Computer 96	17O bolus fluxes in rat head at 21.1 T Victor D. Schepkin[1], Cathy Levenson[2], Andreas Newbauer[3], Christian Schuch[4], Tilo Glaeser[4], Michael Kievel[4], Steven Ranner[1], William Brey[1], Shannon Helsper[1], and Lothar Schad[3] *[1]NHMFL/FSU, Tallahassee, FL, United States, [2]FSU, Tallahassee, FL, United States, [3]Heidelberg University, Mannheim, Germany, [4]NUKEM Isotopes, Alzenay, Germany* 17O MRI is an attractive and promising goal utilizing ultra-high magnetic fields. The current study is devoted to the time changes of 17O MR signals detectable in a rat head at 21.1 T using bolus injection of 17O labeled water-17O and glucose-17O. The time course of 17O-water revealed a two stage process of distribution. During glucose injection the time course has the same stages as for water, and the third stage represents glucose metabolism. The shape of the high resolution glucose time course is important for the accurate determination of tissue glucose consumption.

Electronic Poster

Spectroscopy: NMR & Other

Exhibition Hall	Tuesday 9:15 - 10:15

4007	Computer 97	Metabolic Profiling of Blood Plasma for Distinguishing Prostate Cancer in Patients with Positive Biopsy and Negative Biopsy using NMR Spectroscopy

		Naranamangalam R Jagannathan[1], Pradeep Kumar[1], Rajeev Kumar[2], Virendra Kumar[1], Senthil S Kumaran[1], Sanjay Thulkar[3], Sanajy Sharma[3], and Siddhartha D Gupta[4]
		[1]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [2]Department of Urology, All India Institute of Medical Sciences, New Delhi, India, [3]Department of Radiology, All India Institute of Medical Sciences, New Delhi, India, [4]Department of Pathology, All India Institute of Medical Sciences, New Delhi, India
		The metabolic profiling of blood plasma sample for distinguishing prostate cancer (PCa) patients with positive biopsy (n=32) and negative biopsy (n=30) using NMR spectroscopy was investigated. A significantly higher concentration of lactate, choline, glucose and a lower concentration of histidine, tyrosine and phenylalanine were observed in blood plasma of PCa patients with positive biopsy as compared to negative biopsy. Our results suggest alterations in amino acid, energy, glucose and choline metabolisms, which may have association with disease progression.

4008	Computer 98	Study of Altered Urinary Metabolism in Prostate Cancer Patients using NMR Metabolomics
		Pradeep Kumar[1], Rajeev Kumar[2], Virendra Kumar[3], Senthil S Kumaran[1], Sanjay Thulkar[4], Siddhartha D Gupta[5], and Naranamangalam R Jagannathan[6]
		[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, India, New Delhi, India, [2]Department of Urology, All India Institute of Medical Sciences, New Delhi, India, New Delhi, India, [3]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, New Delhi, India, [4]Department of Radiology, All India Institute of Medical Sciences, New Delhi, India, New Delhi, India, [5]Department of Pathology, All India Institute of Medical Sciences, New Delhi, India, [6]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India
		The present study demonstrated the metabolic profile of urine samples of prostate cancer (PCa) patients (n=33) and healthy controls (HC; n=21) using 700 MHz high-resolution proton NMR for early diagnosis and to define noninvasive biomarker/s. A significantly lower concentration of leucine, histidine, tyrosine, citrate, dimethylglycine, glycerophosphocholine, choline, creatinine, indoxyl sulphate and formate was seen in PCa patients. These findings suggest metabolic alterations due to mitochondrial dysfunction, cell proliferation, energy demand, oxidative stress and protein turnover in PCa patients.

4009	Computer 99	Magnetic resonance spectroscopy-based metabolic biomarkers of IDH1 mutant glioma in response to temozolomide therapy
		Elavarasan Subramani[1], Lydia M Le Page[1], Russell O. Pieper[2,3], and Sabrina M Ronen[1,3]
		[1]Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Department of Neurological Surgery, Helen Diller Research Center, University of California, San Francisco, San Francisco, CA, United States, [3]Brain Tumor Research Center, University of California, San Francisco, San Francisco, CA, United States

		The alkylating agent temozolomide (TMZ), previously used only in the treatment of high-grade glioblastoma, is now being considered for the treatment of low-grade glioma that are driven by mutations in the cytosolic isocitrate dehydrogenase 1 (IDH1) gene. However, early detection of response remains a challenge. ^{1}H magnetic resonance spectroscopy-based metabolic profiling of cells genetically engineered to express mutant IDH1 and treated with TMZ showed significant alterations in metabolites majorly related to the tricarboxylic acid cycle, pyruvate metabolism and the pentose phosphate pathway. These findings hold potential for assessing response of IDH1 mutant cells to TMZ therapy.

4010	Computer 100	In vitro screening of drug response in HIV-1 pseudovirus infected cells using NMR
		Aruna Singh[1], Muzamil Makhdoomi[2], Kalpana Luthra[2], Thirumurthy Velpandian[3], and Rama Jayasundar[1]
		[1]Department of NMR, All India Institute of Medical Sciences, New Delhi, India, [2]Department of Biochemistry, All India Institute of Medical Sciences, New Delhi, India, [3]Department of Ocular Pharmacology & Pharmacy, All India Institute of Medical Sciences, New Delhi, India
		There is a necessity for novel and quick drug response screening methods for providing lead information for drug discovery. In this context, NMR can be a potential screening method. This study has used proton NMR spectroscopy for drug response in HIV-1 psuedovirus infected TZM-bl cells after treatment with TAK 779 (positive control), and benzene extracts of *Terminalia bellerica* and *Zingiber officinale*. Significant reduction in metabolites was observed in infected cells and metabolites were subsequently restored closer to normal levels on treatment with positive control and plant extracts. The study has demonstrated NMR to be a quick screening method for drug response.

4011	Computer 101	Comparative NMR urine metabolomics of whole body or partial body radiation exposure: Stepping towards delivery of potent marker for radiation exposure
		Poonam Rana[1], Ajaswrata Dutta[2], Sushant K Mishra[1], Kiran Maan[1], Manju Lata Gupta[2], and Subash Khushu[1]
		[1]NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences, Delhi, India, [2]Division of Radioprotective Drug Development Research, Institute of Nuclear Medicine and Allied Sciences, Delhi, India
		Stepping forward towards the quest of high throughput radiation marker, the present study looks for a common signature on comparison of NMR based urine metabolomics post whole body or partial irradiation. Different group of animals were exposed to 10 Gy whole body or partial radiation. Irradiated group were clustered apart from controls; showed similar pattern on radiation exposure irrespective of whole body or cranial and identified taurine, citrate as common metabolites in whole body and partial radiation groups. The similar pattern observed post partial or whole body irradiation further confirm these metabolites as potent markers for radiation exposure.

4012	Computer 102	NMR based Metabonomics study of Chronic Cold Stress induced metabolic alterations in rat model SONIA GANDHI[1] and SUBASH KHUSHU[1] *[1]NMR RESEARCH CENTRE, INMAS, DRDO, DELHI, India* Primary hypothermia/cold stress is due to environmental exposure, with no underlying medical condition causing disruption of temperature regulation. The exposure of human to such conditions often leads to decremented physical and mental performance. Metabonomics can provide a quick snapshot of exogenous/endogenous stressors induced metabolic perturbations. The metabolic pathways analysis showed that Taurine and TCA metabolism have maximum contribution to the altered urine metabolic phenotype. Metabolic markers related to liver dysfunction, gut microflora & muscle bioenergetics were altered due to cold exposure. These changes in combination with genomics and proteomics studies would further reveal potential drug targets contributing to cold exposure medicine.

4013	Computer 103	NMR-BASED METABOLOMIC ANALYSIS AS A DIAGNOSTIC TOOL FOR TUBERCULOSIS IN CLINICAL URINE SAMPLES Jose Luis Izquierdo-Garcia[1,2], Ramon Campos-Olivas[3], Mar Serra[4,5], Cristina Prat[4,5], Jose Dominguez[4,5], and Jesus Ruiz-Cabello[2,6] *[1]CNIC, Madrid, Spain, [2]CIBERES, Madrid, Spain, [3]CNIO, Madrid, Spain, [4]Servicio de Microbiologia. Hospital Universitari Germans Trias i Pujol. Institut d'Investigació Germans Trias i Pujol. Universitat Autònoma de Barcelona, Barcelona, Spain, [5]CIBERES, Barcelona, Spain, [6]Universidad Complutense de Madrid, Madrid, Spain* The ability of diagnose the tuberculosis infection is an essential factor in the spreading control of tuberculosis. However, microscopic examination presents a low sensitivity and culture techinques require incubation times up to two months. This study aimed at developing a NMR-based metabolomic approach for the differential diagnosis of tuberculosis in urine samples. We examined samples from patients diagnosed of tuberculosis (n=19), other respiratory infection (n=25) and healthy controls (n=29). Unsupervised PCA provide a nearly perfect discrimination between the three groups. We identified 31 chemical shifts regions to develop predictive models for the diagnostic of tuberculosis, obteining an accuracy of 100%.

4014	Computer 104	Targeted and untargeted NMR phytometabolomics for polar chemosensory markers and signatures Aruna Singh[1], Dushyant Kumar[1], and Rama Jayasundar[1] *[1]Department of NMR, All India Institute of Medical Sciences, New Delhi, India*

		The potential of proton NMR metabolomics to classify medicinal and nutraceutical plants based on their chemosensory property such as taste has been explored in this study. Polar fractions obtained by dual phase (chloroform-methanol/water) extraction of select plants (n=48) from four chemosensory groups were studied using water suppressed 1D proton NMR spectroscopy. Untargeted metabolomics showed distinct chemosensory based clustering using Partial Least Square Discriminant Analysis. Using targeted metabolomics, chemosensory phytomarkers like α- and β- glucose (sweet), swertiamarin (bitter), trigonelline (pungent) and quercetin (astringent) were identified. The study has shown that NMR can play an important role in sensory science.

4015	Computer 105	Determination of the metabolome of Giardia lamblia by 1H Magic Angle Spinning NMR
		Martina Vermathen[1], Joachim Müller[2], Norbert Müller[2], and Peter Vermathen[3]
		[1]Department of Chemistry and Biochemistry, University of Bern, Bern, Switzerland, [2]Institute of Parasitology, University of Bern, Bern, Switzerland, [3]epartments for BioMedical Research and Radiology, University of Bern, Bern, Switzerland
		The intestinal protozoan parasite Giardia lamblia is a major cause of persistent diarrhea in humans and animals worldwide. Details concerning underlying metabolic pathways in Giardia are scarce and a methodology to study giardial intermediary and energy metabolism is required. Here, a high resolution magic angle spinning (HR-MAS) NMR study is presented determining the metabolic profile of G. lamblia trophozoites. This study builds the basis of following investigations on Giardia that are resistant against Metronidazole and other nitro compounds, which have been used since decades as therapy of choice against giardiasis.

4016	Computer 106	Removal of Water Sidebands from ^{1}H-MRSI Data Acquired without Water Suppression
		Yudu Li[1,2], Fan Lam[2], Rong Guo[1,2], Bryan Clifford[1,2], Xi Peng[2,3], and Zhi-Pei Liang[1,2]
		[1]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]Paul C. Lauterbur Research Center for Biomedical Imaging, Institutes of Advanced Technology, Shenzhen, China
		The water sideband artifact is a major obstacle to proton MR spectroscopic imaging (^{1}H-MRSI) without water suppression (WS). This work presents a novel method to remove the sideband artifacts from non-WS MRSI data, characterized by the use of a reference-based parametric model to represent the artifacts. Our method obtains the reference signal from two auxiliary scans and subsequently estimates the sideband signals from a particular MRSI data. The proposed method has been validated using both phantom and *in vivo* experimental data, demonstrating that it can effectively remove the sideband artifacts without introducing spectral distortion. This method is expected to be useful for many non-WS MRSI studies.

4017	Computer 107	Oxidative Stress and Neurotransmitters Imbalance in Amyotrophic Lateral Sclerosis Mona Adel Mohamed[1], Muhammad Saleh[1], Mark Mikkelsen [1], Kristen Riley[2], Jeffrey Rothstein[2], Lora Clawson[2], Peter B Barker[1], and Richard AE Edden[1] *[1]Radiology, Johns Hopkins Medical Institutions, Baltimore, MD, United States, [2]Neurology, Johns Hopkins Medical Institutions, Baltimore, MD, United States* Amyotrophic lateral sclerosis (ALS) is a rapidly progressive and invariably fatal motor neuron disease. The objective of the study was to use the newly developed HERMES (Hadamard Encoding and Reconstruction of MEGA-Edited Spectroscopy) spectral editing methodology to simultaneously measure key compounds related to oxidative stress and glutamatergic metabolism (GSH, GABA, and Glx) in patients with ALS and control subjects. Using HERMES, we were able to look at different metabolic pathways in ALS in one MRS session. Improved understanding of the various metabolic pathways in ALS will lead to the development of new diagnostic surrogate markers and therapeutic approaches.

4018	Computer 108	The effect of a 12-week aerobic exercise intervention on neurometabolites in young healthy adults using 7T 1H-MRS Anouk Schrantee[1,2,3], Jannie Wijnen[4], Michelle M Solleveld[1,3], Aart J Nederveen[1], Serge Dumoulin[2,5], Dennis WJ Klomp[4], Liesbeth Reneman[1], and Paul J Lucassen[3] *[1]Department of Radiology and Nuclear Medicine, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands, [2]Spinoza Centre for Neuroimaging, Royal Netherlands Academy of Arts and Sciences (KNAW), Amsterdam, Netherlands, [3]Swammerdam Institute for Life Sciences, Center for Neurosciences, University of Amsterdam, Amsterdam, Netherlands, [4]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [5]Department of Experimental Psychology, Helmholtz Institute, Utrecht University, Utrecht, Netherlands* Prolonged exercise has beneficial effects on cognition, which could be mediated by changes in neuronal metabolism. We present the first 7T MRS exercise study investigating neurometabolite concentrations before and after randomization to aerobic exercise or toning exercise in a large sample of healthy volunteers. We found that change in cardiovascular fitness was positively associated with changes in hippocampus glutamine, and negatively associated with change in glutamate in the anterior cingulate cortex; regardless of exercise group. This suggests that exercise-induced metabolic changes might not specific to the hippocampus, and that exercise likely has widespread effects on brain metabolism.

4019	Computer 109	Effect of lactate administration on brain lactate concentrations during hypoglycemia in patients with type 1 diabetes Evita Wiegers[1], Hanne Rooijackers[2], Cees Tack[2], Bart Philips[1], Arend Heerschap[1], Bastiaan de Galan[2], and Marinette van der Graaf[1,3]

		[1]Radiology and Nuclear Medicine, Radboud university medical center, Nijmegen, Netherlands, [2]Internal Medicine, Radboud university medical center, Nijmegen, Netherlands, [3]Pediatrics, Radboud university medical center, Nijmegen, Netherlands
		Lactate administration during hypoglycemia suppresses counterregulatory responses, which mimicks the condition of impaired awareness of hypoglycemia (IAH) seen in patients with type 1 diabetes. Lactate can act as an alternative cerebral fuel and/or lactate can drive other brain-protective processes. We examined whether lactate administration affects brain lactate concentrations, as measured with J-difference editing ^{1}H-MRS, during hypoglycemia in patients with normal awareness of hypoglycemia (NAH) and in patients with IAH. Brain lactate concentrations increased modestly upon lactate infusion in both groups. These results suggest that the excess lactate entering the brain is immediately oxidized, which may suppress the hypoglycemic counterregulatory response.

4020	Computer 110	Neurofunctional deficits and cellular metabolic changes associated with working memory dysfunction in patients with generalized anxiety disorder
		Chung-Man Moon[1] and Gwang-Woo Jeong[2]
		[1]Advanced Institute of Aging Science, Chonnam National University, Gwangju, Republic of Korea, [2]Radiology, Chonnam National University Medical School, Gwangju, Republic of Korea
		Generalized anxiety disorder (GAD) negatively affects emotional regulation and cognitive function. However, the causality between neurofunctional and metabolic brain alterations is not clearly revealed since the brain function and metabolic studies have been independently performed. A combined fMRI and ^{1}H-MRS study would be necessary to investigate whether both of the brain functional abnormality and the metabolic changes are associated with the emotional dysregulation and cognitive deficit in GAD. Therefore, the purpose of this study was to assess the association between neurofunctional deficits and cellular metabolic changes under working memory (WM) tasks in patients with GAD.

4021	Computer 111	Signal Enhancement Under Explicit Field Perturbation in Magnetic Resonance Spectroscopy
		Dhiraj Sinha[1] and Smitha Thamarath Surendran[2]
		[1]Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [2]Biosym, SMART, Singapore, Singapore
		The current work presents a novel approach on signal enhancement in magnetic resonance spectroscopy through explicit field perturbatiobn. We have discovered that under certain conditions of artificial perturbation of the existing field, the output signal can be enhanced. The signal enhancement not only happens by increasing the magnitude of the external signal at the precession frequency but also by changing the frequency of the external field. The results have broad application not only in the field of magnetic resonance spectroscopy but also in magnetic resonance imaging.

4022	Computer 112	Use of Ab-Initio Molecular Dynamics Simulations to Estimate Hyperpolarized 13C Agent Spin-Lattice Relaxation Times Joe Wildenberg[1], Stephen Kadlecek[1], Rahim R. Rizi[1], and Terence Gade[1] *[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States* We demonstrated the feasibility of using an *ab-initio* molecular dynamics simulation to estimate the T_1 relaxation time constant of hyperpolarized ^{13}C substrates. The utility of such predictive tools would provide further insight into specific relaxation mechanisms involved in various substrates, allowing us to evaluate candidate strategies to extend their T_1 relaxation time constants. Such screening of candidate hyperpolarized agents may be used to rapidly assess polarizability of agents specific to various molecular pathways.

4023	Computer 113	A metabolomic evaluation of prostate cancer field effects Sarah S. Dinges[1,2], Lindsey A. Vandergrift[1], Shulin Wu[1], Yannick Berker[1], Chin-Lee Wu[1], Piet Habbel[2], and Leo L. Cheng[1] *[1]Pathology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Oncology, Charite Medical University, Berlin, Germany* The gold standard in diagnosing prostate cancer (PCa) is pathological examination of biopsy cores. Still, false negative rates remain between 30-50%. Studies of cancer field effects suggest that tissue without histologically visualizable cancer cells has diagnostic value and could enlarge biopsy target regions. To map metabolic field effects in human prostates, we used HRMAS-MRS to analyze multiple tissue samples throughout entire removed cancer-positive prostates. Evaluation of metabolomic profiles of histologically-benign (Hb) tissue showed that Hb tissues at varying distances to PCa lesions have different metabolic profiles. Hb tissue enables differentiation between clinical parameters (Gleason Score, pathological stage, cancer-affected prostate %).

4024	Computer 114	In vitro NMR spectroscopy identifies metabolic changes resulting from addition of a novel anti-cancer agent (AZD2014) to standard treatment, guiding potential imaging approaches Nada Al-Saffar[1], Jasmin Sidhu[1], Udai Banerji[1], Yuen-Li Chung[1], and Martin O. Leach[1] *[1]The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, London, United Kingdom*

		Previous reports showed that activation of the PI3K/mTOR pathway is associated with chemoresistance in ovarian cancer cells, and this can be reversed by combining chemotherapy with the mTORC1/2 inhibitor vistusertib (AZD2014). This combination is now being pursued clinically. In this study, we used NMR spectroscopy to establish biomarkers for this combination in A2780Cis human ovarian carcinoma cells. We report that this combination resulted in decreases in lactate, PC, GPC and tCho and was associated with inhibition of glycolysis- and choline-regulatory enzymes. This indicates that choline metabolites and lactate may provide potential non-invasive biomarkers of tumour response to this combination therapy.

4025	Computer 115	Exploring Glutamate and Glutamine Metabolism Across Breast Cancer Subtypes using High-resolution Proton MRS Combined with Molecular Approaches
		Caitlin M Tressler[1], Vinay Ayyappan[2], and Kristine Glunde[2]
		[1]Russell H. Morgan Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Johns Hopkins University School of Medicine, Baltimore, MD, United States
		We have studied glutamine metabolism in a panel of breast cancer cell types to examine the utilization of glutamine as an energy source in different subtypes of breast cancer. We utilized high-resolution 1H MRS detection of glutamine and glutamate from cell extracts to determine up regulation of glutamine metabolism as a whole followed by quantitative RT-PCR to begin to establish the critical pathways involved in altered glutamine metabolism within malignant cell types. Altered glutamine metabolite signatures may be used to identify malignancy within cells and key enzymes in glutamine metabolism may prove to be potential therapeutic targets.

4026	Computer 116	MRS-based metabolomic approaches detect multiple metabolic targets for the antitumor action of metformin on U87MG glioma cells.
		Marco Rinaudo[1], Agnese Sacchetti[1], Serena Cecchetti[1], Laura Mercurio[1], Maria Jose Caramujo[1], Mattea Chirico[1], Marika Pinazza[2], Giulia Carpinelli[1], Stefano Indraccolo[2], Franca Podo[1], and Egidio Iorio[1]
		[1]Istituto Superiore di Sanità, Roma, Italy, [2]IRCCS Istituto Oncologico Veneto, Padova, Italy
		There is an urgent need to develop novel therapeutic strategies for malignant brain tumors. Purposes of this study were: 1) to investigate in glioma cells the alterations induced by metformin in the levels of metabolites produced by different biochemical pathways (glycolysis and phosphatidylcholine (PC) metabolism); 2) to evaluate the possibility to enhance the antiproliferative effects of metformin by a combination of metformin with a selected inhibitor of PC metabolism. We found : a) activation of PC-plc and PCho accumulation in metformin-treated cells; b) enhanced cell death in glioma cells with a combination of metformin and the PC-plc.

4027	Computer 117	Probehead design for multi-photon NMR induced homonuclear continuous RF decoupling Christoph Michael Schildknecht[1], David Otto Brunner[1], and Klaas Paul Pruessmann[1] *[1]Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland* Spectra of strongly coupled nuclear systems are frequently obtained by fast magic angle spinning. In biological samples, this is often not feasible, leaving homonuclear RF decoupling as the only alternative. This approach requires fast nutation while receiving a spectrum from the same type of nuclei. This can be achieved by multi-photon excitation, albeit at the expense of high power densities. In this work, we present a construction approach for such probe heads maximizing the excitation efficiency and demonstrating nutations above 20kHz over extended periods of time.

4028	Computer 118	Investigation of bioenergetic adaptations under galactose stress in OXPHOS deficient fibroblasts using a combined metabolic Flux and HR-MAS NMR approach Damian Hertig[1], Andrea Debora Felser[2], Gaëlle Diserens[1], Sandra Kurth[2], Peter Vermathen[1], and Jean-Marc Nuoffer[2] *[1]Departments for BioMedical Research and Radiology University of Bern, Bern, Switzerland, [2]Institute of Clinical Chemistry, University Hospital Bern, Bern, Switzerland* Defects in the mitochondrial OXPHOS lead to an extremely heterogeneous group of disorders and common laboratory screening methods are prone to misinterpretations. In this study we report metabolic adaptation of OXPHOS deficient human skin fibroblasts during galactose stress condition. We report a rapid HR-MAS NMR based method for the relative quantification of untargeted metabolome profiling providing containment of over 40 metabolites, which allowed us to observe unique cellular metabolic profiles in OXPHOS deficient fibroblast.

4029	Computer 119	Betaine detection in human brain Stefan Bluml[1,2], Jessica L Wisnowski[1,2], Marvin D Nelson[1], and Tai-Wei Wu[1] *[1]USC/Children's Hospital Los Angeles, Los Angeles, CA, United States, [2]Rudi Schulte Research Institute, Santa Barbara, CA, United States* Betaine, an essential osmolyte and source of methyl groups, is a metabolite known to be present in brain. However, due to its low concentrations and its overlap with the choline signal, betaine detection and quantitation is difficulty. In this study, we quantified betaine in high-quality spectra of pediatric patients and controls. The measured betaine concentrations of 0.1 - 0.2 mM are consistent with what has been measured in rat brain extracts by high-field NMR.

4030	Computer 120	High resolution localized 2D JPRESS spectroscopy with absorption-mode lineshape Lin Yanqin[1], Dan Tian[2], Bo Duan[2], Qing Zeng[2], and Zhong Chen[2] *[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]Xiamen University, Xiamen, China* Localized two-dimensional J-resolved spectroscopy (JPRESS) has been employed in the study of a number of diseases. However, phase-twisted lineshape and broad dispersion tails of magnitude peaks limit its usefulness. Here, a method based on the combination of JPRESS and anti-JPRESS alike spectra is proposed to remove the dispersive parts of the phase-twisted and to give absorption-mode JPRESS spectroscopy. This can double the resolution of JPRESS spectra at the cost of greatly reduced sensitivity. The method was performed with a phantom on a 7T animal scanner.

Electronic Poster

Thermometry & MR-HIFU

Exhibition Hall	Tuesday 13:45 - 14:45

4031	Computer 1	Fast MRI by Exploiting a Reference Scan (FASTMER) for MR Thermometry Efrat Shimron[1] and Haim Azhari[1] *[1]Department of Biomedical Engineering, Technion - Israel Institute of Technology, Haifa, Israel* **A Compressed Sensing approach for shortening acquisition time in Magnetic Resonance guided Focused Ultrasound (MRgFUS) thermometry is presented. The approach is based on the recently developed Fast MRI by Exploiting a Reference scan (FASTMER) method. The suggested method embeds into the CS optimization problem a regularization term related to a-priori knowledge about the similarity between pre-heating and post-heating acquired data. The results obtained from an in-vitro Focused Ultrasound (FUS) experiment demonstrate that the proposed method provides efficient and accurate temperature mapping from substantially subsampled k-space data. The method is suitable for data acquired with flexible undersampling schemes.**

4032	Computer 2	Combining Compressed Sensing and Parallel Imaging for Accelerating Focused Ultrasound MR Thermometry Efrat Shimron[1] and Haim Azhari[1]

		[1]Department of Biomedical Engineering, Technion - Israel Institute of Technology, Haifa, Israel
		A novel method for accelerated multi-coil Magnetic Resonance guided High Intensity Focused Ultrasound (MRgHIFU) thermometry is presented. This method integrates the two powerful approaches of parallel imaging and Compressed Sensing (CS), and reconstructs temperature rise from sub-sampled k-space data. The proposed reconstruction process utilizes the sparsity of the differences between baseline and post-heating data and operates in a calibrationless manner. The method was validated through a retrospective study of data from a 8-coils in-vivo human prostate treatment and a 2-coils animal experiment.

4033	Computer 3	In vivo feasibility of PRF thermometry in the swine pancreas during laser ablation
		Céline Giraudeau[1], Paola Saccomandi[1], Federico Davrieux[1], Giuseppe Quero[1], Emiliano Schena[2], Michele Diana[1], Francesco Maria Di Matteo[3], Guido Costamagna[4], and Jacques Marescaux[1]
		[1]IHU Strasbourg, Institute of image-guided surgery, Strasbourg, France, [2]Unit of Measurements and Biomedical Instrumentation, Università Campus Bio-Medico di Roma, Rome, Italy, [3]Unit of Endoscopy, Università Campus Bio-Medico di Roma, Rome, Italy, [4]Unit of Digestive Endoscopy, Università Cattolica del Sacro Cuore, Policlinico Gemelli, Rome, Italy
		The purpose of this preliminary work was to investigate the feasibility to get accurate PRF thermometryimages in the in vivo swine pancreas during laser ablation. We show that PRF thermometry images and consistent temperatures curves can be obtained during the procedure, and these results are confirmed by temperature sensor measurements and histological examination. The presence of a susceptibility artifact (presence of gas bubbles) is discussed.

4034	Computer 4	Three-dimensional assessment of MRI-guided percutaneous liver ablation
		Elena Kaye[1], Kathleen Jedruszczuk [2], Jeremy Durack[1], Majid Maybody[1], and Stephen Solomon[1]
		[1]Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Hunter College, New York, NY, United States
		Here we present a 3D registration-based technique for assessment of ablative margins following MRI-guided thermal ablation. The method was developed and evaluated in a retrospective study of 26 MRI-guided cryo, laser or microwave ablations of various liver metastases.

4035	Computer 5	Improved MR thermometry during Microwave ablation by correcting for sporadic electromagnetic interference

		Aiming Lu[1], Krzysztof R Gorny[1], Christopher P Favazza[1], Joel P Felmlee[1], and David A Woodrum[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		Image-guided microwave ablation (MWA) is a minimally invasive treatment for localized diseases. MRI is advantageous for localizing the lesions, guiding microwave antennae placement, and assessing the extent of ablation. Monitoring of MWA in real-time using MR thermometry has also been demonstrated to be feasible, but can suffer from the image quality degradation due to electromagnetic interference (EMI) from the microwave generator (MWG). A novel approach to correct for EMI-contaminated images is presented here by utilizing the uncontaminated k-space data from neighboring frames. Significantly improved temperature and thermal dose maps have been obtained in our clinical patient studies.

4036	Computer 6	Measurement of Focal Laser Ablation Zones in Prostate Cancer using High Resolution Spectroscopic Imaging of the Water Resonance
		Shiyang Wang[1], Xiaobing Fan[1], Ambereen Yousuf[1], Scott Eggener[2], Gregory Karczmar[1], and Aytekin Oto[1]
		[1]Radiology, University of Chicago, Chicago, IL, United States, [2]Urology, University of Chicago, Chicago, IL, United States
		MRI-guided Focal laser ablation (FLA) is used to treat prostate cancer. Contrast enhanced imaging can assess the ablated region, but cannot be used during ablation due to effects of high energy ultrasound on MRI contrast agent stability. Our results show that high resolution MR spectroscopic imaging of the water resonance detects changes in T2* and water resonance peak amplitude that clearly delineate the ablation zone without contrast agent injection. Ablation zones measured by MR spectroscopic imaging are consistent with contrast enhanced images. This suggests that MR spectroscopic imaging can guide FLA during ablation to dynamically optimize treatment and improve outcomes.

4037	Computer 7	Ultrafast Temperature Estimation from Undersampled K-Space for MR Guided Microwave Ablation
		Ke Wang[1], Zijing Dong[2], Fuyixue Wang[2], Bingyao Chen[3], Jiafei Yang[3], Xing Wei[3], and Kui Ying[4]
		[1]Department of Biomedical Engineering, Tsinghua University, Beijing, China, [2]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China, [3]Department of Orthopedics, First Affiliated Hospital of PLA General Hospital, Beijing, China, [4]Key Laboratory of Particle and Radiation Imaging, Ministry of Education, Medical Physics and Engineering Institute, Department of Engineering Physics, Tsinghua University, Beijing, China

		Improved fast k-space temperature estimation using Golden Angle (GA) radial can effectively accelerate the computation process and reduce the motion artifacts. However, existing MR temperature imaging methods are time-consuming and the limited performance prevent their clinical applications. This work proposed a ultrafast method to largely accelerate temperature estimation process. Using a continuous fast k-space temperature estimation, together with improved algorithm design, GPU acceleration and more efficient computation, we achieve temperature estimation with 2 seconds temporal resolution.

4038	Computer 8	Bloch simulation-based correction for 2D VFA T1 mapping for fat MR thermometry
		Ieva Braskute[1], Roel Deckers[1], Max A Viergever[1], Chrit TW Moonen[1], and Lambertus W Bartels[1]
		[1]Imaging Division, University Medical Center Utrecht, Utrecht, Netherlands
		For MR-HIFU thermal therapies, specifically in the breast, MR temperature mapping both in aqueous and fatty tissues is desired, as it would improve treatment monitoring compared to MR thermometry in aqueous tissues only. Fat thermometry based on T1-mapping with 2D variable flip angle method offers high temporal resolution; however, 2D T1 mapping suffers from systematic errors caused by non-rectangular 2D slice profile. We propose a Bloch simulation-based 2D T1 correction technique to improve the accuracy of 2D T1 measurements. We demonstrate the proposed correction on simulated and experimental data.

4039	Computer 9	Early clinical feasibility study of body mounted and motorized needle guidance tool in abdominal MRI-guided cryoablation
		Nobuhiko Hata[1], Brian Ninni[1], Franklin King[1], Takahisa Kato[2], Junichi Tokuda[1], and Kemal Tuncali[1]
		[1]The Ferenc Jolesz National Center for Image Guided Therapy, Radiology, Boston, MA, United States, [2]Healthcare Optics Research Laboratory, Canon USA, Inc., Cambridge, MA, United States
		This study investigates the feasibility of directing cryotherapy probes using a body-mounted and motorized needle guidance device in abdominal MRI-guided cryoablation. Utilizing a motorized needle alignment device offers an alternative solution to the trial-and-error method of probe placement, as it allows one to directly orient cryotherapy probes, efficiently. This study found the method to be feasible for use in cryoablation in 3T with placement accuracy of 8.8mm. Further investigation is warranted to improve the efficiency of probe placement.

4040	Computer 10	Design of Focused Radio Frequency Heating Array Coils for Non-Invasive Hyperthermia with Ultra-High Field MRI
		Joshua de Bever[1,2], Mihir Pendse[1,2], and Brian K Rutt[1,2]

		[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Radiological Sciences Laboratory, Stanford, CA, United States
		This abstract details the implementation of an automated pipeline for designing high channel count RF coils for the purpose of non-invasive Focused RF hyperthermia generated from Ultra-high field MRI parallel transmit coils. The pipeline integrates multiple tools including Sim4Life for EM-FDTD simulations in the Virtual Population physiologically realistic body models, Advanced Design Systems circuit simulator, and Matlab for custom algorithm execution. This work leverages GPU acceleration which has reduced simulation times for an 84 channel RF coil from 77 days on a CPU to 6 hours on three compute nodes equipped with 14 affordable GPUs.

4041	Computer 11	The effect of k-space weighted image contrast (KWIC) and ultrasound focus size on the accuracy of proton resonance frequency (PRF) thermometry
		Bryant T. Svedin[1], Christopher R. Dillon[1], and Dennis L. Parker[1]
		[1]Utah Center for Advanced Imaging Research, Salt Lake City, UT, United States
		Stack of stars acquisitions with k-space weighted image contrast (KWIC) reconstruction provide an effectively high temporal resolution with high spatial resolution. The effective temporal resolution of KWIC reconstructions depend on the size of the object of interest. This abstract investigates the relationship between ultrasound focus size, the size of the KWIC window, and the accuracy/precision of PRF temperature measurements.

4042	Computer 12	Blood-brain barrier disruption and delivery of irinotecan in a rat model using a clinical transcranial MRI-guided focused ultrasound system
		Nathan McDannold[1], Yongzhi Zhang[1], Chanikarn Power[1], and Natalia Vykhodtseva[1]
		[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States
		The feasibility of controlled blood-brain barrier (BBB) disruption in rats was demonstrated with a low-frequency clinical transcranial MRI-guided focused ultrasound device that operates at 230 kHz (ExAblate Neuro, InSightec) combined with microbubbles. Thirty-six targets were sonicated in one hemisphere in each experiment under closed-loop control based on real-time recordings of acoustic emissions. Disruption was confirmed in maps of R1 relaxation following Gadavist administration. After three weekly BBB disruptions covering an entire hemisphere, we always produced BBB disruption with only minor vascular side effects. We also delivered irinotecan chemotherapy across the BBB without apparent neurotoxicity.

4043	Computer 13	Synergistic effect of MR-HIFU hyperthermia mediated drug delivery followed by ablation Edwin Heijman[1], Nicole Hijnen[2], Esther Kneepkens[2], Mariska de Smet[2], Sander Langereis[3], and Holger Grüll[4] *[1]Oncology Solutions, Philips Research, Cologne, Germany, [2]Biomedical NMR, Eindhoven University of Technology, Eindhoven, Netherlands, [3]Oncology Solutions, Philips Research, Eindhoven, Netherlands, [4]Department of Radiology, Experimental Imaging and Image-guided Therapy, University Hospital of Cologne, Cologne, Netherlands* Four Magnetic Resonance-guided High Intensity Focused Ultrasound (MR-HIFU) thermal therapy strategies (no HIFU, hyperthermia, ablation and hyperthermia followed by ablation) in combination with temperature sensitive liposomes (TSLs), co-encapsulating doxorubicin (dox) and ProHance®, were investigated in rhabdomyosarcoma rat tumor model. All HIFU heating strategies combined with TSLs resulted in cellular uptake of dox deep into the interstitial space and significant increase of intratumoral drug concentrations. The combination of hyperthermia-triggered TSLs followed by ablation showed the best therapeutic outcome compared to other strategies due to direct induction of thermal necrosis in the tumor core and efficient drug delivery to the tumor rim.

4044	Computer 14	Shear wave elastography using multi-point acoustic radiation force imaging Lorne W. Hofstetter[1], Henrik Odéen[1], Bradley D. Bolster, Jr.[2], Douglas A. Christensen[3,4], Allison Payne[1], and Dennis L. Parker[1] *[1]Department of Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States, [2]Siemens Medical Solutions USA, Inc., Salt Lake City, UT, United States, [3]Department of Bioengineering, University of Utah, Salt Lake City, UT, United States, [4]Department of Electrical and Computer Engineering, University of Utah, Salt Lake City, UT, United States* Characterizing the mechanical properties of tissue during focused ultrasound ablative therapies could provide useful information for pretreatment planning and treatment endpoint assessment. In this work we present a 3D MR acquisition capable of measuring propagating shear waves from a spatially distributed collection of focused ultrasound generated acoustic radiation force impulses. This new multi-point shear wave elastography technique is demonstrated and compared to conventional MR elastography.

4045	Computer 15	Longitudinal multi-parametric MRI follow-up of ultrasound induced blood-brain barrier disruption in rats Allegra Conti[1], Françoise Geffroy[1], Hermes Kamimura[1], Fawzi Boumezbeur[1], Sébastien Mériaux[1], and Benoit Larrat[1] *[1]CEA/DRF/JOLIOT/NeuroSpin, Gif sur Yvette, France*

		Focused Ultrasound in conjunction with microbubbles allows the reversible and safe opening of the BBB in a narrow range of Acoustic Pressure (AP). Here we wanted to investigate what happens to the brain tissues at short- and long-terms in case of an excessive AP is reached in vivo. Passive Cavitation Detection has been used to register inertial cavitation during the opening. At 1,3,7,14 and 28 days after the BBB opening, $T_{1,2}$-weighted images, T_2*-maps, DWI, MRS acquisitions and histological analysis have been performed. P-gp and myelin expression, cells deaths, and astrocytes/microglial activations have been also imaged postmortem within 28 days.

4046	Computer 16	Experimental demonstration of a HIFU self-scanning treatment in moving tissue using hybrid ultrasound and MR guidance
		Orane Lorton[1], Laura Gui-Lévy[1], Pauline Guillemin[1], Nadia Möri[2], Philippe Cattin[2], Sylvain Terraz[3], Christoph Becker[3], and Rares Salomir[3]
		[1]Radiology, University of Geneva, Faculty of medicine, Geneva, Switzerland, [2]Biomedical Engineering, Center of Medical Image Analysis and Navigation, University of Basel, Basel, Switzerland, [3]Radiology, Geneva Hospitals, Geneva, Switzerland
		MRI-controlled tumor treatment by High Intensity Focused Ultrasound (HIFU) is challenging in the abdominal organs because of the breathing motion. We experimentally demonstrated a self-scanning method for motion compensation by passively scanning the tissue passing through the static focal point. Ex vivo turkey samples were subjected to a breathing-like non-periodic motion and the HIFU power was modulated using the velocity information from landmark tracking on simultaneous ultrasound images. MR imaging provided targeting and on-line thermometry. Temperature map were computed using the reference-less PRFS method. A dramatic improvement of the isotherms uniformity score was achieved for rectilinear volumetric ablation.

4047	Computer 17	Feasibility of MR guided High Intensity Focused Ultrasound (MRgHIFU) for treating recurrent gynecological tumours: a pilot study
		Sharon L Giles[1,2], Ian Rivens[3], Katja De Paepe[1], Veronica A Morgan[2], Georgios Imseeh[4], Gail R ter Haar[3], Alexandra Taylor[4], and Nandita M deSouza[1]
		[1]CRUK Cancer Imaging Centre, Institute of Cancer Research, London, United Kingdom, [2]CRUK Cancer Imaging Centre, Royal Marsden Hospital, London, United Kingdom, [3]Therapeutic Ultrasound, Institute of Cancer Research, London, United Kingdom, [4]Gynae-Oncology, Royal Marsden Hospital, London, United Kingdom

		MR guided high intensity focused ultrasound (MRgHIFU) treatment plans were generated for 16 patients with recurrent gynecological tumors. Treatment volumes (i) ignoring risk to non-target regions ($TV_{unconstrained}$), (ii) considering risk, assuming that patients were optimally prepared ($TV_{optimal}$), and (iii) assuming no preparation was possible ($TV_{no-prep}$), were compared with planning target volume (PTV). 9/16 patients (56%) with tumor volumes ≤53 ml were considered feasible to treat safely if optimally prepared ($TV_{optimal}$≥50% PTV). Main limiting factors were transducer focal range, bone in the beam path, and risk to bowel. However, even without preparation, 4/16 patients (25%) remained feasible to treat ($TV_{no-prep}$ ≥50% PTV).

4048	Computer 18	Feasibility of MR guided High Intensity Focused Ultrasound (MRgHIFU) for treating recurrent gynecological tumours: comparing T2W imaging and diffusion weighted imaging (DWI) for treatment planning
		Sharon L Giles[1,2], Jessica M Winfield[1,2], Ian Rivens[3], Katja De Paepe[1], Veronica A Morgan[2], Georgios Imseeh[4], Gail R ter Haar[3], Alexandra Taylor[4], and Nandita M deSouza[1]
		[1]CRUK Cancer Imaging Centre, Institute of Cancer Research, London, United Kingdom, [2]CRUK Cancer Imaging Centre, Royal Marsden Hospital, London, United Kingdom, [3]Therapeutic Ultrasound, Institute of Cancer Research, London, United Kingdom, [4]Gynae-Oncology, Royal Marsden Hospital, London, United Kingdom
		MR guided high intensity focused ultrasound (MRgHIFU) treatment plans were generated for 16 patients with recurrent gynecological tumors. Gross tumor volumes (GTV) defined on diffusion-weighted imaging using an echo-planar and turbo-spin echo technique (EPI-DWI, TSE-DWI) were approximately 20% smaller than GTV defined on T2W imaging, but did not result in sequence-dependent differences in planning target volume (PTV). PTVs were more easily defined on DWI. However, there were clinically relevant discrepancies (>4 mm) between T2-defined and DWI-defined PTV locations, worst in the phase-encode direction using EPI-DWI, that need to be accounted for if incorporating DWI into MRgHIFU treatment planning.

4049	Computer 19	Shear stiffness determination using MR-acoustic radiation force imaging
		Bradley D. Bolster, Jr.[1], Henrik Odéen[2], Hailey McLean[2], Dennis L. Parker[2], and Allison Payne[2]
		[1]Siemens Medical Solutions USA, Inc., Salt Lake City, UT, United States, [2]Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States

		Magnetic resonance acoustic radiation force imaging (MR-ARFI) has been used pre-clinically to detect tissue displacement changes during magnetic resonance guided focused ultrasound treatments. Although displacement is a quantitative metric, shear stiffness is typically used to clinically describe disease states. This work develops and evaluates a model-based technique to determine tissue shear stiffness from MR-ARFI displacement measurements. The MR-ARFI derived values are compared to conventional MR elastography shear stiffness values in a phantom study.

4050	Computer 20	Optical tracking-guided MR-ARFI for targeting focused ultrasound neuromodulation
		Sumeeth V Jonathan[1,2], M Anthony Phipps[2,3], Vandiver L Chaplin[2,3], Aparna Singh[1,2], Pai-Feng Yang[2,4], Allen T Newton[2,4], John C Gore[1,2,4,5,6], Li Min Chen[2,4], Charles F Caskey[2,4], and William A Grissom[1,2,4,7]
		[1]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [3]Chemical and Physical Biology, Vanderbilt University, Nashville, TN, United States, [4]Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [5]Molecular Physiology and Biophysics, Vanderbilt University, Nashville, TN, United States, [6]Physics and Astronomy, Vanderbilt University, Nashville, TN, United States, [7]Electrical Engineering and Computer Science, Vanderbilt University, Nashville, TN, United States
		Magnetic resonance-acoustic radiation force imaging (MR-ARFI) pulse sequences permit localization and targeting during focused ultrasound (FUS) therapy. MR-ARFI uses motion-encoding gradients (MEGs) to visualize the tissue displacement caused by the acoustic beam's radiation force. However, *a priori* knowledge of the acoustic beam's position and orientation in space is critical for MR-ARFI so that the MEGs can be placed in the proper orientation. We used an optical tracking system to inform the geometry of MR-ARFI acquisitions. The proposed methods will be used to guide ongoing experiments that use MR-ARFI to produce acoustic beam maps for targeting ultrasound neuromodulation in real-time.

4051	Computer 21	Model Predictive control of MRI-guided HIFU for Hyperthermia
		Lukas Christian Sebeke[1], Xi Luo[2], Bram de Jager[2], Edwin Heijman[3], WMPH Heemels[2], and Holger Grüll[1]
		[1]Radiology, University Clinic of Cologne, Cologne, Germany, [2]Eindhoven University of Technology, Eindhoven, Netherlands, [3]Philips Research Germany, Cologne, Germany

		Hyperthermia has been shown in clinical trials to strongly enhance therapeutic efficacy of radio- and chemotherapy. The main challenge in hyperthermia is to achieve spatially homogenous temperatures between about 41-43 ºC for ca. one hour. **M**agnetic **R**esonance Imaging-guided **H**igh **I**ntensity **F**ocussed **U**ltrasound (MR-HIFU) enables heating of tissues with high spatial accuracy. We developed a new regulatory algorithm based on **M**odel **P**redictive **C**ontrol (MPC) for stable MR-HIFU-hyperthermia, which is designed to find effective heating patterns based on predictions of the temperature evolution in tissue. A comparison with the currently available controller is presented, detailing advantages, shortcomings and opportunities.

4052	Computer 22	Development of an 8-channel head array for MRI guided monkey ultrasound stimulation
		Jo Lee[1,2], Xing Yang[3], Qiaoyan Chen[1,2], Changjun Tie[1,2], Xiaojing Long[1,2], Nan Li[1,2], Xiaoliang Zhang[4,5], Hairong Zheng[1,2], and Ye Li[1,2]
		[1]Lauterbur Imaging Research Center, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Shenzhen Key Laboratory for MRI, Shenzhen, China, [3]High-Field Magnetic Resonance Brain Imaging Key Laboratory of Sichuan Province, School of Life Science and Technology, University of Electronic Science and Technology of China, Chengdu, China, [4]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [5]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco, CA, United States
		For flexible operating the ultrasound probe in a monkey model, all three instruments, stereotaxic instrument, ultrasound probe and monkey RF coil, must match to each other. In this study, an 8-channel monkey coil was custom-designed to fit the specific stereotaxic instrument, ultrasound probe, and the rhesus monkey’s head in order to get a high quality images and efficient ultrasound operation. Compared to the commercial small flexible coil array, the custom-designed monkey coil provides higher SNR in all three orientations, higher spatial resolution in vivo, and better parallel imaging capability.

4053	Computer 23	Monitoring High Intensity Focused Ultrasound (HIFU) ablations in real time using interventional MR Elastography (MRE)
		Jonathan Vappou[1], Paolo Cabras[1], Kisoo Kim[1], Pramod Rao[1], Afshin Gangi[1,2], and Elodie Breton[1]
		[1]ICube CNRS / University of Strasbourg, Strasbourg, France, [2]Department of Interventional Imaging, Strasbourg university hospital, Strasbourg, France
		This study introduces the use of interventional Magnetic Resonance Elastography (iMRE) for monitoring HIFU ablations, using the acoustic radiation force as a means for generating the shear waves necessary for MRE directly from the HIFU focus. This method allows for monitoring tissue elasticity and temperature in real time during the ablation. Its feasibility is illustrated in vivo on porcine muscle. Tissue was found to stiffen significantly (+125%) when the temperature increased, and changes in tissue stiffness were found to be irreversible. These findings suggest that tissue stiffness may be an interesting biomarker, complementary to thermal dose, to monitor HIFU ablations.

4054	Computer 24	Longitudinal Observation of Focused Ultrasound Induced Blood-Brain Barrier Opening of Cat Brain from 7-T Contrast-Enhanced MRI
		Xianfeng Feng#[1], Tingting He#[1], Xiao Yu[1], Chih-Hung Tsai[2], Wen-Yen Chai[3], Chao-Ting Wang[1,2], Wei Xiong[1], Bin Xu[1], Yifeng Fan[1], Hao-Li Liu*[1,2], and Hsin-Yi Lai*[1]
		[1]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou City, China, [2]School of Medicine, Department of Electrical Engineering, Chang Gung University, Taoyuan County, Taipei City, Taiwan, [3]Department of Diagnostic Radiology and Intervention, Chang Gung Memorial Hospital, Taoyuan County, Taiwan
		Blood-brain barrier (BBB) has long been impeding the application of many therapeutic agents in treating diseases in central nervous system. Results showed that microbubble-mediated focused ultrasound can open BBB in cats noninvasively and locally. The size and duration of BBB opening can be accurately monitored by 7T MRI longitudinally. The combination of two techniques has the potential to be further applied for further clinical practice in the future.

Electronic Poster

MR Safety of Implants

Exhibition Hall	Tuesday 13:45 - 14:45

4055	Computer 25	Magnetic resonance imaging of patients with conventional and MR-conditional pacemakers: assessment of risk and incidence
		Markus Fahlström[1], Johan Olsrud[2], Tomas Bjerner[1], Elna-Marie Larsson[1], and Carina Blomström-Lundqvist[3]
		[1]Surgical Sciences, Uppsala University, Uppsala, Sweden, [2]Clinical Sciences, Lund University, Lund, Sweden, [3]Cardiology, Uppsala University, Uppsala, Sweden
		Magnetic resonance imaging of patients with conventional- and MR-conditional pacemakers should be considered and may be considered respectively, based on a case-by-case risk-benefit assessment. However, information regarding incidence of risks with respect to exposure to different electromagnetic fields is limited. Based on a literary review, risk, complications and incidence was assessed. Most common risk/complication is reed switch activation. Electrode heating is a relevant risk, with minor clinical implication. Off-label MR-examinations of MR-conditional pacemakers or abandoned leads may be considered.

4056	Computer 26	Safety of Active Catheters in MRI: Termination Impedance vs. RF-induced Heating

		Ali Caglar Özen[1,2], Thomas Lottner[1], and Michael Bock[1]
		[1]Dept.of Radiology, Medical Physics, Medical Center - University of Freiburg, Freiburg, Germany, [2]German Consortium for Translational Cancer Research Freiburg Site, German Cancer Research Center (DKFZ), Heidelberg, Germany
		RF-induced heating of the active catheters was analyzed and analytically modeled to demonstrate that it can be controlled by adjusting the termination impedance. Current distribution of a single-loop active guiding catheter was formulated as a function of the incident electric field, propagation constants, and termination impedances. The tip SAR was displayed on a color-coded Smith chart in terms of the normalized input impedance. For the first time, analytical modeling and transfer function measurements were applied to active catheters. A novel signal level and impedance control unit was introduced, which is applicable also to other interventional devices.

4057	Computer 27	Assessment of Iron Oxide Nanoparticle Concentration for Distinct Intercranial EEG Electrode Localization in MRI
		Johannes B. Erhardt[1,2], Jessica A. Martinez[2], Tyler E Cork[2], Isabel Gessner[3], Sanjay Mathur[3], Thomas Stieglitz[1], and Daniel B. Ennis[2]
		[1]University of Freiburg, Freiburg, Germany, [2]UCLA, Los Angeles, CA, United States, [3]University of Cologne, Cologne, Germany
		IcEEG electrodes for epilepsy and research applications impair fMRI and MR images with compromising susceptibility artifacts. Thin-film implants feature 100x less metal thickness and thus minimal artifacts. However, thin-film implants are inconspicuous in MRI. Therefore we present means of localization using super paramagnetic iron oxide nano particles to make thin-film implants ready for future applications. We present feasible concentrations and proof of concept.

4058	Computer 28	Adaptive SAR mass-averaging to predict RF heating for B1 shimming in the presence of a hip implant for parallel transmit at 3T
		Aurelien Destruel[1], Kieran O'Brien[2,3], Markus Barth[3], Jin Jin[1], Feng Liu[1], and Stuart Crozier[1]
		[1]School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, Australia, [2]Siemens Healthcare Pty Ltd, Brisbane, Australia, [3]Centre for Advanced Imaging, The University of Queensland, Brisbane, Australia

		Parallel-transmit and B_1-shimming techniques may significantly reduce radiofrequency (RF) artefacts when imaging near metal implants at 3T; however, it is known that around metal implants the 10g-averaged specific-absorption-rate (SAR_{10g}) locations do not coincide with the location of maximum heating. In this work, we investigate the behaviour of the B_1 field and RF heating around metal implants in a generic body coil at 3T as a function of shimming parameters using the adaptive SAR method we previously introduced as a fast estimate of temperature increase.

4059	Computer 29	Experience with 7 Tesla MRI of human subjects with passive implants and tattoos: an update
		Oliver Kraff[1], Raphaela M Berghs[1,2], Yacine Noureddine[1], Mark E Ladd[1,3], and Harald H Quick[1,4]
		[1]Erwin L. Hahn Institute for MRI, University Duisburg-Essen, Essen, Germany, [2]Hamm-Lippstadt University of Applied Sciences, Hamm, Germany, [3]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]High Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany
		In this retrospective study, questionnaires and screening forms were analyzed to identify all subjects with implants and/or tattoos cleared for imaging at our passively shielded 7T whole-body MR system. Over the past 11 years, 496 out of 2370 healthy volunteers and volunteers with known pathologies had implants and/or tattoos and underwent a 7T MR examination. None of the subjects reported any discomfort related to heating or force during or after imaging. No findings regarding safety occurred and all examinations could be safely performed.

4060	Computer 30	Estimation of RF-induced temperature rise for helix and straight leads based on the lead electromagnetic model: a case study
		Mikhail Kozlov[1] and Wolfgang Kainz[2]
		[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]U.S. FDA, CDRH, Office of Science and Engineering Laboratories, Division of Biomedical Physics, Silver Spring, MD, United States
		This case study investigated RF-induced heating of straight and helix leads at 127.7 MHz obtained with the lead electromagnetic model (LEM) and direct 3D electromagnetic and thermal co-simulations. A large set of incident electric fields was generated in a phantom by an array of four antennas with varying spatial positions and sources. LEM was a suitable approach for predicting temperature in close proximity to the end face of lead tip. However the variance of the fitted values and observed values was rather high for temperature at other locations around the lead tip.

4061	Computer 31	RF Safety of Transcranial Direct Current Stimulation Equipment during MRI

		Mikhail Kozlov[1], Roland Müller [1], Andre Pampel[1], Benjamin Kalloch[1], Nikolaus Weiskopf[1], and Harald E. Möller[1]
		[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
		We calculated the RF-induced power deposition at 3T due to the presence of tDCS equipment using an approximation of the human body by a single tissue numerical model. Influences of the tDCS lead including a built-in serial resistor on the power deposition were evaluated. Our case study provided strong evidence that the tDCS setup has a relevant impact on power deposition in proximity of the electrode edges at 3T. These particular conditions are not explicitly considered in the procedures that are used for SAR monitoring on the MRI scanner. The peak voltage across the serial resistor has to be carefully considered in terms of sufficient electrical strength to safely prevent sparks.

4062	Computer 32	Temperature measurements in a phantom during a 1.5T MRI in the presence of a µMS implant.
		Giorgio Bonmassar[1], Kuldeepsinh Rana[2], Frederick Haer[2], and Laleh Golestanirad[3]
		[1]A.A. Martinos Center/Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Frederick Haer Corporation, Bowdoin, ME, United States, [3]Radiology, Massachusetts General Hospital, Charlestown, MA, United States
		The technology consists of nanoscale structures for developing micro and nano-scale coils for microscopic magnetic stimulation of brain tissue. This technology will provide an important new tool for further exploration of micro-magnetic stimulation as a prospective tool for clinical and preclinical applications. In this abstract, we have shown that the technology is amenable of MRI imaging with low heating.

4063	Computer 33	Torque abnormality of Ti alloy in a static magnetic field
		Minghui Tang[1], Shingo Kawahira[2], Naoyuki Nomura[3], and Toru Yamamoto[1]
		[1]Faculty of Health Sciences, Hokkaido University, Sapporo, Japan, [2]Graduate School of Health Sciences, Hokkaido University, Sappro, Japan, [3]Graduate School of Engineering, Tohoku University, Sendai, Japan
		Ti alloy has been introduced for medical implants to reduce MRI artifacts for its lower susceptibility than the preceding material of Elgiloy. The magnetic torque of metallic materials theoretically increases with an increase in the susceptibility. However, it was reported that the torque of cerebral aneurysm clips was comparable for both materials. In this study, we accurately measured the torque of Elgiloy and Ti alloy rods in an MR scanner and found that the small susceptibility anisotropy of Ti alloy rod causes a torque that is more than 100 times of the value expected from the conventional torque theory.

4064	Computer 34	A Prospective Study of the Safety of Tattoos in MRI
		Martina F Callaghan[1], Clive Negus[1], Megan Creasey[1], Shiela Burns[1], Janice Glensman[1], David Bradbury[1], Elaine Williams[1], and Nikolaus Weiskopf[1,2]
		[1]Functional Imaging Laboratory (FIL) & Wellcome Centre for Human Neuroimaging, UCL Institute of Neurology, London, United Kingdom, [2]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
		Tattoos are recognised as a potential source of increased risk for MRI. Here we present the results of a prospective study designed to assess the risk of a tattoo-related adverse event occurring during MRI scanning at 3T. The study spanned a 6 year period with 573 independent scanning sessions on 319 individuals. With the inclusion criteria adopted in this study, the probability of an adverse reaction was estimated to be < 1%.

4065	Computer 35	Image-Based MR Safety Evaluation of Heating in Implanted Devices
		Samuel Rob Guyer[1], Ken Sakaie[2], Se-Hong Oh[2,3], and Stephen Jones[2]
		[1]School of Medicine, Case Western Reserve University, Cleveland, OH, United States, [2]Imaging Institute, The Cleveland Clinic, Cleveland, OH, United States, [3]Department of Biomedical Engineering, Hankuk University of Foreign Studies, Yongin, Republic of Korea
		A thermal contrast agent with high sensitivity, thulium 1,4,7,10-tetramethyl-1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetate (TmDOTMA^{-}), was investigated for use in measuring the three-dimensional heating profile surrounding implantable devices with a goal of simplifying the safety assessment process. The technique was first demonstrated by imaging a vertical temperature gradient and was subsequently used to measure the heating profile surrounding a copper wire. We found gross agreement of this technique with concurrent fiber-optic temperature probe measurements, with the TmDOTMA^{-} measurement complicated by a number of technical challenges and imaging artifacts.

4066	Computer 36	Reducing heating of implanted leads through High-Dielectric Capacitive Bleeding of Current (HD-CBLOC): concepts, simulations and experimental results
		Laleh Golestani Rad[1], Lawrence L Wald[2], Boris Keil[3], and Giorgio Bonmassar[2]
		[1]Building 75, Massachusetts General Hospital, Charlestown, MA, United States, [2]Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [3]Department of Life Science Engineering, Institute of Medical Physics and Radiation Protection, Giessen, Germany

		RF heating of conductive implants such as those in cardiac pacemakers and deep brain stimulation devices remains a major issue limiting access to MRI for hundreds of thousands of patients. Here we present a novel technique we call High-Dielectric Capacitive Bleeding of Current (HD-CBLOC) to develop an implanted lead with significantly reduced RF heating. The lead uses a high-permittivity insulating coating around the conductive wires to enable a distributed capacitive dissipation of RF currents along the length of the lead and thus reducing the energy deposition at the tip. Experiments show the configuration reduces heating by more than 15-fold during scans at 1.5 T. Simulations predict a similar effect at 3T and 7T.

4067	Computer 37	Generation of a “virtual population” of deep brain stimulation patient models for MRI safety studies
		Bastien Guerin[1,2], Mathias Davids[1,3], Darin Dougherty[2,4], Leonardo Angelone[5], and Lawrence L. Wald[1,2]
		[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Computer Assisted Clinical Medicine, Heidelberg University, Heidelberg, Germany, [4]Psychiatry, Massachusetts General Hospital, Charlestown, MA, United States, [5]DBP/OSEL/CDRH, US Food and Drug Administration, Silver Spring, MD, United States
		We develop and disseminate a “virtual population” of five deep brain stimulation (DBS) patient models. The models are high-quality, watertight, topologically correct, non-intersecting surface meshes that can be used in conjunction with Finite Element Method (FEM) tools such as Ansys HFSS and CST. They are realistic descriptions of actual DBS patients anatomy (internal air, bone and “average tissue”) as well as the entire DBS path including the Implantable Pulse Generator (IPG) and extension cables. We hope the models can be useful for assessment of inter-subject variability of RF-safety metrics such as SAR and temperature.

4068	Computer 38	Measuring Radio-Frequency Induced Currents On Metallic Leads Using Parallel Imaging
		Yigitcan Eryaman[1], Sean Moen[1], Andrea Grant[1], Gregor Adriany[1], Kamil Ugurbil[1], Noam Harel[1], and J. Thomas Vaughan[1,2]
		[1]CMRR, University of Minnesota, Minneapolis, MN, United States, [2]Mortimer B. Zuckerman Mind Brain Behavior Institute,Columbia University, New York, NY, United States
		We present a method that can be used to calculate the RF induced currents flowing on metallic leads. Proposed method relies on analyzing MR magnitude images (acquired by parallel imaging) , and modeling/matching the null location at the vicinity of the lead. The calculated induced current can be used to predict safe excitation scenarios and reduce heating around the lead.

4069	Computer 39	MRI Implant Safety: Novel Mechanistic Model and Safety Assessment Approach for Small Implants and Abandoned Leads

		Ilaria Liorni[1], Esra Neufeld[1], Sven Kuehn[1], Manuel Murbach[1], and Niels Kuster[1,2]
		[1]IT'IS Foundation, Zuerich, Switzerland, [2]ETHZ, Zuerich, Switzerland
		Safety assessment of active implants is defined in the technical specification ISO/TS 10974. However, the safety of small passive implants must be assessed individually for each device, e.g., via the ASTM F2182-11a standard test method. Computational studies have demonstrated that the mechanism postulated for elongated implants at 64 MHz is not applicable. We propose a new mechanistic theory of general validity applicable across a large frequency range to describe exposure enhancement at critical lead locations. Simulation-based assessment was successfully compared to predictions from the mechanistic model on the impact of several parameters (tissue dielectric properties, insulation thickness, and tip shape).

4070	Computer 40	Measuring dB/dt Induced Vibration in Medical Devices: Comparison of Discrete Frequencies Versus Use of a Variable-Frequency Chirp Pulse
		Christine M. Tarapacki[1], Daniel J. Martire[1], Colin M. McCurdy[1], William B. Handler[1], and Blaine A. Chronik[1]
		[1]The xMR Labs, Department of Physics and Astronomy, Western University, London, ON, Canada
		Determining gradient field-induced vibration of a device typically involves multiple measurements at discrete frequencies. This study compares data from a frequency chirp to discrete frequencies in an effort to decrease testing time and obtain a larger range of information. Results confirm scaled displacement obtained through discrete frequency measurements and a frequency chirp matched for all measured frequencies.

4071	Computer 41	Development of a standard reference object for monitoring quality and reproducibility in dB/dt-heating tests for medical devices
		Christine M. Tarapacki[1], Jack Hendriks[1], Krzysztof Wawrzyn[1], William Bradfield Handler[1], and Blaine A. Chronik[1]
		[1]The xMR Labs, Department of Physics and Astronomy, Western University, London, ON, Canada
		The intent of this study is to introduce and characterize a standard reference object for gradient-induced dB/dt heating studies. Key attributes of a standard reference object would be simplicity, sensitivity (large response to exposure conditions), and reproducibility. Various geometries, materials, and exposure conditions were studied, and the results indicate the temperature rise of a simple copper annulus can be used to verify all components of a dB/dt exposure and measurement system are functioning prior to a device test. The thermal response of a 5-cm diameter copper annulus was characterized as a function of frequency and dB/dt-amplitude, both in air and in tissue-mimicking gel.

4072	Computer 42	MR based transfer matrix determination for a linear implant by joint estimation of the incident and scattered B$$$^+_1\hspace{2mm}$$$fields.
		Janot P. Tokaya[1], Alexander J.E. Raaijmakers[1,2], Alessandro Sbrizzi[1], Peter R. Luijten[1], and Cornelis A.T. Berg[1]
		[1]Center for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [2]Biomedical Image Analysis, Eindhoven University of technology, Eindhoven, Netherlands
		Two findings that are steps towards fully MR-based TF determination in realistic situations are presented. Firstly, the transfer matrix, that is an extension of the transfer function (TF), can describe the RF response of an implant in a human model. Secondly, a joint minimization of the incident field and the scattered field, determined with the transfer matrix, can describe measured and simulated complex B$$$_1^+$$$ distributions in a phantom with a linear implant present. The TM and TF result from this minimization, which enables their determination from a single MRI acquisition with the implant in place.

4073	Computer 43	A robust experimental evaluation method for RF safety assessment of implants during 1.5 T and 3.0 T MRI
		Aiping Yao[1,2], Earl Zastrow[1], and Niels Kuster[1,2]
		[1]IT'IS Foundation, Zurich, Switzerland, [2]ETH Zurich, Zurich, Switzerland
		The accuracy of the traditional SAR-based evaluation is normally limited by the extreme spatial gradient of the induced SAR within the high-heating region. In this work, we propose a reconstruction evaluation method that improves upon the traditional method by using simple numerical modeling and image processing algorithm. The total combined uncertainty caused by the high SAR gradient and limited probe resolution is reduced dramatically from 3dB to 1 dB with the proposed method. A generic implant with helical conductor and single electrode is successfully validated against numerical simulations with less than 0.5 dB deviation at both 1.5 T and 3.0 T MRI RF frequencies.

4074	Computer 44	Power to temperature conversion of AIMD under RF exposure
		Aiping Yao[1,2], Earl Zastrow[1], and Niels Kuster[1,2]
		[1]IT'IS Foundation, Zurich, Switzerland, [2]ETH Zurich, Zurich, Switzerland

		Determining the local tissue temperature rise caused by the RF-induced deposition of an active implantable medical device (AIMD) requires a conversion between localized power deposition to temperature (p2ΔT). We investigate the quasi-static limit by which both the distributions of power and temperature are assumed to depend only on the electrode geometry (when electrically small) and independent of the current distribution along the AIMD's wire conductor. The results confirm that p2ΔT conversion can be derived without the knowledge of incident conditions to the AIMD and complete geometry of the AIMD. The relationship between p2ΔT and the electrode physical geometries is summarized.

4075	Computer 45	MRI RF Safety of Active Implantable Medical Devices (AIMDs): Effect of Conductivity of Tissue Simulating Media on Device Model Accuracy
		Krishna K.N. Kurpad[1], Jingshen Liu[2], Paul J Stadnik[1], Jeffrey Von Arx[1], Larry Stotts[1], Wolfgang Kainz[3], and Ji Chen[2]
		[1]Micro Systems Engineering Inc., Lake Oswego, OR, United States, [2]Department of ECE, University of Houston, Houston, TX, United States, [3]US Food and Drug Administration, Silver Spring, MD, United States
		The Tier 3 procedure for testing electrically long active implantable medical devices (AIMDs) for MRI RF safety involves the development of transfer function models (TFMs) of the AIMDs. Accuracy of the TFM depends on how closely the TSM mimics the tissues in which the AIMD is implanted. We find that the conductivity of the medium surrounding the lead electrode has a strong influence on the transfer function magnitude of the DUT. Therefore, TFMs of the DUT developed in a TSM whose conductivity mimics that of the in-vivo tissue that surrounds the electrode under test results in the most accurate TFM.

4076	Computer 46	Analysis on pulse shape and temporal resolution effects on RF heating with medical implants
		Yuqing Wan[1] and Shiloh Sison[2]
		[1]Research and Development, Abbott, Sylmar, CA, United States, [2]Research and Development, Abbott, Sunnyvale, CA, United States
		MRI RF heating can potentially lead to thermal damages to biological tissues, especially for patients with medical implants, because the RF E-field may induce currents along the implant, leading to concentrated power deposition at implant-tissue interface. Previous methods for computing temperature change through MR scans indicated minimal effect from temporal resolution between 30s and 120s for patients without implants. However, for patients with medical implants, our study suggests that temperature/thermal dose is predicted more accurately with smaller time step sizes (<10s), because immediate response to the heating (increased blood perfusion) needs to be accounted for in a timely fashion.

4077	Computer 47	Investigation of breast imaging SAR hotspot with posable human models
		Xin Chen[1] and Michael Steckner[1]
		[1]Toshiba Medical Research Institute USA, Mayfield Village, OH, United States
		MR users are routinely instructed to eliminate large conducting loops in order to avoid skin/skin contact RF burns. Loops can be formed by skin folds, hands clasped (e.g. above head or on abdomen), hands touching thighs, or touching legs etc. Points of skin/skin contact are often associated with significant local SAR. Modeling with posable human models show that hands clasped skin/skin contact loops associated with prone breast imaging do not necessarily increase local SAR. This suggests that not all skin/skin contact situations are a patient safety concern.

4078	Computer 48	Design And Evaluation Of Head And Neck Low SAR MRI Protocols For Patients With Implanted Electronic Devices
		Jessica A. Martinez[1,2], Kévin Moulin[1], Pablo Villablanca[1], and Daniel B. Ennis[1,2]
		[1]Radiological Sciences, UCLA, Los Angeles, CA, United States, [2]Bioengineering, UCLA, Los Angeles, CA, United States
		Patients with MRI conditional implantable electronic devices (IEDs) will be referred for MRI examinations. Imaging these patients, however, remains a challenge, in part, because there is no framework to follow for designing protocols that meet SAR labeling requirements. The purpose of this work was to generate and test a workflow that can be followed for optimizing protocols to meet a SAR labeling target. Following the workflow, we optimized head and neck protocols to meet whole-body SAR ≤0.1W/kg and head SAR≤0.3W/kg. Each low SAR MRI series was within the conditional SAR labeling while maintaining image quality.

Electronic Poster

Motion Correction in the Brain

Exhibition Hall	Tuesday 13:45 - 14:45

4079	Computer 49	Comprehensive head motion modelling and correction using simultaneously acquired MR and PET data
		Francesco Sforazzini[1], Jakub Baran[1], Alexandra Carey[1,2], Nadim Jon Shah[1,3,4], Gary Egan[1,5,6], and Zhaolin Chen[1,4]

		[1]Monash Biomedical Imaging, Melbourne, Australia, [2]Monash Health, Melbourne, Australia, [3]Institute of Neuroscience and Medicine, Forschungszentrum Jülich GmbH, Jülich, Germany, [4]Department of Electrical and Computer Systems Engineering, Monash University, Melbourne, Australia, [5]Australian Research Council Centre of Excellence for Integrative Brain Function, Monash University, Melbourne, Australia, [6]Monash Institute of Cognitive and Clinical Neuroscience, Monash University, Melbourne, Australia
		Head motion is one of the major issues in neuroimaging. With the introduction of MR-PET scanners, motion parameters can now be estimated from two independent modalities acquired simultaneously. In this work, we propose a new data-driven method that combines MR image registration and PET data driven approach to model head motion during the complete course of MR-PET examination. Without changing the MR-PET acquisition protocol, the proposed method provides motion estimates with a temporal resolution of ~2 secs. Results on a phantom dataset show that the proposed method can significantly reduce motion artefact in brain PET images and improve image sharpness compared with the MR based methods.

4080	Computer 50	Fast and Robust: Prospective Motion Correction Combined with Compressed Sensing for 3D Time-of-Flight MRA
		Christoph Forman[1], Michaela Schmidt[1], Peter Speier[1], Martin Schramm[1], Steffen Schroeter[1], Daniel Nicolas Splitthoff[1], and Tobias Kober[2,3,4]
		[1]Siemens Healthcare GmbH, Erlangen, Germany, [2]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [3]Department of Radiology, University Hospital Lausanne (CHUV), Lausanne, Switzerland, [4]Signal Processing Laboratory (LTS5), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
		We present the combination of prospective motion correction and compressed sensing for 3D Time-of-Flight MRA. This enables fast TOF imaging in high isotropic resolution, while preserving image quality and diagnostic value even in the presence of motion. The method was evaluated in five healthy volunteers and image quality was compared to a conventional TOF MRA. Prospective motion compensation successfully enabled robust diagnostic image quality in the highly accelerated scan. The promising results as well as the full integration of the proposed method in a standard clinical scanner enable a comprehensive evaluation in patients in the near future.

4081	Computer 51	Fast and Accurate 3D Rigid-Body Motion Information From Spherical Lissajous Navigators at Small K-Space Radii
		Richard Buschbeck[1] and N. Jon Shah[1,2]
		[1]Institute of Neuroscience and Medicine - 4, Jülich Research Centre, Juelich, Germany, [2]RWTH Aachen University, Faculty of Medicine, Department of Neurology, JARA, Aachen, Germany

		A new navigator concept is presented which enables the measurement of accurate rigid-body motion information from spherical navigators at extremely small k-space radii. This is achieved by using a 3D Lissajous navigator trajectory and a rotation estimation algorithm known from computer vision. The new method provides motion information with sufficient accuracy and precision for many motion correction techniques and significantly outperforms current spherical navigator methods in terms of acquisition and computation time.

4082	Computer 52	Slice-wise motion tracking during simultaneous EEG-fMRI
		Malte Laustsen[1,2], Mads Andersen[3], Patrick M. Lehmann[1,2,4], Rong Xue[5,6,7], Kristoffer H. Madsen[1,8], and Lars G. Hanson[1,2]
		[1]Danish Research Centre for Magnetic Resonance Imaging, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre, Copenhagen, Denmark, [2]Center for Magnetic Resonance, DTU Elektro, Technical University of Denmark, Lyngby, Denmark, [3]Philips, Copenhagen, Denmark, [4]Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, Halle (Saale), Germany, [5]Beijing Institute for Brain Disorders, Beijing, China, [6]State Key Laboratory of Brain and Cognitive Science, Beijing MR Center for Brain Research, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [7]University of Chinese Academy of Sciences, Beijing, China, [8]DTU Compute, Technical University of Denmark, Lyngby, Denmark
		Slice-wise motion tracking during combined electroencephalography (EEG) and echo planar imaging (EPI) is developed. Using gradient-induced noise on the EEG for tracking, no interleaved navigator modules or additional hardware is needed. The motion parameters are determined after a calibration and training scan. The method is explored in a phantom and in vivo.

4083	Computer 53	Zero-Dimensional Self Navigated Autofocus for Motion Corrected Magnetic Resonance Fingerprinting
		Gastao Cruz[1], René M Botnar[1], and Claudia Prieto[1]
		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom
		Magnetic Resonance Fingerprinting (MRF) provides simultaneous multi-parametric maps from a continuous transient state acquisition of many time-point images. Motion occurring during the MRF acquisition can create artefacts in the consequent T_1/T_2 maps. Here we propose to derive an intermediate 1D motion model from the acquired MRF data itself via self-navigation of the k-space central point and further refine the motion estimates using an autofocus algorithm for MRF motion correction. The proposed approach was evaluated in simulations.

4084	Computer 54	Segmented 3D fat navigators for faster brain motion tracking at 7T

		Frédéric Gretsch[1] and Daniel Gallichan[2]
		[1]LIFMET, EPFL, Lausanne, Switzerland, [2]CUBRIC, School of Engineering, Cardiff University, United Kingdom
		Fat Navigators have previously demonstrated their utility for high-accuracy motion tracking. We investigate a segmented 3D version of the navigators which allows significant acquisition time reduction while maintaining high motion accuracy.

4085	Computer 55	Evaluating the influence of motion on FISP-MRF
		Gregor Körzdörfer[1,2], Peter Speier[1], Steffen Schröter[1], Martin Schramm[1], Josef Pfeuffer[1], Bernhard Hensel[2], and Mathias Nittka[1]
		[1]Siemens Healthcare GmbH, Erlangen, Germany, [2]Max Schaldach-Stiftungsprofessur für Biomedizinische Technik, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany
		Magnetic Resonance Fingerprinting (MRF) is an MR technique that generates parameter maps by matching pseudo randomly generated MR signals to a precalculated dictionary. MRF sequences in general consist of a long series of closely spaced excitations. An assumption underlying MRF is that a partially motion-corrupted signal is not able to significantly alter results. Corrupted signal segments are supposed to have no respective counterpart in the dictionary and therefore do not affect the pattern match. This assumption is evaluated in this study. Controlled motion was added to phantom and in vivo MRF experiments, and the results were related to realistic patient movement recorded by a 3D camera system.

4086	Computer 56	Evaluating Motion Artifact Correction of the Linearized Geometric Solution in bSSFP MRI
		Michael Nicholas Hoff[1] and Qing-San Xiang[2,3]
		[1]Radiology, University of Washington, Seattle, WA, United States, [2]Radiology, University of British Columbia, Vancouver, BC, Canada, [3]Physics, University of British Columbia, Vancouver, BC, Canada
		The linearized geometric solution (LGS) is known for demodulating balanced steady state free precession (bSSFP) MRI signal of its dependence on magnetic field inhomogeneity, but has also recently shown signs of mitigating motion artifact. Here the extent of motion artifact correction by the LGS is explored via simulations of variable motion schedules, image noise, and T1/T2 ratio. It corrects motion artifact to a greater extent than a complex image averaging solution, except in scenarios of low signal-to-noise ratio (SNR). This study motivates clinical applications of bSSFP in imaging fluid structures that normally suffer from motion and/or field inhomogeneity artifacts.

4087	Computer 57	Revealing sub-voxel motions of brain tissue using phase-based amplified MRI (aMRI) Itamar Terem[1], Wendy Ni[1], Maged Goubran[1], Greg Zaharchuk[1], Kristen Yeom[1], Michael Moseley[1], Mehmet Kurt[2], and Samantha Holdsworth[3] *[1]Radiology, Stanford University, Stanford, CA, United States, [2]Stevens Institute of Technology, Hoboken, NJ, United States, [3]Department of Anatomy and Medical Imaging, University of Auckland, Auckland, New Zealand* Problem:Amplified Magnetic Resonance Imaging (aMRI) was recently introduced as a new brain motion detection and visualization method. In this work we strive to improve aMRI by incorporating a phase-based motion amplification algorithm.Methods:Phase-based aMRI was developed, validate using digital phantom simulations and compared with EVM-based aMRI in healthy volunteers at 3T. Data were also acquired on a patient with Chiari I malformation, and displacement maps were produced using free form deformation (FFD) of the aMRI output. Results:Phantom simulations showed that phase-based aMRI has a linear dependence of amplified displacement on true displacement. Amplification was independent of temporal frequency, phantom size, Rician noise, and partial volume effect, but had a slight dependence on phantom shape. Phase-based aMRI supported larger amplification factors than EVM-based aMRI, and was less sensitive to noise and artifacts. Abnormal biomechanics were seen on FFD maps of the Chiari I malformation patient.Conclusion: Phase-based aMRI can be used for quantitative analysis of minute changes in brain motion, and may reveal subtle physiological variations of the brain due to pathology. Preliminary data shows the potential of phase-based aMRI to assess abnormal biomechanics in Chiari I malformation.

4088	Computer 58	A Comparison of Prospective versus Retrospective Motion Correction for Reliable T1-Weighted Neuroimaging Steven Kecskemeti[1], Abigail Freeman[1], and Andrew Alexander[1] *[1]University of Wisconsin - Madison, Madison, WI, United States* Prospective motion corrected MPRAGE T1-weighted images were compared against retrospectively motion corrected MPnRAGE T1-weighted images. 14 young children were scanned without sedation and without the head being stabilized with pads. Dice-overlap of automatic tissue segementation masks (FAST and FLIRT) were used as a measure of reliability. MPnRAGE with motion correction showed exceptional regional label consistency (>=80% Dice overlaps for all 16 regions and >90% in 12 of the regions). Conversely, MPRAGE-PROMO demonstrated lower performance than even MPnRAGE without motion correction.

4089	Computer 59	Combined prospective motion correction and retrospective B0 correction for EPI using optical tracking and predictive B0 maps.

		James Smith[1], Olivier Mougin[1], Kingkarn Aphiwatthanasumet[1], Matthew Clemence[2], Andrew Peters[1], Richard Bowtell[1], Paul Glover[1], and Penny Gowland[1]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]Philips Healthcare, Nottingham, United Kingdom
		We demonstrate a combination of prospective motion correction and retrospective B_0 unwarping using predictive field maps to improve the registration of EPI images. Prospective motion correction is performed using an optical tracking camera and custom scanner code. Field maps were generated using a multilinear fit of subject orientation using data gathered at known orientations. Results show a higher correlation when registering EPI data to a high-resolution anatomical, post-correction.

4090	Computer 60	Influence of tracking system latency on prospective motion correction
		Patrick Hucker[1], Bruno Riemenschneider[1], Stefan Kroboth[1], and Maxim Zaitsev[1]
		[1]Dept. of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany, Freiburg, Germany
		Tracking latency in prospective motion correction (PMC) with external tracking systems is commonly assumed to influence image quality, however no studies attempted to quantify this effect. This work presents a method to visualize latency-induced artifacts in simulated MR images. At first a MR sequence with PMC is simulated using vendor tools and recorded or synthetic motion with varying latency is added. Thereafter the effective encoding trajectory based on the exported gradient/ADC events is calculated. The resulting trajectory is used to simulate MR data with the inverse FFT, visualizing artifacts due to the tracking latency.

4091	Computer 61	A dynamic MR-signal model to capture 3D motion-fields at ultra-high frame-rate
		Niek R.F. Huttinga[1,2], Cornelis A.T. van den Berg[1,2], Peter R. Luijten[1,2], and Alessandro Sbrizzi[1,2]
		[1]Centre for image sciences, University Medical Centre Utrecht, Utrecht, Netherlands, [2]Utrecht University, Utrecht, Netherlands
		We present a framework that has the potential to capture non-rigid 3D motion at 50 Hz, hereby drastically accelerating state-of-the-art techniques. Our model directly and explicitly relates the motion-field to the k-space data and is independent of the spatial resolution, allowing for extremely high under-sampling. We illustrate proof-of-principle validations of our method through a simulation test and whole-brain 3D in-vivo measured data. Results show that the 3D motion-fields can be reconstructed from extremely under-sampled k-space data consisting of as little as 64 points, enabling 3D motion estimation at unprecedented frame-rates.

4092	Computer 62	Contact-Free Respiration Motion Monitoring Using a Markerless Structured Optical System in MRI
		Chen Zhang[1], Jin Liu[2], Jiarui Cai[2], Haikun Qi[1], Jinnan Wang[2], Chun Yuan[2], and Huijun Chen[1]
		[1]Tsinghua University, BEIJING, China, [2]University of Washington, Seattle, WA, United States
		Respiration motion artifacts remain a major problem in MRI, particularly at higher imaging resolution and field strength. In this study, we investigated the feasibility of using a MR-compatible in-bore camera system to perform contactless monitoring of respiratory information during MRI of human subjects. A good match to the respiratory data is apparent in terms of the timing of trough, and ICC between trigger intervals from the respiratory belt data and video-derived signals is 0.97, meaning that this optical system can monitor and correct in end-expiratory, in addition to simultaneously detecting random motion based on our previous work.

4093	Computer 63	Wasserstein GAN for Motion Artifact Reduction of MR images
		Sandro Braun[1], Pascal Ceccaldi[1], Xiao Chen[1], Benjamin Odry[1], Boris Mailhe[1], and Mariappan Nadar[1]
		[1]Medical Imaging Technologies, Siemens Healthineers, Princeton, NJ, United States
		Subject motion is a common artifact in MR acquisition that can severely degrade image quality. We take advantage of the recent advances in deep generative network to compensate motion and generate images of increased quality, measured by evaluating changes in MSSIM and normalized L_2 distance (NRMSE). We trained an image to image network to predict motion compensated magnitude images given motion-corrupted input images, coupled with an adversarial network to help refine those predicted images. For the discriminator loss, we use the Wasserstein objective. The results suggest clear improvements on MSSIM and NRMSE metrics for the majority of cases.

4094	Computer 64	Using Machine Learning to accelerate fat-based head motion-navigators – a preliminary simulation study
		Daniel Gallichan[1]
		[1]CUBRIC, Cardiff University, Cardiff, United Kingdom
		We hypothesise that machine learning approaches could be applied to speed up motion-correction navigators – potentially obviating the need for image reconstruction and co-registration. In this preliminary 2D simulation study we investigate the ability of a simple 5-layer convolutional neural network to predict motion-parameters based on difference images between two head poses. Our results indicate that the CNN is able to outperform linear regression over the range of parameters tested, supporting our aim to develop this concept in more detailed future work.

4095	Computer 65	Deep learning-based real time MRI Vahid Ghodrati[1,2], Jiaxin Shao[1], Ziwu Zhou[1,3], Yu Gao[1,2], Fadil Abbas Ali[1,2], Fei Han[1], and Peng Hu[1] *[1]Department of Radiological Sciences, University of California, Los Angeles, los angeles, CA, United States, [2]Biomedical Physics Interdepartmental Program, University of California, Los Angeles, los angeles, CA, United States, [3]Department of Bioengineering, University of California, Los Angeles, los angeles, CA, United States* In this work, we use the dilated U-net to reconstruct the dynamic free breathing cine images from regular under sampled raw data. Also, we consider different under sampling rate to determine maximum achievable rate. Moreover, we modify the acquisition procedure of sequence to show the possibility of prospective dynamic imaging. The proposed method is capable of reconstructing high quality real time 2D cardiac images with up to 6X acceleration with excellent image quality and minimal latency of only 6ms on a typical workstation.

4096	Computer 66	Accelerating cardiac dynamic imaging with video prediction using deep predictive coding networks Xue Feng[1] and Craig H Meyer[1] *[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States* Deep predictive coding networks based on stacked recurrent convolutional neural network have shown great success in video prediction since they can learn to recognize and analyze the motion patterns of each element from previous frames. In this study we adopted this model to predict future frames in cardiac cine images and used a k-space substitution method to improve the prediction accuracy. It showed promises in accelerating cardiac dynamic imaging.

4097	Computer 67	Machine learning algorithms for detection of motion artifacts: a general approach Alessandro Sciarra[1], Hendrik Mattern[1], and Oliver Speck[1,2,3,4] *[1]Department of Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Magdeburg, Germany, [2]German Center for Neurodegenerative Diseases, Magdeburg, Germany, [3]Center for Behavioral Brain Sciences, Magdeburg, Germany, [4]Leibniz Institute for Neurobiology, Magdeburg, Germany*

		Despite all the developments to overcome MRI motion artifacts, there are still open questions. When do we need to repeat a scan? Is the image quality sufficient for segmentation or to make a diagnosis? Is the motion correction working properly? Independent of the type of image acquired (structural, diffusion, functional, etc.), machine learning algorithms can detect automatically motion artifacts and provide feedback in real time. In this work different machine learning algorithms have been tested to detect motion artifacts in synthetic and in vivo data.

4098	Computer 68	Motion correction in MRI using deep learning
		Patricia M Johnson[1,2] and Maria Drangova[1,2]
		[1]Robarts Research Institute, London, ON, Canada, [2]Medical Biophysics, Western University, London, ON, Canada
		Subject motion in brain MRI remains an unsolved problem. We propose a machine learning approach for motion correction of brain images. Our initial objective is to train a neural network to perform a motion corrected image reconstruction on image data with simulated motion artefacts. Training pairs were generated using an open source MRI data set; a unique motion profile was applied to each 2D image. A deep neural network was developed and trained with over 3000 image pairs. The images predicted by the network, from motion-corrupted k-space, have improved image quality compared to the motion corrupted images.

4099	Computer 69	Ultra-High-Resolution Dental MR Imaging Using an Ultra-Short-TE Sequence with Prospective Motion Correction
		Xiang Gao[1], Philipp Amrein[1], Johannes Fischer[1], Davide Piccini[2,3], Patrick Hucker[1], Ute Ludwig[1], Jan-Bernd Hövener[4], and Maxim Zaitsev[1]
		[1]Department of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany, [2]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [3]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Department of Radiology and Neuroradiology, Section Biomedical Imaging, MOIN CC University Medical Center Schleswig-Holstein, University of Kiel, Kiel, Germany
		High-resolution dental MR Imaging with clear boundaries is of interest for clinical applications e.g. for tooth implant planning. Due to the fast signal decay of the dental tissues, 3D ultra-short-TE (3D-UTE) sequences are employed, which combine rapid center-out half-projection readouts with a phyllotaxis ordering on the surface of k-space sphere. Even though 3D-UTE is relatively robust against subject motion, motion artifacts still limit the achievable image quality. In this work, we implement a 3D-UTE sequence with a camera-based prospective motion correction and apply it in an *in vivo* experiment to achieve motion-free dental imaging with an isotropic resolution of 0.35mm.

4100	Computer 70	Motion robust Magnetic Resonance Fingerprinting using Echo-Planar Imaging and intensity based motion correction Mario Wenning[1], Benedikt Rieger[1], Lothar R. Schad[1], and Sebastian Weingärtner[1,2,3] *[1]Computer Assisted Clinical Medicine, University Medical Center Mannheim, Heidelberg University, Heidelberg, Germany, [2]Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN, United States, [3]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States* Quantitative magnetic resonance imaging (MRI) enables the quantification of biomarkers and the detection of tissue changes. Recently, various magnetic resonance fingerprinting (MRF) sequences were proposed to enable simultaneous quantification of T_1 and T_2/T_2^*relaxation times. In this study, we demonstrate motion sensitivity of the original MRF and MRF-EPI. Intensity-based image registration is used in six healthy subjects to eliminate motion artifacts in MRF-EPI. The effectiveness is demonstrated by a significant improvement in the Dice coefficient. As the algorithm is independent of patient and slice, it facilitates motion robust acquisition of parameters maps with MRF ready for clinical use.

4101	Computer 71	Separation And Quantification Of Head Motion Modes By Pilot Tone Measurements Peter Speier[1], Bacher Mario[1], Jan Bollenbeck[1], Matthias Fenchel[2], and Tobias Kober[3] *[1]Siemens Healthcare GmbH, Erlangen, Germany, [2]Siemens Medical Solutions, New York, NY, United States, [3]Siemens Healthcare GmbH, Lausanne, Switzerland* Pilot Tone Navigation, a new highly integrated electromagnetic navigation method, was applied to characterize head motion in a guided volunteer experiment. Nodding ("yes") and shaking ("no") motion could be separated and quantified by optimizing linear signal combinations from 20 receive channels on fluoroscopically acquired images. These initial results suggest that head motion can be continuously monitored via the regular MRI receive chain without interaction with the acquisition using a single Pilot Tone generator.

4102	Computer 72	Novel and Efficient Generation of Diffeomorphic Motion Phantom Xia Zhu[1], Dipanjan Sengupta[1], Theodore L Willke[1], Andrew Beers[2], and Jayashree Kalpathy-Cramer[2,3] *[1]Parallel Computing Lab, Intel Corporation, Hillsboro, OR, United States, [2]Department of Radiology, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States, [3]The Center for Clinical Data Science, Massachusetts General Hospital and Brigham and Women's Hospital, Boston, MA, United States*

		Dealing with motion artifacts is a fundamental preprocessing step in magnetic resonance imaging (MRI). In this work, we present three novel methods to generate MRI phantoms for diffeomorphic motion which can be used to validate motion correction algorithms. Previous research efforts for diffeomorphic motion generation, employ a brute force approach in which random pixel/voxel displacements are repeatedly generated until a topologically valid displacement is found. Such methods are not only time consuming but also doesn't guarantee a valid displacement. Our approach algorithmically ensures that the topological properties are always maintained resulting in guaranteed diffeomorphic motion with much faster runtime.

Electronic Poster

Motion & Artefact Correction

Exhibition Hall	Tuesday 13:45 - 14:45

4103	Computer 73	Sliding Motion Corrected Low-rank Plus Sparse Reconstruction for Free-breathing Liver DCE-MRI
		Wenyuan Qiu[1], Dongxiao Li[1], Fan Liu[1], Xinyu Jin[1], Thanh D. Nguyen[2], Martin R. Prince[2], Yi Wang[2,3], and Pascal Spincemaille[2]
		[1]College of Information Science and Electronic Engineering, Zhejiang University, Hangzhou, China, [2]Department of Radiology, Weill Cornell Medical College, New York, NY, United States, [3]Department of Biomedical Engineering, Cornell University, Ithaca, NY, United States
		Liver dynamic contrast enhanced MRI (DCE-MRI) requires high spatiotemporal resolution to clearly visualize enhancement patterns. Image reconstruction quality is often compromised due to unavoidable respiratory motion during the long-time acquisition. This abstract presents a novel sliding motion corrected low-rank plus sparse (SMC-LS) reconstruction algorithm for free-breathing liver DCE-MRI. The sliding motion of the liver along the superior-inferior direction is estimated directly from the under-sampled k-space data. Low-rank and sparse regularization are enforced on the sliding motion corrected image reconstructions. Results demonstrated that SMC-LS can substantially reduce motion blurring and preserve more details in free breathing liver DCE-MRI.

4104	Computer 74	Self-Calibrated Soft Gating for Respiratory Resolved 3D+Time Lung ZTE
		Anne Menini[1], Peng Lai[1], Graeme C McKinnon[2], and Florian Wiesinger[3]
		[1]Global MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [2]Global MR Applications and Workflow, GE Healthcare, Waukesha, WI, United States, [3]Global MR Applications and Workflow, GE Healthcare, Munich, Germany

		3D + Time lung ZTE reconstruction can provide combined anatomical imaging and motion extraction for RTP and PET/MR-type applications. In this work, we propose a soft-gating method for non-Cartesian imaging, via a solver preconditioner, to improve the sharpness and SNR of 4D ZTE. No a priori knowledge is used for the soft gating weights, as they are self-calibrated based on coil-image bin to bin similarities. The proposed soft gating method provides a SNR gain while maintaining resolution.

4105	Computer 75	Prospectively Respiratory-Cardiac Double-Triggered Three-Dimensional T2-Weighted Abdominal MRI
		Yuji Iwadate[1], Atsushi Nozaki[1], Yoshinobu Nunokawa[2], Shigeo Okuda[3], Mitsuharu Miyoshi[1], Masahiro Jinzaki[3], and Hiroyuki Kabasawa[1]
		[1]Global MR Applications and Workflow, GE Healthcare Japan, Hino, Japan, [2]Office of Radiation Technology, Keio University Hospital, Tokyo, Japan, [3]Department of Radiology, Keio University School of Medicine, Tokyo, Japan
		We developed a prospective respiratory-cardiac double-triggering technique with navigator echo and incorporated it into 3D T_2-weighted variable refocusing flip-angle fast spin echo (Cube) for abdominal MRI. The respiratory and cardiac navigator signals synchronized well with the signals from the external devices, and resultant double-triggered Cube images had higher sharpness scores of the left liver lobe than the respiratory-triggered Cube images. The double-triggering technique is feasible and can be applied to other applications where both respiratory and cardiac motions are problematic.

4106	Computer 76	Improved non-rigid motion suppression for free-breathing PROPELLER with adaptively weighted blade combination
		Hai Luo[1], Gaojie Zhu[1], Xiang Zhou[1], Meining Chen[1], Chao Wang[1], Xia Liu[1], Wei Bian[1], and Ziyue Wu[1,2]
		[1]AllTech Medical Systems, Chengdu, China, [2]Alltech Medical System America, Solon, OH, United States
		PROPELLER has been applied to suppress respiratory motion for free-breathing abdomen imaging but the results are often unsatisfactory with existing weighting mechanisms. In this study, a novel adaptive weighting method is proposed to maximize the respiratory motion suppression without using a fallible reference blade. First, mutual information is used to measure the motion correlation across different blades. Second, principal components analysis is applied to adaptively reject/keep the acquired data by assigning proper weights to all blades. Our experiments show that the proposed method can provide abdominal images with less blurring and less partial volume artifacts compare to the conventional PROPELLER.

4107	Computer 77	Joint Non-rigid Motion and Image MRI SENSE Reconstruction

		Javier Royuela-del-Val[1], Alejandro Godino-Moya[1], Rosa María Menchón-Lara[1], Santiago Sanz-Estébanez[1], Federico Simmross-Wattenberg[1], Marcos Martín-Fernández[1], and Carlos Alberola-López[1]
		[1]Image Processing Lab, University of Valladolid, Valladolid, Spain
		In this work a method of the reconstruction of magnetic resonance images in the presence of non-rigid motion is presented. A non-rigid deformation model is introduced in the reconstruction problem in order to obtain 1) a motion-free image and 2) a set of non-rigid transformations that describe the motion of the structures being imaged. The method is able to reconstruct the motion information without reconstructing the images in additional motion states avoiding extra computational costs and resulting in a better posed reconstruction problem. Preliminary results for 2D cardiac cine MRI are shown.

4108	Computer 78	Tracking Respiratory Motion Throughout Arbitrary MRI Sequences via Pilot Tone Navigation
		David Rigie[1], Thomas Vahle[2], Ryan Brown[1], Tiejun Zhao[1], Matthias Fenchel[3], Peter Speier[2], Kimberly Jackson[1], and Fernando Boada[1]
		[1]Radiology, NYU School of Medicine, New York, NY, United States, [2]Siemens Healthcare GmbH, Erlangen, Germany, [3]Siemens Medical Solutions, New York, NY, United States
		In this work, we demonstrate a flexible approach to track respiratory motion throughout arbitrary MRI sequences without requiring any additional patient setup time or sequence modification. A reference RF signal, which has previously been referred to as the “pilot tone” (PT), is tracked throughout MR imaging, and its amplitude modulation provides information about respiratory motion. Specifically, we demonstrate continuous tracking of respiratory motion throughout multi-echo and multi-shot sequences on a human volunteer via PT navigation.

4109	Computer 79	Comparison of three surrogate-based respiratory motion correction methods for 3D high resolution cardiac MRI
		Juliane Ludwig[1], Peter Speier[2], Frank Seifert[1], Tobias Schaeffter[1,3], and Christoph Kolbitsch[1,3]
		[1]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, [2]Siemens Healthcare, Erlangen, Germany, [3]King's College London, Division of Imaging Sciences and Biomedical Engineering, London, United Kingdom

		Respiratory motion correction has been proposed to improve scan efficiency and ensure high image quality for 3D cardiac MRI. Nevertheless, these techniques often require dedicated data acquisition and cannot necessarily capture intra-cycle variations of the breathing. Here we compare three different surrogate signals (“pilot tone”, respiratory belt and MR-navigator) for a surrogate-based motion correction approach which provides motion information with high temporal resolution and can be combined with a wide range of different MR acquisition schemes. The temporal stability of these surrogates is assessed and motion correction of a 3D cardiac MR scan is demonstrated.

4110	Computer 80	Motion-correction algorithm for free-breathing, fast-heart rate small animal studies on clinical scanners
		Matthew Tarasek[1], Jeannette Roberts[2], Deirdre Cassidy [3], Thomas Foo[1], Desmond Yeo[1], Randall Carter[2], and Brian Bales[2]
		[1]MRI, GE Global Research, Niskayuna, NY, United States, [2]Life Sciences, GE Global Research, Niskayuna, NY, United States, [3]Life Sciences, GE Healthcare UK, United Kingdom, United Kingdom
		Small animal scanning methods are common for preclinical efficacy evaluation of contrast agents, and naïve animal studies done on clinical scanners are becoming more prevalent. Unfortunately, scanning small animals on large-bore clinical scanners creates several challenges such as motion effects due to organ movement and very fast heart-rates. Here we provide a retrospective motion-correction algorithm for fast-heart-rate/free-breathing small animals based on diaphragm tracking. Results show a ten-fold reduction in baseline contrast region signal uncertainty and significant accuracy improvement of pharmacokinetic time-constant estimation.

4111	Computer 81	Atlas-based breathing motion correction for dynamic lung XeMRI
		ADAM SZMUL[1], Bartlomiej Papiez[1], Ozkan Doganay[2], Fergus Gleeson[2,3], Daniel Bulte[1], Julia A. Schnabel[4], and Vicente Grau[1]
		[1]Department of Engineering Science, University of Oxford, Oxford, United Kingdom, [2]Department of Oncology, University of Oxford, Oxford, United Kingdom, [3]Department of Radiology, University of Oxford, Oxford, United Kingdom, [4]Department of Biomedical Engineering, King's College London, London, United Kingdom
		In this work we propose a framework to compensate for the breathing motion for dynamic lung XeMRI (DXeV), aligning images from different breathing phases and therefore increasing the accuracy of the ventilation analysis process. We build a lung atlas, to delineate a plausible shape of the lungs in the ventilation images, which is further used to co-register all ventilation volumes in the sequence to the reference lung atlas. After applying the proposed breathing motion correction method, the tidal breathing motion has been largely compensated and all masks of ventilation volumes correspond to each other spatially.

4112	Computer 82	Implementation of a control system for prospective respiratory motion correction during Cardiovascular MR imaging Stephen G Jermy[1,2], Ali Alhamud[1,2], Ian H Burger[1], Ntobeko A B Ntusi[3], and Ernesta M Meintjes[1,2] *[1]Division of Biomedical Engineering, Department of Human Biology, University of Cape Town, Cape Town, South Africa, [2]Cape Universities Body Imaging Centre (CUBIC), University of Cape Town, Cape Town, South Africa, [3]Department of Medicine, University of Cape Town, Cape Town, South Africa* Navigated free-breathing techniques are commonly used during cardiovascular MR (CMR) acquisitions when breath-holding techniques are not a viable option. Navigated free-breathing techniques with acceptance windows suffer from much longer scan times. A control system using an adaptive Kalman filter was developed to continuously update the slice position throughout the imaging segment during free-breathing CMR, allowing the acquisition to continue throughout the respiratory cycle, regardless of diaphragm position, thereby improving respiratory efficiency and reducing scan times.

4113	Computer 83	Motion Correction based on Z-spectral Consistency for APTw/CESTw MRI Applications in Body Oncology Jochen Keupp[1] and Elwin de Weerdt[2] *[1]Philips Research, Hamburg, Germany, [2]Philips MRI, Best, Netherlands* CESTw imaging in body areas with significant physiological motion is strongly hampered because of the inherent motion sensitivity of this MRI technique. In particular, slow physiological motion in the abdomen, e.g. peristaltic motion or bladder filling may lead to Z-spectral inconsistency and artifacts in CESTw images. Here, a method is introduced which analyzes Z-spectral consistency to mask CESTw image areas affected by motion. The technique is successfully demonstrated on a volunteer example in liver CESTw MRI, indicating a future application in body oncology.

4114	Computer 84	Automatic Motion Artifact Detection as Scan-aided Tool in an Autonomous MRI Environment Wenwen Jiang[1], Okai Addy[1], William Overall[1], Bob Hu[1], and Juan Santos[1] *[1]HeartVista, Inc, Los Altos, CA, United States*

		Motion artifacts in MRI can be confused with pathology, and render the scans not diagnosable. Ideally during examination, scan operators should identify these artifacts immediately, and reacquire the scan. But it can be challenging to do so in a clinical time-constraint workflow. Motion artifacts are especially difficult to identify accurately, as they come in a wide variety. Here, we propose an autonomous scan control framework, based on deep learning, to detect motion artifacts immediately after reconstruction. The deep learning model was integrated into a real-time imaging system, and enabled an interactive scanning pipeline.

4115	Computer 85	MR-assisted PET reconstruction in the presence of respiratory motion: A phantom study
		Cihat Eldeniz[1], H. Michael Gach[1], Richard Laforest[1], and Hongyu An[1]
		[1]Washington University in St. Louis, St. Louis, MO, United States
		Simultaneous PET/MR provides an unprecedented opportunity for motion correction. We aimed at developing an integrated MR-assisted PET motion correction method which would allow accurate PET quantification in the presence of respiratory motion. In this study, we evaluated the impact of motion correction on lesions of various sizes by using a deformable motion phantom. A static scan was used as the ground truth for PET activity. The combined MR and PET motion correction recovered the activity from 55% to >97% of the static scan activity.

4116	Computer 86	MR/PET motion correction using deep learning
		Yasheng Chen[1], Cihat Eldeniz[1], Richard Laforest[1], and Hongyu An[1]
		[1]Washington Univ. School of Medicine, St. Louis, MO, United States
		In abdominal imaging, the simultaneous acquisition of MR and PET provides a unique opportunity to take advantage of MR (which has high spatial and temporal resolution) to resolve the respiratory motion artefacts in PET. But this motion correction scheme requires MR motion scans during the whole PET session. To improve the imaging efficiency, we use simultaneously acquired MR/PET signal to train a PET re-binning motion correction classifier, which can be deployed to correct the motion in the PET scans without concurrently acquired MR motion detection. We have demonstrated the feasibility of this online motion correction scheme with a phantom study.

4117	Computer 87	CS+M: A Simultaneous Reconstruction and Motion Estimation Approach for Improving Undersampled MRI Reconstruction.
		Angelica I. Aviles-Rivero[1], Guy B. Williams[2], Martin J. Graves[3], and Carola-Bibiane Schönlieb[4]

		[1]Department of Pure Mathematics and Mathematical Statistics (DPMMS), University of Cambridge, Cambridge, United Kingdom, [2]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [3]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [4]Department of Applied Mathematics and Theoretical Physics (DAMTP), University of Cambridge, Cambridge, United Kingdom
		Current research in MRI is based on using CS implications to reconstruct high-quality images from a subset of $$$k$$$-space data acquired in an incoherent manner. In this work, we introduce a mathematical framework for improving undersampled MRI data reconstruction, which we call CS+M, where M stands for motion. The significance here, and unlike existing solutions is that by modeling *explicitly and simultaneously* the inherent complex motion patterns, given by physiological or involuntary motion, in a CS setting, synergies in a complex variational problem are created. These synergies have *clinical potentials* in terms of improving image quality while reducing motion artifacts.

4118	Computer 88	An alternating algorithm for dynamic cardiac MRI reconstruction and motion estimation
		Ningning Zhao[1], Daniel O'Connor[1], Dan Ruan[1], and Ke Sheng[1]
		[1]University of California, Los Angeles, Los Angeles, CA, United States
		This work deals with the problem of dynamic MRI reconstruction and motion estimation jointly. Specifically, a multi-scale affine optical flow model is incorporated into the compressed sensing framework. Simulation results demonstrate the efficiency of the proposed algorithm in image reconstruction and motion estimation against the standard CS based method for MRI reconstruction.

4119	Computer 89	3D Motion Estimation and Correction of Motion in Sequential Slices of Kidney Diffusion-Weighted MRI
		Sila Kurugol[1], Bahram Marami[1], Onur Afacan[1], Simon K. Warfield[1], and Ali Gholipour[1]
		[1]Boston Children's Hospital and Harvard Medical School, Boston, MA, United States
		In this paper we introduced a motion-compensated model estimation technique for renal DW-MRI. The technique has two main components: 1) we adapted an approach based on robust state estimation, which was recently utilized to solve slice-based motion estimation, to track physiological motion (including respiratory motion); 2) we used weighted least squares to estimate diffusion tensor model and calculate diffusion parameters from motion-compensated data. Overall, our method achieved the highest FA values in the medulla, compared to no motion correction and volume to volume registration which resulted in reduced FA values, artifacts, and blurrier FA, MD and AD maps.

4120	Computer 90	Correction of Slice-Specific Nyquist Ghost Artifact for Simultaneous Multi-Slice EPI

		Uten Yarach[1] and Oliver Speck[2]
		[1]Department of Radiologic Technology, Chiang Mai University, Chiang Mai, Thailand, [2]Department of Biomedical Magnetic Resonance, Otto von Guericke University Magdeburg, Magdeburg, Germany
		The slice-specific ghosting artifact has been challenging for SMS-EPI. A standard 1D-based phase correction usually leads to increased residual ghosting artifacts in case of subject motion or eddy current variations at different time points. In this study, we propose a dynamic 2D slice-specific phase correction to address the slice-specific phase error. This correction scheme does not require additional time for acquiring 2D phase difference scans. It is a combination between slice-GRAPPA and model-based framework. The result shows that the ghost-to-signal ratios for MB3Ry2 in human brain obtained by the proposed and vendor-provided reconstruction were 1.37% and 2.66%, respectively.

4121	Computer 91	Nyquist Artifact Correction for Multi-band and Multi-shot EPI Using Multiplexed Sensitivity Encoding (MUSE) - A Self-reference 2D Phase Correction Method
		Xiaoxi Liu[1], Di Cui[1], Edward S. Hui[1,2], Queenie Chan[3], Nan-Kuei Chen[4,5], and Hing-Chiu Chang[1]
		[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]The State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, Hong Kong, Hong Kong, [3]Philips Healthcare, Hong Kong, Hong Kong, [4]Department of Biomedical Engineering, University of Arizona, Tucson, AZ, United States, [5]Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, United States
		Echo planar imaging (EPI) suffers from Nyquist artifact that is typically corrected by using 1D phase correction with reference scan. In oblique-plane acquisition, 2D phase corrected is warranted to effectively reduce Nyquist artifact. However, Nyquist artifact correction is challenging in the case of multi-band EPI due to the presence of slice-dependent phase error. In this study, we aim to develop a self-reference 2D phase correction method to eliminate the Nyquist artifact in multi-band multi-shot EPI data, which utilizes the recently developed multiplexed sensitivity encoding (MUSE) reconstruction algorithm.

4122	Computer 92	Removal of Pseudo-lesion Artifact in Diffusion-Weighted Echo-Planar Imaging Using Virtual Coil Acquisition and Multiplexed Sensitivity Encoding (MUSE)
		Xiaoxi Liu[1], Edward S. Hui[1,2], and Hing-Chiu Chang[1]
		[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]The State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, Hong Kong, Hong Kong

		In routine brain DW-EPI with SENSE, the pseudo-lesion artifact due to residual aliasing of eyeball has been previously reported. We have found that the incidence of pseudo-lesion artifact was over 50% when performing double-oblique imaging on stroke patients. The possible cause is highly likely related to inference between residual Nyquist ghost and unfolding process in SENSE reconstruction. In this study, we propose a self-reference method to effectively remove pseudo-lesion artifact in double-oblique DW-EPI using virtual coil acquisition and multiplexed sensitivity encoding (MUSE). Our proposed method reveals higher image quality, better SNR performance, and lower artifact level than conventional SENSE reconstruction.

4123	Computer 93	Characterization and suppression of stripe artifact in velocity-selective magnetization-prepared unenhanced MR angiography
		Taehoon Shin[1,2] and Qin Qin[3]
		[1]Ewha Womans University, Seoul, Republic of Korea, [2]Case Western Reserve University, Cleveland, OH, United States, [3]Johns Hopkins University, Baltimore, MD, United States
		While velocity-selective magnetization-prepared MR angiography (VS-MRA) has shown great promise for diverse arterial territories, artifactual stripes often occur in resultant angiograms. We investigate the formation of the stripe artifact using extended phase graph analysis and show that the stripes contain not only the fundamental frequency determined by the area of VS unipolar gradient but higher-order components with multiples of the fundamental frequency. Based on this finding, we propose and test efficient strategies for suppression of the artifact in a phantom and healthy human subjects.

4124	Computer 94	Metal artifact reduction in MRI-based radiation therapy
		H Michael Gach[1], Stacie L Mackey[2], Mo Kadbi[3], Jacqueline E Zoberi[1], Jose Garcia-Ramirez[1], Yuan (James) Rao[1], S Murty Goddu[1], Perry W Grigsby[1], Hiram A Gay[1], Christina I Tsien[1], Jiayi Huang[1], and Jeff M Michalski[1]
		[1]Radiation Oncology, Washington University in St Louis, St Louis, MO, United States, [2]Radiation Oncology, Barnes-Jewish Hospital, St Louis, MO, United States, [3]MRI, Philips Healthcare, Cleveland, OH, United States
		A large percentage of patients receiving MRI simulations for radiotherapy treatment planning have metal in their bodies. Often the metal is in or near the target or organs at risk. Metal creates susceptibility artifacts that can saturate the tissue signal and distort the tissue geometry. In this case report, examples of the benefits of metal artifact reduction using slice encoding for metal artifact correction (SEMAC) are presented for patients scanned at 1.5 T. Critical regions that were obscured by artifact were restored using SEMAC, thus allowing MRI-based treatment planning.

4125	Computer 95	Robust Virtual Coil SAKE with Automatic Rank Thresholding for Removal of EPI Ghost Artifacts
		Zhenda Xu[1,2], Mengye Lyu[1,2], Yilong Liu[1,2], Markus Barth[3], and Ed X. Wu[1,2]
		[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China, [3]Centre for Advanced Imaging, The University of Queensland, Brisbane, Australia
		Ghost artifacts in EPI can arise from phase error between positive- and negative-echo and inter-shot phase error. Virtual coil SAKE (VC-SAKE) can be used to eliminate these phase errors simultaneously, but its performance relies on selection of parameters. In particular, proper rank thresholding is extremely important. In this study, we proposed to automatically determine the optimal rank threshold by minimizing the image entropy, and evaluated its performance with various datasets from different scanner systems.

4126	Computer 96	Clinical Evaluation of Pile-up and Ripple Artifact Suppression Near Metal by Alternating Gradients
		Xinwei Shi[1,2], Kathryn Stevens[2], and Brian Hargreaves[1,2]
		[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States
		Multi-Spectral Imaging techniques have been shown to significantly reduce metal-induced artifacts. However, they often suffer from pile-up/ripple artifacts near metal, where metal-induced-off-resonance gradients “cancel” the frequency-encoding gradient. We have previously proposed a method to reduce these artifacts by combining two acquisitions with alternating-sign readout and slice-select gradients. Here we demonstrate that the alternating-gradient method is compatible with robust PCA, which provides 2-fold acceleration beyond parallel imaging and half-Fourier acquisition to compensate for the additional acquisition. Our study shows that the alternating-gradient method can significantly reduce pile-up/ripple artifacts in volunteers with hip and knee arthroplasties, and provides additional diagnostic advantages compared to the standard sequence.

Electronic Poster

Encoding & Beyond

Exhibition Hall	Tuesday 13:45 - 14:45

4127	Computer 97	fMRI at 7 Tesla with 0.5mm Isotropic Resolution and Full Field of View
		Patrick Liebig[1,2,3], Robin Martin Heidemann[2], Bernhard Hensel[1], Yuehui Tao[4], Wei Liu[5], and David Porter[3]

		[1]*Center of medical physics and engineering, University of Erlangen-Nuremberg, Erlangen, Germany,* [2]*Siemens Healthcare GmbH, Erlangen, Germany,* [3]*University of Glasgow, Glasgow, United Kingdom,* [4]*Siemens Healthcare United Kingdom, Glasgow, United Kingdom,* [5]*Siemens Shenzen Magnetic Resonance Ltd., Shenzen, China*
		fMRI protocols at ultra-high field typically use pixel sizes below 1mm. With single-shot EPI, this results in a prolonged readout train relative to the T2* decay time, resulting in image blurring and a limit to the true resolution that can be achieved. This effect can be mitigated by using multi-shot EPI to reduce the echo-train length, but this is associated with a reduction in temporal SNR. Previous work demonstrated a less severe reduction in temporal stability with readout-segmented EPI than with interleaved EPI. This study investigates the application of readout-segmented EPI to ultra-high resolution fMRI of the motor cortex.

4128	Computer 98	A CAIPIRINHA-based approach to the referenceless reconstruction of high-definition SPEN images with simultaneous multislice
		Gilad Liberman[1], Samuel F Cousin[1], Eddy Solomon[1], and Lucio Frydman[1]
		[1]*Chemical Physics, Weizmann Institute of Science, Rehovot, Israel*
		Spatiotemporal Encoding (SPEN) is an ultrafast imaging technique where the low-bandwidth axis is rasterized in a joint spatial/k-domain. SPEN benefits from increased robustness to inhomogeneities, folding-free reconstruction of subsampled data, and an ability to combine multiple interleaved or signal averaging scans in a referenceless fashion. SPEN's relatively high SAR, however, complicates its volumetric uses. Here we show how this can be solved by merging a controlled aliasing for parallel imaging (CAIPIRINHA) protocol involving phase-cycling of multi-banded excitation pulses in independent scans, so as to enable a referenceless reconstruction of interleaved multislice acquisitions delivering high in-plane definition and excellent inter-slice decoupling.

4129	Computer 99	Constrained Lossy Compression for MR Raw Data Transmission
		Matthew Restivo[1], Adrienne Campbell-Washburn[1], Peter Kellman[1], Hui Xue[1], Rajiv Ramasawmy[1], and Michael Hansen[1]
		[1]*National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD, United States*

		Computationally intensive image reconstruction algorithms can be made accessible to the diagnostic workflow by streaming data to remote workstations in real-time. Due to bandwidth constraints, data compression is an important tool to ensure that network transmission is not a bottleneck. However, since image quality losses are unacceptable for clinical MRI, it is important to constrain any compression losses below the thermal noise. Here we propose a framework for online data compression based on constraining SNR loss using a custom-built compression library. Greater than 5-fold data reduction was achieved by accepting a negligible SNR loss.

4130	Computer 100	Anisotropic Field-of-Views in 3D Golden Angle Radial Imaging
		Guruprasad Krishnamoorthy[1,2], Jouke Smink[1], Marc Kouwenhoven[1], and Marcel Breeuwer[1,2]
		[1]MR Clinical Science, Philips Healthcare, Best, Netherlands, [2]Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands
		3D Golden angle Radial sequence (3D-GA_{rad}) permits reconstruction with varying temporal / spatial resolution from the same dataset. It is less sensitive to motion, flow artifacts and supports ultra-short echo times. It supports self-gated retrospective motion correction techniques. One of the limitations of the current implementations of 3D-GA_{rad} is, it only supports isotropic field-of-view (FOV), which leads to redundant sampling and increased scan time when the imaging volume has anisotropic dimensions. In this work, we have developed a method based on the work by Larson et al., to support anisotropic FOV with different FOV-shapes for 3D-GA_{rad}.

4131	Computer 101	A quadrature filter approach to diffusion weighted imaging with application in pore size estimation
		Hans Knutsson[1], Filip Szczepankiewicz[2], Cem Yolcu[1], Magnus Herberthson[3], Evren Özarslan[1], Markus Nilsson[4], and Carl-Fredrik Westin[1,5]
		[1]Department of Biomedical Engineering, Linköping University, Linköping, Sweden, [2]Random Walk Imaging AB, Lund, Sweden, [3]Department of Mathematics, Linköping University, Linköping, Sweden, [4]Diagnostic Radiology, Department of Clinical Sciences, Lund University, Lund, Sweden, [5]Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States
		We present a novel approach to gradient waveform design for diffusion weighted MRI. The approach is founded on the temporal frequency domain formulation of the signal attenuation. The objective is to obtain a set of circularly polarized oscillating gradient waveforms that are optimal in terms of b-value, frequency selectivity and in-plane rotational invariance. A new pore size estimation algorithm is presented. We show phantom and in vivo results based on MRI scans using an opimized waveform set.

4132	Computer 102	In vivo O-space Turbo Spin Echo Imaging with New Reconstruction Algorithm Nadine Luedicke Dispenza[1], Hemant Tagare[1,2], R. Todd Constable[2,3], and Galiana Gigi[2] *[1]Department of Biomedical Engineering, Yale University, New Haven, CT, United States, [2]Department of Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [3]Department of Neurosurgery, Yale University, New Haven, CT, United States* We report the first in-vivo T2 weighted O-space TSE images, and demonstrate that a single TSE dataset can generate T2w images for any of the echo times while still tolerating further undersampling from parallel imaging. In addition to reconstructions based on a refinement of a previously introduced filtering algorithm, we introduce a more general and rigorous reconstruction approach that exploits the geometric relationship between images in the T2w series. The proposed reconstruction algorithm reduces T2 blur and improves contrast agreement to Cartesian TSE images.

4133	Computer 103	Enhancing Spatial-Temporal Resolution in Simultaneous Multi-Slab Echo Volumar Imaging Kishore Vakamudi[1], Steen Moeller[2], Sudhir Ramanna[2], Akio Yoshimoto[3], Essa Yacoub[2], Ricardo Otazo[3], Alam Abbas Syed[4], and Stefan Posse[1] *[1]Neurology, Physics and Astronomy, University of New Mexico, Albuquerque, NM, United States, [2]Center for Magnetic Resonance Research, Radiology, University of Minnesota, Minneapolis, MN, United States, [3]Center for Advanced Imaging, Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States, [4]Neurology, University of New Mexico, Albuquerque, NM, United States* We develop multi-band echo-volumar-imaging (MB-EVI) by combining multi-slab encoding with EVI to investigate BOLD sensitivity, resting-state connectivity in different frequency bands, and spatial-temporal resolution limits. We also study the effect of compressed sensing (CS) reconstruction on fMRI sensitivity. Mapping of major resting-state networks with 3mm^3 voxel size was feasible in multiple frequency bands. High spatial resolution (2mm^3) improved delineation of neuroanatomy and enabled sensitive mapping task-based activation. CS with 2.4-fold undersampling showed negligible loss in image quality and moderate region-specific losses in BOLD sensitivity. MB-EVI provides flexibility for maximizing spatial-temporal resolution, volume-coverage and BOLD-sensitivity for mapping task-activation and functional connectivity.

4134	Computer 104	Respiration resolved imaging using continuous steady state multiband excitation with linear frequency sweeps Laurence H Jackson[1], Anthony N Price[1], Jana Hutter[1], Lucilio Cordero-Grande[1], Alison Ho[1], Paddy J Slator[2], Ana Dos Santo Gomes[1], Joshua F.P. van Amerom[1], Maria Murgasova[1], Laura McCabe[1], Mary A Rutherford[1], and Joseph V Hajnal[1]

		[1]Centre for the Developing Brain, School of Imaging Sciences and Biomedical Engineering, Kings College London, London, United Kingdom, [2]Centre for Medical Image Computing, University College London, London, United Kingdom
		Free-breathing abdominal MRI is challenging due to the unpredictable and complex 3D deformation caused by respiration. We present a novel acquisition where short TR single-band or multiband slice acquisitions are swept smoothly across the anatomy of interest while preserving steady state conditions. This is achieved by adding a frequency offset to successive RF pulses shifting the excited slice by fraction of slice thickness for each acquired k-space. This creates a highly efficient acquisition with high redundancy in respiration. A method is presented to produce 4D respiration-resolved volumes from this data and examples of human placenta and kidney are presented.

4135	Computer 105	SWI+: A robust artifact-free SWI procedure with improved contrast
		Yongquan Ye[1], Jinguang Zong[2], Jingyuan Lyu[1], and Weiguo Zhang[1]
		[1]United Imaging of Health America, Inc., Houston, TX, United States, [2]Shanghai United Imaging of Healthcare, Shanghai, China
		A robust image reconstruction and processing strategy to achieve minimal susceptibility artifact for SWI is developed and demonstrated. With a multi-echo GRE data acquisition and a newly developed robust rapid phase unwrapping algorithm, an enhanced version of SWI imaging procedure, namely SWI+, is developed to address the pitfalls in classic SWI, which collects only one echo and simply employs high pass filtering on phase images.

4136	Computer 106	Reducing eddy currents in radial cardiovascular MRI using tiny 3D golden-angle
		Alexander Fyrdahl[1], Karen Holst[1], Martin Ugander[1], and Andreas Sigfridsson[1]
		[1]Department of Clinical Physiology, Karolinska Institutet and Karolinska University Hospital, Stockholm, Sweden
		Three-dimensional double golden-angle radial imaging has shown great potential in free-breathing whole-heart cardiac cine imaging using data binning, and respiratory resolved cardiac imaging. However, the original golden-angle trajectory involves large jumps in k-space, which leads to eddy current artifacts in bSSFP imaging. For successful binned cardiac imaging, two conditions must be fulfilled; first, the trajectory should provide high k-space uniformity, and second, the trajectory should avoid eddy current induced degradation of image uniformity. The purpose of this work was to develop a double golden-angle radial trajectory that fulfills both of these conditions.

4137	Computer 107	Model-based Reconstruction with Automatic Scaling for Real-Time Phase-Contrast Flow MRI with Complementary Sets of Radial Spokes
		Zhengguo Tan[1], Jost M Kollmeier[1], Arun A Joseph[1,2], Oleksandr Kalentev[1], Dirk Voit[1], Klaus-Dietmar Merboldt[1], Thorsten Hohage[3], and Jens Frahm[1,2]
		[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institute for Biophysical Chemistry, Goettingen, Germany, [2]German Center for Cardiovascular Research, partner site Goettingen, Goettingen, Germany, [3]Institut für Numerische und Angewandte Mathematik, Goettingen, Germany
		Real-time phase-contrast flow MRI is extended from sequential acquisitions of flow-compensated and flow-encoded data with the same set of radial spokes to interleaved acquisitions with different radial spokes oriented by a small Golden angle, thereby improving spatial accuracy and reducing streaking artifacts. To apply model-based reconstructions for this sampling scheme, an automatic scaling of unknowns is proposed, which is capable of balancing partial derivatives and regularizations during the iterative nonlinear inversion.

4138	Computer 108	Hybrid O-Space and FRONSAC Imaging
		Haifeng Wang[1], Yuchou Chang[2], and Dong Liang[1]
		[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Computer Science and Technology Engineering, University of Houston-Downtown, Houston, TX, United States
		Nonlinear spatial encoding magnetic (SEM) fields can accelerate data acquisitions and improve the imaging quality. In this work, the O-Space and FRONSAC imaging are combined into a hybrid nonlinear spatial encoding approach with dynamic nonlinear gradients. The preliminary experiment of phase mapping shows that the proposed method can be implemented in the current O-Space system. Simulations based on the preliminary experiment demonstrate that this approach can accelerate data acquisitions and reduce artefacts caused by highly undersampling acquisitions.

4139	Computer 109	MR Image Reconstruction via Denoising (MR-RED)
		Adam Rich[1] and Rizwan Ahmad[1]
		[1]Department of Biomedical Engineering, The Ohio State University, Columbus, OH, United States

		In this work, the feasibility of employing denoising to recover MR images from undersampled data is demonstrated. By embedding denoisers into the Laplacian-based regularization functional and solving the resulting optimization problem, state-of-the-art results are achieved. Performance of several denoisers and compressed sensing methods is compared in four cardiac MRI datasets. We show that denoising-based reconstruction can outperform soft-thresholding-based algorithms in terms of normalized MSE.

4140	Computer 110	Optimizing Cartesian compressed sensing for ultra-high resolution Time of Flight angiography
		Hendrik Mattern[1] and Oliver Speck[1,2,3,4]
		[1]Biomedical Magnetic Resonance, Otto-von-Guericke-University Magdeburg, Magdeburg, Germany, [2]German Center for Neurodegenerative Disease, Magdeburg, Germany, [3]Center for Behavioral Brain Sciences, Magdeburg, Germany, [4]Leibniz Institute for Neurobiology, Magdeburg, Germany
		Ultra-high resolution Time of Flight (ToF) angiography requires long scan times. Compressed sensing (CS) can reduce the scan time but requires pseudo-random sampling and may blur image details. We present a framework to create Cartesian pseudo-random sampling patterns from any given probability density function and to evaluate quantitatively vessel depiction with CS reconstruction. Results from 0.30 mm and 0.15 mm isotropic ToF data show that moderate acceleration with CS can reduce the scan time considerably while providing vessel depiction similar to the non-accelerated reference.

4141	Computer 111	Improved Parallel Echo-Planar Imaging (EPI) with Ghost Removal and Distortion Correction
		Yuan Zheng[1], Yu Ding[1], Xiaodong Ma[2], and Weiguo Zhang[1]
		[1]UIH America, Inc., Houston, TX, United States, [2]United Imaging Healthcare, Shanghai, China
		We have developed a procedure for reconstructing high-quality EPI images with parallel imaging, and presented both in-vitro and in-vivo results. Interleaved EPI and the PLACE technique are used to generate coil sensitivity maps (CSM) and a distortion map. These maps do not suffer from ghosting and match the distortion of the imaging data. The CSM are used in the PEC-SENSE reconstruction to generate images with significantly reduced ghosting artifacts. Geometric distortions are subsequently corrected using the distortion map. This technique can be used to improve the image quality of many EPI applications, such as diffusion imaging, when parallel imaging is involved.

4142	Computer 112	Efficient $$$k$$$-space coverage using a 3D accelerated low-discrepancy trajectory
		Tobias Speidel[1] and Volker Rasche[2]

		[1]AG Experimental Cardiovascular Imaging (ExCaVI), University of Ulm, Ulm, Germany, [2]University Hospital of Ulm, Ulm, Germany
		Acquiring three-dimensional (3D) images in MRI is a time consuming process. The overall duration of acquiring a Nyquist sampled 3D dataset can be significantly shortened by enhancing the efficiency of $$$k$$$-space sampling. This can be achieved by accelerating each $$$k$$$-space read-out and by additionally increasing the coverage of $$$k$$$-space for every trajectory interleave. In this work, we present a 3D $$$k$$$-space trajectory that is highly accelerated in terms of $$$k$$$-space velocity that leads to a low-discrepant coverage of suchlike using a considerably reduced number of read-outs.

4143	Computer 113	3D Golden Angle Stack-of-Stars with Anisotropic Field-of-View
		Joao Tourais[1,2], Guruprasad Krishnamoorthy[1,2], Marc Kouwenhoven[1], Jouke Smink[1], and Marcel Breeuwer[1,2]
		[1]Division MR Clinical Science, Philips Healthcare, Best, Netherlands, [2]Dept. of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands
		Radial sampling techniques are often used in dynamic MRI because they are robust to flow and motion, support short echo times, and have a diffuse aliasing pattern. However, standard implementations of radial imaging do not support in-plane anisotropic FOV, which leads to sampling redundancy when the object being imaged has anisotropic in-plane dimensions (e.g. abdomen, chest, spine, leg, etc.). In this work we demonstrate the feasibility of 3D golden angle stack-of-stars acquisition with an in-plane anisotropic FOV in abdominal acquisitions.

4144	Computer 114	Asymmetric-echo-based Ultrashort Echo-time (ASE-UTE) Imaging
		Jinil Park[1], Jeongtaek Lee[1], and Jang-Yeon Park[1,2]
		[1]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Republic of Korea, [2]Center for Neuroscience Imaging Research, Institute for Basic Science, Suwon, Republic of Korea
		The first 3D-UTE sequence used FID acquisition techniques using ramp sampling to minimize TE, but defining the center of k-space precisely was a difficult problem (true-k_0). In case of echo acquisition containing echo peaks, it is better to define true-k0 than FID acquisition although true-k_0 problem still exists because echo peaks often do not agree with true-k_0 due to the echo shifts caused by system imperfections such as gradient delays and eddy currents. Here, we propose an asymmetric-echo-based 3D-UTE (ASE-UTE) sequence where echo peaks are acquired on the ramp.

4145	Computer 115	Simultaneous Multi-slice Ultra-short Echo Time Imaging Using POMP Half Pulses and CAIPI
		Christoph Alexander Rettenmeier[1] and V. Andrew Stenger[2]
		[1]JABSOM, University of Hawai'i, Honolulu, HI, United States, [2]University of Hawai'i, Honolulu, HI, United States
		Phase offset multi-planar (POMP) encoding is applied in a simultaneous multi-slice (NSMS = 4) excitation scheme using half sinc pulses. In combination with a gradient echo 2D spiral readout trajectory and controlled aliasing in parallel imaging (CAIPI) via a model-based reconstruction a fast ultra-short echo time (UTE) sequence is developed. Sequence details and performance tests on short T2* phantoms are presented.

4146	Computer 116	Improvement of 2D-multi-slice, multi-shot Cartesian T2-weighted TSE using golden angle shot reordering
		Yuki Furukawa[1], Takashige Yoshida[1,2], Masami Yoneyama[3], Kouhei Yuda[1], Mariko Okura[1], and Nobuo Kawauchi[1]
		[1]Radiology, Tokyo Metropolitan Police Hospital, Tokyo, Nakano-ku, Japan, [2]Graduate School of medicine Health Sciences, Images Analysis, Tohoku University, Sendai, Miyagi, Japan, [3]IS Business Group, Philips Japan, Minato-ku, Tokyo, Japan
		2D multi-slice, multi-shot Cartesian TSE sequence is frequently used for routine MRI but it is sensitive to motion. We evaluated the feasibility of golden angle shot reordering for 2D-multi-shot TSE with 60 patients. Golden angle shot reordering reduced effectively ghost artifacts by randomly filling in each segment of Cartesian k-space. We demonstrated that golden angle shot reordering intrinsically has a motion robustness without penalty for image quality and scan time. This technique might be useful for all anatomies in routine clinical examination..

4147	Computer 117	APIR4EMC: Autocalibrated Parallel Imaging Reconstruction for Extended Multi-Contrast Imaging
		Chaoping Zhang[1,2], Alexandra Cristobal-Huerta[2], Juan Antonio Hernandez-Tamames[2], Stefan Klein[1,2], and Dirk H.J. Poot[1,2]
		[1]Departments of Medical Informatics, Erasmus Medical Center, Rotterdam, Netherlands, [2]Departments of Radiology and Nuclear Medicine, Erasmus Medical Center, Rotterdam, Netherlands

		Multi-contrast images of the same region are routinely acquired in clinical MRI. This abstract proposes a fast reconstruction method for multi-contrast imaging: Autocalibrated Parallel Imaging Reconstruction for Extended Multi-Contrast (APIR4EMC). Unlike conventional parallel imaging (GRAPPA) which reconstructs the image for individual contrast, APIR4EMC additionally includes the inter-contrast signals in the prediction of unsampled positions in the k-space of each contrast and simultaneously reconstructs images for all contrasts. Experiments show significant improvement of APIR4EMC compared to conventional parallel imaging in terms of artifacts and SNR.

4148	Computer 118	Wind Out-In Dual-Echo Yarn-Ball with Application to Knee Imaging
		Robert W. Stobbe[1] and Christian Beaulieu[1]
		[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada
		3D centre-out Yarn-Ball k-space acquisition is implemented in a wind-out/wind-in dual-echo format for the first time. As with standard 3D-Radial acquisition this technique facilitates short (first ‘echo’) TE with utility for imaging tissues with short T_2*. However, the advantage of centre-out Yarn-Ball is much greater k-space sampling efficiency than 3D-Radial. Smooth variation from wind-out to wind-in minimizes potential errors in k-space trajectory evolution as a result of eddy-currents. Spoiled-steady-state dual-echo 3D Yarn-Ball images with 0.7x0.7x0.7 mm^3 voxels were acquired from the knee of a healthy volunteer in 6 minutes, and the difference image shows ligament and meniscus conspicuity.

4149	Computer 119	A rapid 3D spiral readout with uniform sampling density and smooth T2* weighting
		Maria Engel[1], Lars Kasper[1], Christoph Barmet[1,2], Thomas Schmid[1], and Klaas Paul Pruessmann[1]
		[1]ETH Zürich, Zurich, Switzerland, [2]Skope Magnetic Resonance Technologies, Zurich, Switzerland
		A stack of disks trajectory for fast 3D acquisitions with long readouts is introduced and compared to interleaved stack of spiral and Yarn-ball trajectories. Isotropic 1.6 mm whole-brain coverage is achieved in less than a second.

4150	Computer 120	Redesigned Cones Trajectory based on Discretization of Cones Coordinate
		Kwang Eun Jang[1,2], Dwight G. Nishimura[2], and Shreyas S. Vasanawala[3]

[1]Department of Bioengieering, Stanford University, Stanford, CA, United States, [2]Magnetic Resonance Systems Research Lab (MRSRL) in Department of Electrical Engineering, Stanford University, Stanford, CA, United States, [3]Department of Radiology, Stanford University, Stanford, CA, United States

We propose a new non-Cartesian sampling scheme based on a 3D cones k-space trajectory. The design framework uses a cones coordinate system that uniquely represents a point in 3D k-space with a rotation of a spiral that resides on a conic surface. The new trajectory is obtained by discretizing the proposed coordinate system. Incorporation of a variable-density spiral improves the sampling efficiency. Simulations and phantom studies demonstrate the improved efficiency of the new scheme compared to the conventional cones design.

Electronic Poster

MR-Guided Interventions (Not Thermo nor HIFU)

Exhibition Hall	Tuesday 14:45 - 15:45

4151 | Computer 1

Motion Prediction using a Multi-Rate Kalman Filter with Golden Angle Radial Acquisition for Real-Time MRI-Guided Interventions

Xinzhou Li[1,2], Samantha Mikaiel[1,3], and Holden H. Wu[1,2,3]

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Real-time MRI can provide high soft-tissue contrast without ionizing radiation for interventional procedure guidance. To achieve accurate and low-latency tracking of target tissues for decision support and feedback control, this work proposes a motion prediction framework based on a multi-rate Kalman filter and real-time golden-angle radial MRI. The proposed framework leverages the unique sampling pattern of golden-angle radial acquisition to combine image-based with surrogate-based motion tracking. Initial results demonstrate that the proposed framework can achieve significantly reduced error in motion prediction and provide low-latency feedback for real-time MRI guided interventions.

4152 | Computer 2

Simultaneous 3D Whole-Heart Bright-Blood Visualization of the Coronary Sinus and Heart Anatomy and Black-Blood PSIR Quantification of Atrial Wall Thickness for Non-Contrast Enhanced Interventional Planning

Giulia Ginami[1], Karina Lopez[1], Radhouene Neji[1,2], Camila Munoz[1], Sebastien Roujol[1], Peter Mountney[2], Reza Razavi[1], Rene M Botnar[1], and Claudia Prieto[1]

		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Frimley, United Kingdom
		Atrial wall thickness quantification has the potential of providing important clinical information when planning electrophysiological interventions. Imprecise delivery of thermal energy during catheter ablation can prevent the success of the procedure. Furthermore, pre-interventional knowledge of subject-specific variations in the anatomy of the coronary sinus (CS) is crucial for adequate catheterization. Here, we propose a free-breathing 3D whole-heart phase-sensitive inversion recovery sequence suitable for non-contrast enhanced interventional planning, offering simultaneous visualization of the atrial walls and CS anatomy. The sequence is integrated in a framework with image-based navigation and non-rigid respiratory motion correction for 100% scan efficiency and improved image sharpness.

4153	Computer 3	Active-tracked versus Passive-tracked MRI-guided Cervical-cancer Brachytherapy catheter placement in 11 patients: Improved accuracy and reduced procedure time
		Jose De Arcos[1,2], Ehud J Schmidt[1,3], Wei Wang[1], Junichi Tokuda[1], Kamal Vij[4], Charles L Dumoulin[5], Ravi T Seethmaraju[6], Robert A Cormack[7], and Akila N Viswanathan[7,8]
		[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States, [2]Biomedical Engineering, King's College London, London, United Kingdom, [3]Cardiology, Johns Hopkins University, Baltimore, MD, United States, [4]MRI Interventions Inc., Irvine, CA, United States, [5]Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [6]Siemens Healthcare Inc., Boston, MA, United States, [7]Radiation Oncology, Brigham and Women's Hospital, Boston, MA, United States, [8]Radiation Oncology, Johns Hopkins University, Baltimore, MD, United States
		We performed MRI-guided placement of high dose rate (HDR) brachytherapy catheters in 11 cervical-cancer patients within a 3.0 T MRI scanner. We compared placing MR-tracked metallic stylets to passively-tracked conventional stylets. Comparisons were performed during three procedure stages: coarse stylet navigation to the approximate region of the tumor; fine-tuned navigation to the clinician's desired (final) location; stylet pull-back (withdrawal) from the body, which provided catheter trajectories for Radiation Treatment Planning. Active-tracking's main benefits; (I) catheters placed much closer to the clinician's intended location, including via complex manipulations requiring complete withdrawal and repositioning, (II) placement durations similar to transrectal-ultrasound guided HDR procedures.

4154	Computer 4	Noninvasive assessment of great vessel stents using a susceptibility-based imaging method
		Caiyun Shi[1], Shi Su[1], Xin Liu[1], Dong Liang[1], Haifeng Wang[1], Jim Ji[2], and Guoxi Xie[3,4]
		[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, shenzhen, China, [2]Texas A&M University, Texas, TX, United States, [3]Guangzhou Medical University, Qingyuan, China, [4]Guangzhou Medical University, Guangzhou, China

		Previous studies have demonstrated that a susceptibility-based positive contrast MR method exhibits excellent efficacy for visualizing MR compatible metal devices by taking advantage of their high magnetic susceptibility. However, the method was not evaluated in the assessment of stent restenosis. The purpose of this study is to assess whether the susceptibility-based positive method can be used to assess the stent restenosis, with the comparison of two typical MR positive contrast techniques, i.e., SUMO and GRASP. The experimental results showed that the susceptibility-based method not only provides better localization of the stent than SUMO and GRASP but also has capabiltiy to assess the stent restenosis.

4155	Computer 5	Percutaneous MR-guided Interventions Using an Optical Moiré Phase Tracking System
		Urte Kägebein[1], Frank Godenschweger[1], Frank Wacker[2], Oliver Speck[1], and Bennet Hensen[2]
		[1]Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Germany, [2]Department of Radiology, Hannover Medical School, Hannover, Germany
		The development of an appropriate guidance support is essential to simplify and shorten MRI guided percutaneous interventions. We present a new tracking system and sequence enabling intuitive, interactive and precise instrument navigation with the aid of an optical Moiré Phase tracking system from the inside of the MRI scanner. The system was evaluated regarding targeting error and skin to target time by experienced interventional radiologist and novice users, revealing a precise (0.99mm±0.47mm), fast (155s±62s) and simple real-time needle guidance.

4156	Computer 6	Feasibility of MRI image based synthetic CT generation in radiotherapy using deep convolutional neural network
		Yafen Li[1], Wen Li[1], Yaoqin Xie[1], and Jun Xia[2]
		[1]Institute of Biomedical and Health Engineering, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Radiology, Shenzhen Second People's Hospital (the First Affiliated Hospital of Shenzhen University), Shenzhen, China
		Generating electronic density information for MRI images is crucial for MRI-based dose calculation in a MRI-only workflow of radiotherapy. To address this problem, we proposed a deep convolutional neural network plus with an auto-context model to predict synthetic CT from MRI images of routine-sequence. The highly accuracy of generated synthetic CT results shows that the proposed method is effective and robust.

4157	Computer 7	Transcatheter intra-arterial perfusion (TRIP)-MRI for the evaluation of immediate Irreversible Electroporation effects in the VX2 rabbit liver tumor model.

		Matteo Figini[1], Kang Zhou[1,2], Liang Pan[1,3], Junjie Shangguan[1], Chong Sun[1,4], Bin Wang[1,5], Na Shang[1], Quanhong Ma[1], Daniele Procissi[1], Andrew Christian Larson[1], and Zhuoli Zhang[1]
		[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Radiology, Peking Union Medical College Hospital, Chinese Academy of Medical Science and Peking Union Medical College, Beijing, China, [3]Radiology, The Third Affiliated Hospital of Soochow University, Changzhou, China, [4]Orthopedics, Qilu Hospital, Shandong University, Jinan, China, [5]General Surgery, Nanfang Hospital, Southern Medical University, Guangzhou, China
		Six rabbits with liver tumors underwent anatomical and perfusion MRI immediately after irreversible electroporation (IRE) treatment of the tumors, using a catheter inserted in the left hepatic artery to deliver the contrast agent (TRIP-MRI). All the treated regions showed low perfusion as measured by the Area under the tissue response Curve. In some cases, a rim or a few spots with higher AUC were present, and were presumably associated with the penumbra of reversible electroporation that is known to be present in IRE-treated tissues. TRIP-MRI could be a valuable non-invasive tool to assess IRE effect and to immediately plan retreatment.

4158	Computer 8	Using 2D image slices for obtaining the guidewire coupling modes of a PTx transmit array
		Felipe Godinez[1], Arian Beqiri[1], Jose N Teixeira[1], Joseph V Hajnal[1], and Shaihan Malik[1]
		[1]School of Biomedical Engineering & Imaging Sciences, King's College London, LONDON, United Kingdom
		A multislice method for measuring relative coupling between elements of a parallel transmit (PTx) array and conductive structures such as guidewires at multiple internal locations. Fast 2D image slices are used to measure the relative coupling along the guidewire inside a large phantom. This is useful during conditions where the coupling modes can only be measured from within the object volume and where current sensors cannot be placed. Such conditions exist in large phantoms and can exist in humans.

4159	Computer 9	Intraarterial chemotherapy of glioblastoma following osmotic blood-brain barrier opening under real-time MRI guidance
		Chengyan Chu[1,2], Monica Pearl[3], Yanrong Chen[1,2], Anna Jablonska[1,2], Xiaolei Song[1,2], Miroslaw Janowski[1,2], and Piotr Walczak[1,2]
		[1]Russell H. Morgan Department of Radiology and Radiological Sciences, Division of MR Research, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Institute for Cell Engineering, Cellular Imaging Section, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]Division of Interventional Neuroradiology, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

		Blood-brain barrier (BBB) prevents effective chemotherapy of brain tumors. Intra-arterial (IA) injection of hyperosmotic mannitol has been attempted for many years to permeabilize the BBB, however due to high variability, this procedure never became a routine clinical practice. We have previously shown that real-time MRI may circumvent that obstacle in large animal model. However, for drug screening purposes the mouse model if preferred. Here, we have shown that real-time, interventional MRI is also instrumental to precisely open BBB in rodents, and more importantly combining it with subsequent delivery of chemotherapeutic drug melphalan provides therapeutic benefit warranting consideration of clinical application.

4160	Computer 10	Comparison of MR-guided joint injection with a fluoroscopic approach for pediatric MR arthrography
		Sphoorti Shellikeri[1], Anne Marie Cahill[1], Victor Ho-Fung[1], Randolph Setser[2], Michael Acord[1], Seth Vatsky[1], Fernando Escobar[1], and Abhay Srinivasan[1]
		[1]Radiology, The Children's Hospital of Philadelphia, Philadelphia, PA, United States, [2]Siemens Medical Solutions Inc, Hoffman Estates, IL, United States
		Magnetic resonance imaging (MRI) provides excellent soft-tissue contrast and multiplanar capability in joint imaging, but often requires direct joint injection of gadolinium to provide adequate depiction of cartilage and ligaments. MRI-guided joint interventions are not commonly performed as routine practice. In MR arthrography, the contrast injections are usually performed under fluoroscopy and is followed by a diagnostic MRI to evaluate the abnormalities in the rotator cuffs. This work describes our experience with combined interventional and diagnostic MR shoulder arthrography, and evaluates the efficacy of MR-guided injection, comparing technical success, diagnostic quality, and procedure times to fluoroscopic-guided arthrography.

4161	Computer 11	Application of SSFSE T1-weighted imaging for MRI-guided bone biopsy
		Elena Kaye[1], Daniel V Litwiller[2], Maggie Fung[2], Stephen Solomon[1], and Majid Maybody[1]
		[1]Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]GE Healthcare, New York, NY, United States
		MRI guided biopsy plays an important role in the diagnosis of bone lesions. Although T1w FSE offers exceptional signal-to-noise ratio and resolution, its acquisition time is relatively long. In this study, we evaluate a single-shot FSE with centric partial Fourier encoding, variable refocusing flip angle, and an inversion recovery preparation pulse (vrfSSFSE-IR) for MRI-guided bone biopsy application with the goal to reduce the overall procedure time.

4162	Computer 12	Real-Time Golden Angle Radial iSSFP: Impact of the Gradient Spoiler Direction on Motion and Flow Effects

Samantha Mikaiel[1,2], Thomas Martin[1,2], Xiaodong Zhong[3], Kyunghyun Sung[1,2,4], and Holden H Wu[1,2,4]

[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Physics and Biology in Medicine, University of California, Los Angeles, Los Angeles, CA, United States, [3]MR R&D Collaborations, Siemens Healthineers, Los Angeles, CA, United States, [4]Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States

Real-time visualization is crucial to the success of MRI-guided minimally invasive cancer interventions. We have developed golden-angle (GA) ordered radial integrated-SSFP (iSSFP), which can suppress banding artifacts associated with bSSFP while maintaining similar contrast. However, the addition of the gradient spoiler in iSSFP removes the flow and motion compensation along the axis of the gradient. In this work, we analyze pelvic and abdominal iSSFP scans acquired in the axial, sagittal and coronal planes to investigate the effects of having the gradient along different directions with respect to motion/flow. GA radial iSSFP can potentially improve tissue contrast for real-time MRI-guided interventions, after careful consideration for the imaging plane, gradient spoiler direction, and motion/flow direction.

4163 | Computer 13

Accuracy and Time Efficiency of Real-Time MRI-Guided Remote-Controlled Targeted Needle Placement During Motion Using Hydrostatic Actuators

Samantha Mikaiel[1,2], James Simonelli[3], Xinzhou Li[1,4], Yu-Hsiu Lee[3], Yong Seok Lee[5], Kyunghyun Sung[1,2,4], David Lu[1], Tsu-Chin Tsao[3], and Holden H Wu[1,2,4]

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In this work, we investigate the accuracy and time efficiency for real-time MRI-guided targeted needle placement using a rolling-diaphragm hydrostatic actuator system during motion. We show that the actuator-assisted approach was able to guide the needle to targets with greater accuracy and in less time than the conventional step-and-shoot strategy for both static and dynamic conditions using a programmable motion phantom. The new actuator system can potentially enable physicians to remotely perform real-time MRI-guided interventions during motion.

4164 | Computer 14

Non-contrast MRA Guidance in Pediatric Endovascular Interventions

Lingyun Chen[1], Onno Wink[2], Amber Pokorney[1], Ryan Robison[1], Robyn Augustyn[1], Marrit Thorkelson[1], and Richard Towbin[1]

		[1]Phoenix Children's Hospital, Phoenix, AZ, United States, [2]Philips Healthcare, Bothell, WA, United States
		The goal of this research project is to investigate the feasibility of using non-contrast 3D MRA imaging in the planning and guidance of catheter-based pediatric vascular disease treatment. It may result in a reduction in patient radiation exposure, contrast (Gadolinium and Iodine) usage and procedure time as compared to traditional 2D fluoroscopy guidance.

4165	Computer 15	A Phantom for Evaluation of Motion Quantification Methods in MR-Guided Radiotherapy
		Lukas Leiner[1], Gernot Echner[2], Matthias Borutta[2], Reiner Umathum[1], Arthur W. Magill[1], Steffen Seeber[1], Sebastian Flassbeck[1], Florian Friedrich[1], Anna Fischer[1], Nicolas G. R. Behl[1], Mark E. Ladd[1], and Florian Maier[1]
		[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Medical Physics in Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany
		MR-guided radiotherapy enables real-time tracking of targets during therapy application, with the aim of improving targeting accuracy and, hence, treatment efficiency. To evaluate MR-based motion quantification techniques, a phantom that can generate reproducible, known motion is an extremely valuable tool. A modular motion phantom was designed and implemented that provides precise and reproducible linear motion, including accurate position information. The phantom was found to be MR-compatible. An initial evaluation of real-time bSSFP imaging was performed. The developed device can be used as research tool for MR-guided therapy and as a clinical quality assessment tool to improve treatment of patients.

4166	Computer 16	Imaging latencies for Cartesian and Golden Angle 2D MRI in real-time MR-guided radiotherapy
		Pim T.S. Borman[1,2], Rob H.N. Tijssen[1], Clemens Bos[2], Chrit T.W. Moonen[2], Bas W. Raaymakers[1], and Markus Glitzner[1]
		[1]Radiotherapy, UMC Utrecht, Utrecht, Netherlands, [2]Imaging Division, UMC Utrecht, Utrecht, Netherlands
		For tumor tracking it is vital to minimize the latency between the moment of anatomic change and its appearance on the MR image. Apart from the temporal footprint of the acquisition, the readout trajectory itself influences the latency. We explore how the latency is minimized by shifting the collection of the center of k-space to the end of the acquisition. For Cartesian sequences this is achieved by changing the profile order, whereas in golden angle acquisitions a smaller window or k-t filter is able to achieve this.

4167	Computer 17	A Three-dimensional Template Matching Technique in Target Tracking Technique of MRgHIFU for liver Tomiki Morita[1], Etsuko Kumamoto[1,2], Daisuke Kokuryo[1], and Kagayaki Kuroda[3,4] *[1]Graduate School of System Informatics, Kobe University, Kobe, Japan, [2]Information Science and Technology Center, Kobe, Japan, [3]Graduate School of Engineering, Tokai University, Hiratsuka, Japan, [4]Center for Frontier Medical Engineering, Chiba University, Chiba, Japan* MRgHIFU treatment for liver requires a tracking technique to “lock on” to the focal spot at the target tissue region during respiratory-induced motion. We proposed three-dimensional focus tracking technique using template matching method. In this method, by creating a deformity / mutation model reconstructed from multi-slice volume data and extracting multiple blood vessel branch points, the focal spot can be estimated from the relative positional relationship. In this study, we optimized template size of template matching for extracting branching points in preoperative. Experimental results demonstrated to improve accuracy of blood vessel extraction.

4168	Computer 18	Robust quantitative diffusion weighted MR on an MR-Linac system Tim Schakel[1], Rob H.N. Tijssen[1], Hans M. Hoogduin[2], and Marielle E.P. Philippens[1] *[1]Radiotherapy, UMC Utrecht, Utrecht, Netherlands, [2]Radiology, UMC Utrecht, Utrecht, Netherlands* Quantitative diffusion weighted imaging is demonstrated on a clinical MR-Linac system. ADC values were measured using a standardized diffusion phantom using two different diffusion sequences, single shot EPI and single shot TSE: SPLICE. In general, accurate and repeatable ADC measurements could be acquired using both sequences. EPI showed more susceptibility and eddy current related image distortions, whereas SPLICE was geometrically more robust. Large deviations in ADC start to occur when moving further away from the isocenter, suggesting the need for gradient non-linearity correction of ADC values.

4169	Computer 19	Real-time SNR enhancement in surgical region for intraoperative MRI combining a stationary and a small freely-moving RF coils Jun-Hee Kim[1], Won-Joon Do[1], Jong-Woo Lim[2], Sang-Chul Lee[2], and Sung-Hong Park[1] *[1]Magnetic Resonance Imaging Laboratory, Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea, [2]Division of MRI Research, StemLab Inc, Sungnam-si,Gyeonggi-Do, Republic of Korea*

		This study introduces a new technique to enhance SNR in a surgical region for real-time intraoperative MRI that combines a static big and an endoscopic small RF coils. Segmented imaging using the static RF coil and fast imaging using the small RF coil were performed simultaneously with a reduced FOV. The images from the static and freely-moving RF coils were updated in multiple shots and in every shot, respectively. This technique not only reduces computing time, but also improves SNR in surgical region without intensity variation, which would be beneficial in intraoperative MRI.

4170	Computer 20	3D specific absorption rate estimation from focused ultrasound sonications using the Green's function heat kernel
		Nick Freeman[1], Henrik Odéen[1], and Dennis L Parker[1]
		[1]Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States
		In-vivo determination of tissue thermal and acoustic properties, such as the specific absorption rate (SAR) for focus ultrasound, are important for accurate thermal modeling in treatment planning, monitoring, and control using, e.g., Pennes bioheat transfer equation. In this work we derive and present a numerical method using the Green's function and MR thermometry data as input to estimate SAR non-invasively. The method is as accurate but substantially faster (on the order of seconds, compared to minutes) compared to two other SAR determination methods. Simulation and phantom experiments in a tissue mimicking gel phantom are performed.

4171	Computer 21	Assessment of Immediate Response to Irreversible Electroporation for Targeted Ablation of Liver Tissues Using Dynamic Contrast Enhancement in a Rabbit Model
		Junjie Shangguan[1,2], Matteo Figini[1], Chong Sun[1,3], Liang Pan[1,4], Bin Wang[1,5], Quanhong Ma[1], Kang Zhou[1,6], Na Shang[1], and Zhuoli Zhang[1]
		[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Driskill Graduate Program, Northwestern University, Chicago, IL, United States, [3]Orthopedics, Qilu Hospital, Shandong University, Jinan, China, [4]Radiology, The Third Affiliated Hospital of Soochow University, Changzhou, China, [5]General Surgery, Nanfang Hospital, Southern Medical University, Guangzhou, China, [6]Peking Union Medical College Hospital, Chinese Academy of Medical Science and Peking Union Medical College, Beijing, China
		Irreversible electroporation (IRE) may be visualized by MRI immediately post-procedure to monitor and assess tissue response peri-operatively. Dynamic contrast-enhanced MRI (DCE-MRI) allows measurement of tissue perfusion. We will demonstrate that DCE-MRI allows early visualization of IRE ablated tissue margins for prediction of the ablated region and quantification of tissue response. 6 rabbits underwent IRE ablation of the liver and pre-IRE and post-IRE DCE-MRI. A decrease in post-IRE apparent diffusion coefficients in the ablated region compared with baseline indicates tissue damage. Post-IRE AUC is decreased compared with baseline, suggesting decreased but still present blood perfusion in the ablated region post-IRE.

4172	Computer 22	Dedicated 3-Channel Surface Coil for Interventional Magnetic Resonance Imaging at 3T - First Evaluation
		Lena Sonnow[1,2,3], Wesley D Gilson[4], Arne Hengerer[5], Clifford R Weiss[1], Himanshu Bhat[5], Frank Wacker[2,3], and Jan Fritz[1]
		[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Department of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [3]Research Campus STIMULATE, Hannover, Germany, [4]Siemens Healthcare USA, Baltimore, MD, United States, [5]Siemens Healthcare USA, Malvern, PA, United States
		We developed a dedicated interventional MRI coil with 3 receiver channels and a wide central aperture for interventional access, which we benchmarked against a 4-channel system surface coil. We assessed signal-to-noise-ratios (SNR), geometry (g)-factors and instrument artifact size in a phantom and 100 subjects. The interventional MRI prototype coil produced similar SNR values and g-factors than the 4-channel system coil. There was no significant difference in artifacts, which were suitable for accurate and safe procedures. The central aperture of the interventional MRI prototype coil improved access and the coil performed error-free during a large variety of interventional MRI procedures.

4173	Computer 23	Validation study of high framerate source localization for MR-guided HDR brachytherapy
		Ellis Beld[1], Marinus A. Moerland[1], Max A. Viergever[2], Jan J.W. Lagendijk[1], and Peter R. Seevinck[2]
		[1]Department of Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands, [2]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands
		For the development of MR-guided high-dose-rate (HDR) brachytherapy, the accuracy and precision of an MR-based HDR source localization method were investigated in a phantom study, by a comparison with CT. MR images were acquired for various angulations of the source with respect to B_0, and a 3D CT scan was acquired. The MR source positions were compared to the CT source position. The results demonstrated a high, subvoxel accuracy (0.4-0.6 mm) and a high precision (≤0.1 mm) at high temporal resolutions (0.15-1.2 s per slice). This proved that our proposed MR-based source localization method is valuable for MR-guided HDR brachytherapy.

4174	Computer 24	Platform for investigating spatial and intensity parameters for phase-sensitive MRI focal localization with steerable single element focused ultrasound transducers through skull
		Spencer Brinker[1], Frank Preiswerk[1], and Nathan McDannold[1]
		[1]Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

		A platform is designed and constructed for investigating Focused Ultrasound (FUS) spatial and intensity focal parameters during phase-sensitive MRI focal localization. Recently, there has been a large interest to use single element transducers to deliver therapy to the brain. Spatial accuracy and intensity safety limits need further investigation. The platform developed in this project uses 3D Slicer software to incorporate MRI and neuronavigation camera coordinates for guiding an automated 3D hydrophone mapping system. A 272 kHz single element FUS transducer, ex vivo skull, and gel phantom are used to demonstrate components of the integrated MRI and navigation based hydrophone mapping system.

Electronic Poster

Safety: Bioeffects, Magnetic Fields & Contrast Agents

Exhibition Hall	Tuesday 14:45 - 15:45

4175	Computer 25	Simulation of Peripheral Nerve Stimulation Thresholds of MRI Gradient Coils
		Mathias Davids[1,2], Bastien Guérin[2,3], Valerie Klein[1], Lothar R Schad[1], and Lawrence L Wald[2,3,4]
		[1]Computer Assisted Clinical Medicine, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany, [2]Martinos Center for Biomedical Imaging, Dept. of Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [3]Harvard Medical School, Boston, MA, United States, [4]Harvard-MIT Division of Health Sciences and Technology, Cambridge, MA, United States
		Peripheral Nerve Stimulation (PNS) has become the major limitation in many fast MRI sequences for state-of-the-art gradient systems. We recently presented the first (to our knowledge) full peripheral nerve model for assessing magnetostimulation thresholds and validated it for solenoid coils. Our model consists of a comprehensive body model for EM simulations, a detailed atlas of human nerve fibers, and a numerical model describing nerve responses to induced electrical fields. Here, we extend our approach to realistic MRI gradient coils in simulations of male and female body models. The average threshold closely matches experimentally obtained group PNS threshold curves.

4176	Computer 26	Automatic Generation of Topologically Correct, High Quality, Finite-Element Tetrahedral Body Models from Voxel and Surface Data
		Mathias Davids[1,2], Bastien Guérin[2,3], Lawrence L Wald[2,3,4], and Lothar R Schad[1]
		[1]Computer Assisted Clinical Medicine, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany, [2]Martinos Center for Biomedical Imaging, Dept. of Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [3]Harvard Medical School, Boston, MA, United States, [4]Harvard-MIT Division of Health Sciences and Technology, Cambridge, MA, United States

		Assessment of MR safety, e.g., Specific Absorption Rate (SAR) and Peripheral Nerve Stimulation (PNS), relies on the accurate estimation of electromagnetic fields in complex human body models. Finite Element Methods (FEM) can use tetrahedral meshes that can model curved geometries much more accurately than voxel-based meshes. The creation of high-quality surface body models (needed to generate tetrahedral meshes), however, is complex due to the requirements for the surface models (water-tightness, correct topology, no intersections, etc.). We developed an automatic pipeline that, starting with arbitrary surface and voxel data, generates high quality, watertight, topologically correct surface models to be practically useful in FEM simulations.

4177	Computer 27	Optimization of the order and spacing of the sequences in an MRI examination to minimize the thermal dose
		Giuseppe Carluccio[1,2] and Christopher Michael Collins[1,2]
		[1]Radiology, Center for Advanced Imaging Innovation and Research (CAI2R), New York, NY, United States, [2]Radiology, Bernard and Irene Schwartz Center for Biomedical Imaging, New York, NY, United States
		Thermal dose is a parameter to evaluate the potential to damage tissues by exposure to high temperatures. In case of SAR-induced heating, we show that the maximum thermal dose can be reduced by changing the order of the sequences and delays between sequences without increasing the total exam duration. Using numerical simulations, we have optimized the order of the sequences of a comprehensive spine exam, and the optimized sequence has a maximum thermal dose equal to 0.80 cumulative equivalent minutes at 43 °C (CEM43), while the original exam had a maximum thermal dose equal to 1.72 CEM43.

4178	Computer 28	Impact of Constant BMI and Variable Lean-Body-Mass on B1+ and SAR
		Matthew Tarasek[1], Yihe Hua[1], Desmond Yeo[1], and Thomas Foo[1]
		[1]MRI, GE Global Research, Niskayuna, NY, United States
		Magnetic resonance imaging (MRI) uses radiofrequency energy which is absorbed by the patient. This energy is expressed in terms of specific absorption rate (SAR). Here we analyze the EM and thermal effects of increased lean-body-mass proportions with constant body-mass-index (BMI). We use a combination of techniques to achieve morphed expansion of lean-body-mass (LBM muscle) of non-head skeletal muscle tissue in a computational anatomical human body model. Results indicate that LBM may be a worthwhile anatomical descriptor to consider for impact on thermal risk assessment.

4179	Computer 29	Effects of Respiration on B1+ and SAR in Whole-Body Imaging at 7 Tesla

		Emma Doran[1], Stephen Bawden[1], Paul Glover[1], Susan Francis[1], Richard Bowtell[1], and Penny A. Gowland[1]
		[1]*Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom*
		The work aimed to quantify the effect of the phase of respiration on calculated local SAR and B_1^+ excitation fields using electromagnetic simulations using XFDTD software and to verify these results by comparing with B_1^+ maps acquired in vivo. The results show that the variation in local SAR was greater for the anterior elements due to the movement of the chest between inhale and exhale breath holds. The change in B_1^+ in the abdominal organs and in regions of interest under each transmit element was not significant.

4180	Computer 30	Investigating the Relationship between CEM43 and Brain Tissue Damage with MRI
		Yigitcan Eryaman[1], Lynn Utecht[1], Dee M Koski[1], Gregor Adriany[1], Noam Harel[1], Kamil Ugurbil[1], and J. Thomas Vaughan[1,2]
		[1]*CMRR, University of Minnesota, Minneapolis, MN, United States,* [2]*Mortimer B. Zuckerman Mind Brain Behavior Institute,Columbia University, New York, NY, United States*
		An experimental paradigm that can be used to investigate the relationship between CEM43 metric and tissue damage is presented.

4181	Computer 31	Simple transmission antenna resonance Q value measurement method using RF power monitors
		Hideta Habara[1], Yoshiaki Sato[1], Masaharu Ono[1], Kenta Sakuragi[1], Masahiro Takizawa[1], and Kosuke Ito[1]
		[1]*Hitachi, Ltd. Healthcare Business Unit, Tokyo, Japan*
		In MRI system it is important that whole body SAR is controlled accurately to obtain good scanning images and to keep patients' safety. A simple transmission antenna resonance Q value measurement system has been developed using conventional RF power monitors. The system has been validated comparing with the network analyzer measurements. Based on this validation, whole-body SAR management system was integrated. Using the integrated system, accurate whole-body SAR management has been made possible.

4182	Computer 32	Reducing PNS with Minimal Performance Penalties via Simple Pulse Sequence Modifications on a Compact 3T Scanner

		Myung-Ho In[1], Yunhong Shu[1], Joshua D Trzasko[1], Shengzhen Tao[1], Erin M Gray[1], John Huston[1], and Matt A Bernstein[1]
		[1]Department of Radiology, Mayo Clinic, Rochester, MN, United States
		More than 170 volunteers (patient subjects and normal controls) have been scanned since April 2016 following installation of a compact 3T MRI system with high-performance gradients (gradient strength=80mT/m, slew-rate=700T/m/s) at our institution. Despite peripheral nerve stimulation (PNS) related concerns associated with the high-performance gradients, no or minimal PNS sensation has been reported, with the exception of three normal control subjects. To mitigate the effect of PNS in these and other especially sensitive subjects, a simple pulse sequence modification was developed. Two of the subjects who reported PNS from their initial exam were available to be re-imaged with the modified pulse sequence, and subsequently reported no PNS.

4183	Computer 33	The impact of pad thickness on RF burn prevention: is a 1mm pad sufficient?
		Michael Steckner[1] and Xin Chen[1]
		[1]Toshiba Medical Research Institute USA, Mayfield Village, OH, United States
		RF burns are typically categorized according to appearance and suspected mechanism. Skin/skin contact burns are postulated to be caused by significant current flows through a restricted contact area. While not definitively proven, patients are instructed to not clasp hands and pads should be routinely used to minimize skin/skin contact. The effectiveness of a thin pad is investigated with EM modeling. A reported calf burn (peak 10g SAR:whole body SAR ratio ~86) may be avoidable with a 1 mm air gap (SAR hotspot ratio ~2). Understanding that thin pads are sufficient may permit greater flexibility in possible pad solutions.

4184	Computer 34	Variation in RF shimming SAR with patient position for 3 T breast imaging
		Mariya Lazebnik[1]
		[1]GE Healthcare, Waukesha, WI, United States
		This work investigates the variation in peak spatial SAR for RF shimming for different patient positions in the MR scanner for breast imaging. SAR simulations were performed on the Ella human body model in a 3 T 70 cm-diameter RF birdcage coil. Whole body SAR, peak spatial SAR, and SAR ratio (= peak SAR / whole body SAR) were computed for different patient elevations above the table (i.e., the patient lying on top of a breast coil). Patient position has important implications for setting safe RF shimming ranges due to the variations in peak spatial SAR in different patient positions.

4185	Computer 35	Comparison of electromagnetic and thermal simulations with measurements of different orthopedic implants system at 1.5T
		Keran Wang[1], Zainul Ihsan[1], Joerg Seehafer[1], Thomas Doering[1], Wolfgang Goertz[1], and Gregor Schaefers[1,2]
		[1]MR:comp GmbH Service for MR Safety & Compatibility, Gelsenkirchen, Germany, [2]MRI-STaR-Magnetic Resonance Institute for Safety,Technology and Research GmbH, Gelsenkirchen, Germany
		With aid of the numerical simulations the test of a typical commercial orthopedic implant system composed of huge amount of multi-component implants varying in dimensions or materials is doable in realistic time and cost regarding the radio frequency induced heating. Electromagnetic and thermal simulations are applied to confirm the worst case configuration, locate the hotpot and interpret the temperature rise which is compared with the experiment test. To catch the worst case scenario the placement of the test object should be considered in relation to the local electrical field and the setup of simulation should approach the experimental condition.

4186	Computer 36	B1+ and Temperature Analysis in Two UHF RF Coils
		Sossena Wood[1], Tales Santini[2], Nadim Farhat[2], Tiago Martins[3], Narayanan Krishnamurthy[3], and Tamer S Ibrahim[2,4]
		[1]Bioengineering, University of Pittsburgh, Cranberry Twp, PA, United States, [2]Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States, [3]University of Pittsburgh, Pittsburgh, PA, United States, [4]Radiology, University of Pittsburgh, Pittsburgh, PA, United States
		Our work makes a comparison of the RF performance of a TEM resonator and a TTT coil on a 2-compartment agar phantom. While the results show lower B1+/RF power efficiency for the TTT coil when compared to the TEM coil, the temperature rise in the TEM coil is higher (resulting in lower B1+/SAR efficiency) for a fixed average B1+ intensity across the volume of the coil load.

4187	Computer 37	Reduced SAR excitation with linear phase coils
		Glen Morrell[1] and Rock Hadley[1]
		[1]Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States
		A novel method for SAR reduction for slice- or slab-selective excitation is proposed which uses an array of two linear phase RF coils and two channel transmission to reduce SAR with no change in pulse length, bandwidth, or slice profile compared to conventional excitation. FDTD simulation results show a reduction of SAR by a factor of two.

4188	Computer 38	Assessment of high dielectric material in different sizes for fetal MRI at 3T
		Chao Luo[1,2], Nan Li[1,2], Guoxi Xie[3], Xiaoliang Zhang[4,5], Xin Liu[1,2], and Ye Li[1,2]
		[1]Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Shenzhen Key Laboratory for MRI, Shenzhen, China, [3]School of Basic Science, Guangzhou Medical University, Guangzhou, China, [4]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [5]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco, CA, United States
		In this paper, we investigate the effect of the size and thickness of high permittivity dielectric pads to the imaging performance in fetal imaging at 3T through numerical modeling and simulations. The results of this study can be used as a guide in selection of appropriate size and thickness of dielectric pads in fetal magnetic resonance imaging for gaining the highest imaging performance.

4189	Computer 39	Evaluation of Macrocyclic Gadolinium-Based Contrast Agent Retention in a Longitudinal Multiple Sclerosis Study
		Gabriel Kocevar[1], Salem Hannoun[2], Claudio Stamile[1], François Cotton[1,3], Françoise Durand-Dubief[1,4], and Dominique Sappey-Marinier[1,5]
		[1]CREATIS Laboratory, Université Claude Bernard - Lyon 1, Lyon, France, [2]Nehme and Therese Tohme Multiple Sclerosis Center, American University of Beirut, Beirut, Lebanon, [3]Centre Hospitalier Lyon-Sud - Service de Radiologie, Hospices Civils de Lyon, Lyon, France, [4]Hôpital Neurologique - Service de Neurologie A, Hospices Civils de Lyon, Lyon, France, [5]CERMEP - Imagerie du Vivant, Université de Lyon, Lyon, France
		Gadolinium-based contrast agents (GBCA) are commonly used to identify blood-brain-barrier disruption. Recent studies reported gadolinium deposition in deep gray matter (GM) structures, following serial injections of linear complexes of GBCA. While it is recognized that linear complexes of GBCA may lead to gadolinium retention in brain, macrocyclic GBCA should also be evaluated. In this study, we investigated the effect of serial macrocyclic GBCA injections in 92 Multiple Sclerosis patients followed during seven years. Our results did not show any significant signal intensity changes in deep GM structures, and particularly in the dentate nuclei and the globus pallidus.

4190	Computer 40	Deep Learning Enables 90% Reduction in Gadolinium Dosage for Contrast Enhanced MRI
		Enhao Gong[1], John Pauly[1], Max Wintermark[2], and Greg Zaharchuk[2]
		[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States

		There are increasing concerns over gadolinium-based-contrast-agents-administration(GBCA). A deep-learning (DL) method was developed to reduce the gadolinium dose in Contrast-Enhanced-MRI (CE-MRI). The proposed method includes an acquisition step(pre-contrast, 10% low-dose and full-dose CE-MRI with T1-weighted-IR-FSPGR), a pre-processing step and a deep learning model trained to predict full-dose CE-MRI from pre-contrast and low-dose images. Evaluated on a clinical neuro CE-MRI dataset (10 patients for training and another 20 patients for evaluation), both quantitative metrics and radiologists' ratings showed the proposed method achieved improved synthesis, with better motion-artifact-suppression and NO significant differences in contrast-enhancement quality, compared with ground-truth full-dose CE-MRI. Thus, using the proposed Deep Learning method, GBCA can be reduced, by at-least-10-fold, while preserving image quality and diagnostic information.

4191	Computer 41	New occurrences of macroscopic myocardial fibrosis in thalassemia at long term by multiple follow-up
		Antonella Meloni[1], Vincenzo Positano[1], Laura Pistoia[1], Pietro Giuliano[2], Stefania Renne[3], Riccardo Righi[4], Priscilla Fina[5], Petra Keilberg[1], Crocetta Argento[6], Cristina Paci[7], Antonella Massa[8], and Alessia Pepe[1]
		[1]Fondazione G. Monasterio CNR-Regione Toscana, Pisa, Italy, [2]"ARNAS" Civico, Di Cristina Benfratelli, Palermo, Italy, [3]Presidio Ospedaliero "Giovanni Paolo II", Lamezia Terme, Italy, [4]Ospedale del Delta, Lagosanto (FE), Italy, [5]Ospedale "Sandro Pertini", Roma, Italy, [6]Ospedale "San Giovanni Di Dio", Agrigento, Italy, [7]Ospedale "S Maria alla Gruccia", Montevarchi (AR), Italy, [8]Ospedale "Giovanni Paolo II", Olbia, Italy
		We investigated the evolution of myocardial fibrosis in terms of new occurrences over a period of 6 years in thalassemia patients who underwent to multiple LGE CMR scans and we detected an high number of new occurrences of myocardial fibrosis. Our data suggest the importance of repeating the LGE CMR over time using 'low risk' macrocyclic agents.

4192	Computer 42	Absence of T1 hyperintensity in the brain of high-risk iron loaded thalassemia patients after multiple administrations of high dose Gadobutrol
		Antonella Meloni[1], Domenico Montanaro[1], Vincenzo Positano[1], Daniele De Marchi[1], Mariachiara Resta[2], Petra Keilberg[1], Laura Pistoia[1], Anna Spasiano[3], Tommaso Casini[4], Caterina Cinzia De Bari[5], Sara De Cori[1], and Alessia Pepe[1]
		[1]Fondazione G. Monasterio CNR-Regione Toscana, Pisa, Italy, [2]Policlinico Università di Bari, Bari, Italy, [3]Azienda Ospedaliera di Rilievo Nazionale "A. Cardarelli", Napoli, Italy, [4]Ospedale "Meyer", Firenze, Italy, [5]Ospedale "San Donato", Arezzo, Italy
		Our study describes the lack of increased signal intensity (SI) in T1-weighted MRI images after repeated administrations of Gadobutrol in a high-risk population (high dose/scan, iron overload that facilitates the transmetallation of gadolinium). A potential role of the chelation therapy cannot be excluded. Moreover, it is highlighted that SI ratios in the sampled areas differ between 1.5T and 3T.

4193	Computer 43	Safety for the Off-label Use of Ferumoxytol in Magnetic Resonance Imaging: Early Results from the FeraSafe Multi-Center Registry™
		Kim-Lien Nguyen[1], Rola Saouaf[2], Cynthia K. Rigsby[3], Lindsay M. Griffin[4], Mark L. Fogel[5], Kevin K. Whitehead[5], Mark L. Schiebler[4], David E. Newby[6], and J. Paul Finn[1]
		[1]Department of Radiological Sciences and Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Department of Radiology, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Department of Medical Imaging, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [4]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [5]Division of Cardiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States, [6]British Heart Foundation Centre for Cardiovascular Science, University of Edinburgh, Edinburgh, United Kingdom
		Ferumoxytol is approved in the United States (U.S.) for treatment of iron deficiency anemia in chronic kidney disease. However, its superparamagnetic properties can be leveraged for off-label use in MRI. In 2015, the U.S. Food and Drug Administration (FDA) issued a “black-box” warning regarding risk of rare but serious hypersensitivity reactions based on post-marketing surveillance therapeutic use data. Preliminary experience from the FeraSafe Multi-Center Registry™ suggests a low incidence of adverse events with the off-label diagnostic use of ferumoxytol. To date, these preliminary results suggest that with appropriate clinical use and monitoring, there is an acceptable benefit /risk profile.

4194	Computer 44	Mapping Gadolinium Entry and Clearance from the Brain using Dynamic MRI
		Payam Nahavandi[1], Ian F Harrison[1], May Z Thin[1], John J Connell[1], Ozama Ismail[1], Yolanda Ohene[1], Jack A Wells[1], and Mark F Lythgoe[1]
		[1]Centre for Advanced Biomedical Imaging, Division of Medicine, University College London, London, United Kingdom
		Recently, evidence for gadolinium retention in the brain was provided, raising concerns regarding the safety of these agents. This accumulation raised important questions, most crucially, by which pathway does gadolinium enter the brain. We provide insight into this by dynamic monitoring of the infiltration and clearance of gadolinium into the brain parenchyma following an IV injection. Following gadolinium injection, inflow of contrast into the cerebrospinal fluid spaces was prominent. 25mins post injection, contrast enhancement is detected in the periventricular regions and hypothalamus. This finding provides insight into the entry routes by which gadolinium infiltrates the brain following a systemic administration.

4195	Computer 45	Linear contrast agent-induced high signal intensity in the dentate nucleus and globus pallidus on unenhanced T1-weighted images in pediatric patients
		Shintaro Ichikawa[1], Utaroh Motosugi[1], Yoshie Omiya[1], and Hiroshi Onishi[1]

		[1]Department of Radiology, University of Yamanashi, Chuo-shi, Japan
		Hyperintensity in the dentate nucleus (DN) and globus pallidus (GP) on unenhanced T1-weighted images (T1WI) was associated with previous administration of linear gadolinium-based contrast agent (GBCA) in pediatric patients. The DN-to-pons ratio increased as the number of linear GBCAs administrations increased. The GP-to-thalamus ratio of the "Linear GBCAs ≥ 5 administrations" group was significantly higher than that of the "No GBCAs administration" and the "Linear GBCAs 1–4 administrations" groups. The number of previous administrations of linear GBCAs was positively correlated with the DN-to-pons ratio and the GP-to-thalamus ratio.

4196	Computer 46	STUDY OF SKIN ENHANCEMENT BY AGE IN WOMEN
		Akira Yamamoto[1], Tsutomu Okada[1], Yasutaka Fushimi[1], Tomohisa Okada[2], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University, Graduate School of Medicine, Kyoto, Japan, [2]Human Brain Research Center, Kyoto University, Graduate School of Medicine, Kyoto, Japan
		In women, the head skin signal enhancing effect tends to decrease with age.

4197	Computer 47	Dentate Nucleus Signal Intensity Decrease on T1-Weighted MR Images after Switching from Linear to Macrocyclic GBCA
		Ashkan Heshmatzadeh Behzadi[1], Yize Zhao[2], Zerwa Farooq[1], George Shih[1], and Martin R. Prince[1,3]
		[1]Radiology, Weill Cornell University, New York, NY, United States, [2]Weill Cornell University, New York, NY, United States, [3]Radiology, weill Cornell Medical College, New York, NY, United States
		Dentate Nucleus signal intensity ratios decreased with time after switching from linear (gadopentetate) to macrocyclic (gadobutrol) agent.

4198	Computer 48	Gd accumulation in tissues of healthy mice upon repeated administrations of Gd-based contrast agents
		Eliana Gianolio[1], Enza Di Gregorio[1], Giuseppe Ferrauto[1], and Silvio Aime[1]
		[1]Molecular Biotechnologies and Health Science, University of Torino, Torino, Italy

		GBCAs are routinely used in many clinical MRI protocols, their high stability should ensure that the Gd-complexes are excreted intact without side effects. Recently, it was reported that tiny amounts of Gd3+ may be retained in the brain of patients. The aim of this study was to investigate, in an animal model, the in vivo fate of Gadoteridol and Gadodiamide extending the investigation of Gd retention to other body tissues besides brain. Several administration protocols differing for i) the number of total doses, ii) the frequency of the administrations and iii) the sacrifice time after the last administration, were compared.

Electronic Poster

System Imperfections & Artifacts: Characterization & Correction

Exhibition Hall	Tuesday 14:45 - 15:45

4199	Computer 49	Variability of B1+ and B0 fields in the human brain at 7T.
		William T Clarke[1], Olivier Mougin[2], Ian D Driver[3], Catarina Rua[4], Susan Francis[2], Richard Bowtell[2], Richard Wise[3], Adrian Carpenter[4], Keith Muir[5], and Stuart Clare[1]
		[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [3]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, Cardiff, United Kingdom, [4]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [5]Institute of Neuroscience & Psychology, University of Glasgow, Glasgow, United Kingdom
		B_1^+ and B_0 whole brain field-maps were collected from three human subjects, on four different 7 tesla scanners. Three different scanner systems from two different vendors were used; all acquisitions used the same RF coil. The data was used to assess the inter-subject and inter-scanner variability, and to calculate typical field values over a range of different brain regions. Systematic difference in B_1^+ calibration and B_0 shimming between scanners were found, necessitating user validated B_1^+ calibration and B_0 shimming for quantitative multi-site studies.

4200	Computer 50	Comparison of ASL quantification results across 3T scanners with different hardware/software – insight for multisite ASL studies
		Yu Fen Chen[1], James Patrick Higgins[1], and Todd B Parrish[1]
		[1]Feinberg school of medicine, Department of Radiology, Northwestern University, Chicago, IL, United States

		Combination of data across different scanner platforms is a major concern for multisite studies. The quantitative nature of arterial spin labeling (ASL) is thought to be free from such concerns, but our results on data collected on the same scanner before and after hardware upgrade demonstrate that ASL is also subject to this confound. Normalization to a reference region greatly reduces variation even for non-quantitative data, and is a recommended approach for removing scanner-related variations.

4201	Computer 51	Initial Investigation of Multi-Probe Magnetic Field Monitoring on a Whole-Body Human System Operating at 10.5 Tesla: Application to Spin Echo Diffusion Weighted EPI
		Ruoyun E Ma[1], Edwards Auerbach[1], Kamil Ugurbil[1], and Pierre-François Van de Moortele[1]
		[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States
		DW-EPI is subjected to image distortion induced by eddy currents. Magnetic field camera has been shown to provide corrected reconstruction based on accurate measurement of actual k-space trajectories. In this study, initial effort was made to implement this approach in the context of a whole body human system operating at 10.5T where susceptibility challenges are greater. After characterization of the probe behavior and careful design of the probe signal acquisition scheme, field evolution during the EPI readout was mapped. Image reconstruction corrected with the measured encoding information demonstrated a significant reduction of image distortion in DW-EPI.

4202	Computer 52	Motion Encoding Gradient Nonlinearity Correction for Magnetic Resonance Elastography
		Joshua D. Trzasko[1], Arvin Arani[1], Philip A. Araoz[1], Matt A. Bernstein[1], Richard L. Ehman[1], John Huston III[1], Yunhong Shu[1], and Ek Tsoon Tan[2]
		[1]Mayo Clinic, Rochester, MN, United States, [2]General Electric Global Research Center, Niskayuna, NY, United States
		Due to engineering limitations, the spatial encoding gradient fields produced by an MRI scanner are never perfectly linear. Gradient non-ideality is typically associated with image geometric distortion, but it also imparts spatially varying bias in the signal generated during gradient-based motion encoding. In this work, we theoretically investigate how motion encoding gradient nonlinearity affects MR elastography and develop a corrective strategy applicable to any MRE protocol.

4203	Computer 53	Image Distortion Correction via Gradient Nonlinearity Encoding at 9.4T MRI with Radial Ultra short TE (UTE) Sequence
		Shanshan shan[1], Mingyan Li[1], Haiwei Chen[1], Feng Liu[1], and Stuart Crozier[1]

		[1]The University of Queensland, Brisbane, Australia
		Radial-encoding sequences can be more sensitive to gradient trajectory deviations caused by gradient nonlinearity (GNL) than Cartesian encoding. In this work, we developed a method to alleviate image distortion caused by GNL specifically for radial-encoding. Experimental results acquired from a 9.4 T pre-clinical MRI scanner with using Ultra-short TE sequence were used to validate the proposed method.

4204	Computer 54	Distortion measurements empirically validate gradient model impact on diffusion weighting
		Dariya I Malyarenko[1], Enzo Barberi[2], Yuxi Pang[1], Julien Sénégas[3], Ajit Devaraj[4], Johannes Peeters[5], Teodor Stanescu[6], and Thomas L Chenevert[1]
		[1]Radiology, University of Michigan, Ann Arbor, MI, United States, [2]Modus Medical Devices, London, ON, Canada, [3]Philips Research Laboratories, Hamburg, Germany, [4]Philips Research Laboratories, Cambridge, MA, United States, [5]Philips MR Clinical Science, Best, Netherlands, [6]University Health Network, Princess Margaret Cancer Center, Toronto, ON, Canada
		Distortion fields induced by gradient nonlinearity were measured for two channels of two MRI systems to validate vendor-provided gradient design models intended for correcting spatially nonuniform diffusion weighting. Excellent agreement was observed between the model and the empiric displacement measurements recast into first two diagonal elements of system nonlinearity tensor for both systems. The measurements were sensitive enough to detect sub-millimeter differences between nominally symmetric right-left and anterior-posterior gradients. Unexplained minor deviation from spatially symmetric design was detected for right-left gradient of both systems by diffusion and distortion measurement.

4205	Computer 55	Concomitant Field Compensation Improves Quality of Clinical Fast Spin Echo Images Acquired on an Asymmetric MRI Gradient System
		Shengzhen Tao[1], John Huston III[1], Erin Gray[1], Joshua Trzasko[1], Myung-Ho In[1], Yunhong Shu[1], and Matt Bernstein[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		The fast-spin-echo (FSE) acquisitions are the workhorse for routine MRI, but can be affected by concomitant field (CF)-induced phase errors. Recently, a compact 3T (C3T) MRI platform equipped with an asymmetric, high-performance gradient was developed. The asymmetric design of this gradient induces zeroth/first-order CFs (in addition to the second-order CF on conventional whole-body gradients), which can degrade image quality of FSE acquisitions. We have previously developed real-time gradient pre-emphasis and frequency shifting techniques to compensate for these additional CFs. Here, we demonstrate that these compensations significantly improve image quality of FSE using a clinical T2w-FSE protocol and a preliminary dataset.

4206	Computer 56	Fast eddy current characterization for the development of in-bore devices David Otto Brunner[1,2], Betram Jakob Wilm[1,2], Simon Gross[1], Benjamin Emmanuel Dietrich[1], Christoph Barmet[1,2], and Klaas Paul Pruessmann[1] *[1]Institute for Biomedical Engineering, ETH and University of Zurich, Zurich, Switzerland, [2]Skope Magnetic Resonance Technologies Inc., Zurich, Switzerland* Devices operating in the magnet bore, such as coil arrays, receivers or shim inserts become ever more sophisticated as well as the employed image acquisition schemes. However, quantitative testing for their influence on the gradient switching performance is often difficult and time consuming. In this work we present a methodology for measuring, evaluating and predicting eddy current effects fast and quantitatively, employing a dynamic magnetic field camera and a framework of linear time invariant system characterization. For demonstration, standard components and several frequently applied RF coils are assessed.

4207	Computer 57	Extending the Simple Method for Adaptive Gradient-Delay Compensation in Radial MRI Sebastian Rosenzweig[1], Hans Christian Martin Holme[1,2], Robin Niklas Wilke[1,2], and Martin Uecker[1,2] *[1]Intistut für Diagnostische und Interventionelle Radiologie, University Medical Center Göttingen, Göttingen, Germany, [2]Partner Site Göttingen, German Centre for Cardiovascular Research (DZHK), Göttingen, Germany* Lately, radial k-space trajectories have become very popular especially for fast MRI. However, radial sampling is prone to streaking artifacts caused by gradient delays. Here, we propose two extensions for a simple but powerful method that compensates gradient delays by estimating the corresponding sample shift using cross-correlation of opposed spokes. First, we show that the opposed spokes don't have to be acquired in calibration scans but can be taken directly from the actual measurements. Second, we show that it is also possible to generate synthetic spoke-pairs for gradient delay estimation.

4208	Computer 58	Measuring Eddy Currents Induced by Switching Gradient/Shim Currents Paul Chang[1,2], Sahar Nassirpour[1,2], and Anke Henning[1,3] *[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience, Eberhard-Karls University of Tuebingen, Tuebingen, Germany, [3]Department of Physics, Ernst-Moritz-Arndt University Greifswald, Tuebingen, Germany*

		In this work, we measured eddy currents for a very high order B_0 shim system. The eddy currents were measured using two methods: a low-resolution B_0 mapping sequence and a NMR field camera. The high temporal resolution of the field camera allowed the eddy currents to be corrected using a digital pre-emphasis setup.

4209	Computer 59	Using field monitoring to map and correct image distortions due to gradient nonlinearities
		Ying-Hua Chu[1,2], Yi-Cheng Hsu[1,2], Fa-Hsuan Lin[2], and Maxim Zaitsev[1]
		[1]Dept. of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, Freiburg, Germany, [2]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan
		We demonstrate how a field probe array can be used to measure gradient nonlinearities. Brain imaging results show that the distortion was most prominent at image voxels away from the iso-center. Compared to MRI vendor's solution, our measurements and reconstruction could further reduce the image distortion by 35%.

4210	Computer 60	Improved thermal modelling and prediction of gradient response using sensor placement guided by infrared photography
		Jennifer Nussbaum[1], Bertram J Wilm[1,2], Benjamin E Dietrich[1], and Klaas Paul Pruessmann[1]
		[1]Information Technology and Electrical Engineering, ETH Zurich, Zurich, Switzerland, [2]Skope Magnetic Resonance Technologies AG, Zurich, Switzerland
		In MRI, the dynamics of gradient fields can be predicted by assuming that the system is linear and time-invariant. However, time-invariance can be violated by thermal effects. To address this shortcoming, it has been proposed to expand the GIRF model by thermal variation parametrized with the help of temperature sensors. It has remained open how many relevant thermal degrees of freedom the system actually had and where the matching number of sensors should be placed to capture them. In the present work, we address these questions using infrared photography and principal component analysis of gradient heating. Response modelling is additionally enhanced by accelerating GIRF measurements and including cross-terms. The improvements are shown in the prediction of gradient waveforms for image reconstruction and in the effects on the images.

4211	Computer 61	Reduction of artefacts in Bloch-Siegert based $$$B_1^+$$$-Mapping in CPMG-Sequences with imperfect refocussing pulses
		Volker JF Sturm[1,2], Thomas Kampf[3,4], Lukas R Buschle[2], Ke Zhang[2], Peter M Jakob[4], Mirko Pham[3], Christian Ziener[2], Martin Bendszus[1], Sabine Heiland[1], and Felix T Kurz[1,2]

		[1]Experimental Neuroradiology, University Hospital Heidelberg, Heidelberg, Germany, [2]German Cancer Research Center, Heidelberg, Germany, [3]Diagnostic and Interventional Neuroradiology, University Hospital Würzburg, Würzburg, Germany, [4]Experimental Physics V, University Würzburg, Würzburg, Germany
		The Bloch-Siegert-effect imprints the rf-coil's transmission field in the phase of the acquired signal. Consequently the measured amplitude information can be used to determine other MR-Parameter. A previously published sequence based on a CPMG spin echo train uses both information pathways and allows simultaneous acquisition of T_2- and B_1^+-maps. However, the formerly proposed method produces potentially erroneous B_1^+-map in inhomogeneous B_0-fields. This work presents a method to reduce those errors by combining signal from different echoes. This allows a robust measurement of B_1^+-maps in inhomogeneous B_0-fields as present in high-field MRI with simultaneous T_2 quantification.

4212	Computer 62	Mapping B0 inhomogeneities through a self-contained analysis of single-shot 2D MRI data
		Gilad Liberman[1], Samuel F Cousin[1], and Lucio Frydman[1]
		[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel
		Ultrafast MRI is susceptible to main field distortions ΔB_0 that affect these images' quality and faithfulness –particularly along the low-bandwidth dimension. This work shows that these distortions can be mapped from the spatial images themselves, without requiring additional information. This information becomes available from a time-frequency analysis of the signals, after freeing them from phase-wrapping complications. This hypothesis is explained, and results are demonstrated using both simulations and single-shot human brain images collected by spatiotemporal encoding (SPEN) techniques. The method opens a route to enhancing SPEN's and EPI's robustness to field inhomogeneities.

4213	Computer 63	Accurate Slice-Selective MRI near Metallic Implants with FOCUSED-xSPEN
		Gil Farkash[1], Gilad Liberman[2], and Lucio Frydman[2]
		[1]Chemical & Biological Physics, Weizmann Institute, Rehovot, Israel, [2]Chemical & Biological Physics, Weizmann Institue, Rehovot, Israel

		Metals frequently cause dramatic spatial inhomogeneities in the static field B_0. This causes severe localization errors, including slice z-displacements and slice-thickness variations. Clinically used techniques often avoid such errors by adding a phase encoding loop in z, prolonging examination times. This study examines a novel Fully refOCUSED cross-term SPatio-temporal ENcoding (FOCUSED-xSPEN) approach, as a slice selection technique for 2D MRI in the presence of metal implants. The method relies on xSPEN's proven immunity to in-plane distortions caused by B_0 heterogeneities, to design a new excitation scheme that delivers faithful 2D slices near implants with reduced scan times.

4214	Computer 64	EPI Nyquist ghost removal by incorporating iterative k-space based phase error estimation and correction with SPIRiT (PEC-SPIRiT)
		Yilong Liu[1,2], Mengye Lyu[1,2], Victor B. Xie[1,2,3], and Ed X Wu[1,2]
		[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China, [3]Toshiba Medical Systems (China), Beijing, China
		EPI acquisition suffers from Nyquist ghost due to inconsistency between opposite readout directions. As proposed in our previous work, such inconsistency induced phase error can be removed by incorporating the Phase Error Correction with SENSE (PEC-SENSE). In this study, we employ a k-space based phase error estimation, and remove the EPI Nyquist ghost by incorporating phase error correction with SPIRiT (PEC-SPIRiT). Here, a FLASH scan is used for calibration. The proposed method was evaluated using both phantom and in vivo studies, demonstrating its robustness against distortion mismatch and at high accelerations.

4215	Computer 65	Undersampled Spiral Magnetic Resonance Fingerprinting with Water and Fat Blurring Correction
		Teresa Nolte[1,2], Daniel Truhn[3], Nicolas Gross-Weege[2], Mariya Doneva[4], Peter Koken[4], Aaldert Elevelt[5], and Volkmar Schulz[2,5]
		[1]Multiphysics & Optics, Philips Research Europe, Eindhoven, Netherlands, [2]Physics of Molecular Imaging, RWTH Aachen, Aachen, Germany, [3]Clinic for Diagnostic and Interventional Radiology, Uniklinik RWTH Aachen, Aachen, Germany, [4]Tomographic Imaging Systems, Philips Research Europe, Hamburg, Germany, [5]Oncology Solutions, Philips Research Europe, Eindhoven, Netherlands
		In the presence of aqueous and fatty tissues, Magnetic Resonance Fingerprinting (MRF) acquisitions with spiral readout suffer from blurring artifacts. We propose to correct undersampled spiral MRF data by combining MRF with a Dixon acquisition and a subsequent conjugate phase reconstruction correction. With the proposed method, the blurring artifacts are removed from the MRF data. T_1 and T_2 parameter maps with improved homogeneity are obtained.

4216	Computer 66	An efficient eddy current correction method for fat quantification by bipolar readout sequence Chao Zou[1], Chuanli Cheng[1,2], Yangzi Qiao[1], Hao Peng[1], Changjun Tie[1], Qian Wan[1], Xin Liu[1], Hairong Zheng[1], and Min Pan[1,3] *[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, CAS, Shenzhen, China, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Shenzhen Hospital of Guangzhou University of Traditional Chinese Medicine, Shenzhen, China* Multi-echo GRE sequence with bipolar readout gradients can reduce the achievable echo spacing compared to unipolar readout gradients for fat fraction (FF) quantification, and has higher acquisition efficiency. The eddy current induced phase (EC-phase) in bipolar sequence corrupts the phase consistency between the echoes, making it one of the confounding factors for the accurate fat quantification. In this study, we proposed an accurate EC-phase estimation method in bipolar acquisition sequence for FF quantification. The proposed method is validated through comparing the FF quantification from the EC-phase corrected bipolar data to the well-established unipolar acquisition through phantom experiments.

4217	Computer 67	Fat Shift Correction in Bipolar Multi-Echo Dixon Imaging using Water-Fat Separation in k-Space Holger Eggers[1] *[1]Philips Research, Hamburg, Germany* Fat is shifted relative to water in opposite directions in the odd and even single-echo images obtained with bipolar multi-echo sequences. Considering this effect in a water-fat separation permits suppressing associated artifacts, but has required regularization so far to cope with a locally ill-conditioned inverse problem in k-space. In this work, an alternative approach to limiting noise amplification in the water-fat separation is proposed and explored, which promises to avoid the loss of image sharpness observed with regularization.

4218	Computer 68	Single echo radial random alternating TE acquisition for B0 field inhomogeneity robust fat suppression Dongyeob Han[1], Taehwa Hong[1], and Dong-Hyun Kim[1] *[1]Yonsei University, Seoul, Republic of Korea* A single echo method which provides B0 field inhomogeneity robust fat suppression was proposed using a radial acquisition with random alternating echo time. To validate this study, simulation and in vivo experiments were performed. This technique would be useful in fat suppressed applications (e.g., MSK, liver, ...) which are required fast scan and robustness of B0 field inhomogeneity.

4219	Computer 69	Accelerated Imaging of Metallic Implants Using a 3D Convolutional Neural Network Xinwei Shi[1,2], Kathryn Stevens[2], and Brian Hargreaves[1,2] *[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States* Multi-Spectral Imaging (MSI) methods, such as SEMAC and MAVRIC-SL, resolve metal-induced field perturbations by applying additional encoding in the spectral dimension, at the cost of increased scan time. In this work, we introduce a 3D-CNN-based reconstruction to accelerate MSI utilizing spatial-spectral features of aliasing artifacts. We demonstrate in in vivo experiments that the proposed method can accelerate MAVRIC-SL acquisitions by a factor of 3 when used alone, and 17-25 when combined with parallel imaging and half-Fourier acquisition. The 3D-CNN showed significant improvement in image quality compared with parallel image and compressed sensing (PI&CS), with negligible additional computation time.

4220	Computer 70	bin-SENSE: Accelerated MRI Near Metal With No Additional Hardware Philip K. Lee[1,2], Xinwei Shi[1,2], Daehyun Yoon[1], Evan G. Levine[1,2], and Brian A. Hargreaves[1,2] *[1]Radiology, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford, CA, United States* MAVRIC-SL suppresses artifacts induced by field inhomogeneities induced by metal, but requires increased scan time due to the acquisition of a fourth spectral dimension. We accelerate MAVRIC-SL acquisitions limited to the body coil by exploiting fieldmap information implicitly provided by the MAVRIC-SL acquisition. SENSE is applied to undo the coherent aliasing, using the spectral profiles as the spatial weights required for matrix inversion. A region growing method is applied to estimate the fieldmap and spectral profiles from uniformly undersampled data. We demonstrate 1.3x retrospective acceleration at a minimal g-factor penalty with no additional hardware requirement.

4221	Computer 71	A fast quality assessment and follow-up of transmit and receive coil paths Franck Mauconduit[1], Chantal Ginisty[2], Séverine Desmidt[2], Séverine Roger[2], Lionel Allirol[2], Lucie Hertz-Pannier[2], and Alexandre Vignaud[3] *[1]Siemens Healthcare, Sant-Denis, France, [2]Joliot/Neurospin/UNIACT, CEA, Gif sur Yvette, France, [3]Joliot/Neurospin/UNIRS, CEA, Gif sur Yvette, France*

		To operate a MRI system within the best conditions of reproducibility, Quality Assurance (QA) is mandatory to prevent defects and to detect abnormalities in subparts of the system. When using third-party or home-made coils, it is particularly important to guaranty stability of transmit and receive coil paths. For this purpose, we implemented a fast and user-friendly integrated assessment and follow-up to prevent or quickly detect failures.

4222	Computer 72	Interlaced Total Variation for Gibbs Artifact Reduction in the Presence of Zero Padding
		Kaixuan Zhao[1], Zhongbiao Xu[1], Feng Huang[2], Yingjie Mei[1,3], and Yanqiu Feng[1]
		[1]School of Biomedical Engineering, Guangdong Provincial Key Laboratory of Medical Image Processing, Southern Medical University, Guangzhou, China, [2]Neusoft Medical System, Shanghai, China, [3]Philips Healthcare, Guangzhou, China
		The Gibbs artifact can be effectively eliminated by searching the local sub-voxel shifts (LSS) that minimize total variations, but it is only applicable to images reconstructed without zero padding. This work extends the LSS method to Gibbs artifact reduction in the presence of zero padding by introducing an interlaced total variation (iTV). The simulation and in vivo experimental results demonstrate that the proposed method can effectively remove Gibbs artifact in the presence of zero padding.

Electronic Poster

Pulse Sequences & Beyond

Exhibition Hall	Tuesday 14:45 - 15:45

4223	Computer 73	In-vivo water T2 mapping in tissues containing water and fat using a T2-prepared 3D Dixon TSE sequence and a pre-calibrated fat spectrum model
		Dominik Weidlich[1], Maximilian N. Diefenbach[1], Sarah Schlaeger[1,2], Andreas Hock[3], Stefan Ruschke[1], and Dimitrios C. Karampinos[1]
		[1]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Department of Diagnostic and Interventional of Neuroradiology, Technical University of Munich, Munich, Germany, [3]Philips Healthcare, Hamburg, Germany

		Water T2 is seen as a potential biomarker for brown adipose tissue presence and as a marker of disease activity in patients with neuromuscular disorders. Measuring water T2 in tissues containing water and fat is challenging due to the need to separate the effects of water and fat during T2 quantification. The present work proposes an adiabatic T2 prepared 3D TSE Dixon sequence in combination with a novel DIXON water-fat decomposition method and demonstrates in vivo its feasibility to measure water T2 of brown adipose tissue in the supraclavicular fossa.

4224	Computer 74	3D CSI-Electrical Properties Tomography
		Reijer L. Leijsen[1], Wyger M. Brink[1], Cornelis A.T. van den Berg[2], Andrew G. Webb[1], and Rob F. Remis[3]
		[1]C.J. Gorter Center, Leiden University Medical Center, Leiden, Netherlands, [2]Department of Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands, [3]Circuits and Systems Group, Delft University of Technology, Delft, Netherlands
		The goal of Contrast Source Inversion – Electrical PropertiesTomography is to iteratively reconstruct the conductivity and permittivity of tissue from $$$B_1^+$$$ field data. Up to now, this method has only been implemented in two dimensions. Here we demonstrate a proof-of-principle of a three-dimensional (3D) extension, thereby potentially turning CSI-EPT into a volumetric EPT technique. We present the basic 3D CSI-EPT equations, illustrate the performance of 3D CSI-EPT for realistic 3D body models, and show that accurate reconstructions are obtained even at tissue boundaries. The influence of the magnitude of the electric field on the reconstructions is also discussed.

4225	Computer 75	Inversion-Recovery UTE multispoke sequence: comparison of two excitation schemes
		Lucas Soustelle[1], Julien Lamy[1], François Rousseau[2], Jean-Paul Armspach[1], and Paulo Loureiro de Sousa[1]
		[1]Université de Strasbourg, CNRS, ICube, FMTS, Strasbourg, France, [2]Institut Mines Télécom Atlantique, INSERM, LaTIM, Brest, France
		Inversion-Recovery UTE sequences have been used to highlight and quantify short-T2 structures. Covering a 3D volume remains time-consuming, and a trade-off often needs to be found between k-space undersampling and acceptable appearing streaking artifacts. As such, acquiring several radial spokes within a single repetition time represents a supplementary sequence acceleration possibility. In this work, we propose to quantify the short-T2 signal difference between a constant and an optimized variable flip angle strategy in a multispoke acquisition module, and within a long-T2 suppression condition in vitro.

4226	Computer 76	On the use of frequency modulated pulses in sat-UTE

		Lucas Soustelle[1], Ericky Caldas de A. Araujo[2,3], François Rousseau[4], Jean-Paul Armspach[1], Pierre G. Carlier[2,3], and Paulo Loureiro de Sousa[1]
		[1]Université de Strasbourg, CNRS, ICube, FMTS, Strasbourg, France, [2]NMR laboratory, Institute of Myology, Paris, France, [3]NMR laboratory, CEA/DRF/IBFJ/MIRCen, Paris, France, [4]Institut Mines Télécom Atlantique, INSERM, LaTIM, Brest, France
		Conventional slice selection in 2D-UTE sequences is challenging as eddy currents and gradient non-idealities make difficult to achieve an appropriate slice selection and a minimum TE. The sat-UTE sequence proposes a simplification that separates slice selection from excitation, ensuring an easily implementable 2D-UTE sequence. The selection part was originally proposed with a short gaussian pulse, constraining slice selectivity to a gaussian profile and demanding exceedingly high RF power for ensuring efficient saturation. In this work, we propose an alternative implementation using low-peak-amplitude and selective quadratic phase pulses for slice saturation, providing an efficient and sharp short-T2 slice selection in sat-UTE.

4227	Computer 77	Fast High-Resolution Endodontic MRI
		Philipp Madörin[1], Matthias Weigel[1,2], Thomas Connert[3], Sebastian Kühl[4], and Oliver Bieri[1,2]
		[1]Division of Radiological Physics, Department of Radiology, University Hospital Basel, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland, [3]Department of Periodontology, Endodontology, and Cariology, University School of Dental Medicine, University of Basel, Basel, Switzerland, [4]Department of Oral Surgery, Oral Radiology and Oral Medicine, University School of Dental Medicine, University of Basel, Basel, Switzerland
		The aim of this study was to explore standard MRI hardware and sequences as an alternative radiation-free modality to Cone Beam Computer Tomography for imaging the dental root canals rapidly and with high-resolution for the planning and guidance of the bur to the root canal orifice in combination with an intraoral surface scan.

4228	Computer 78	Accelerated Spin Echo Imaging using Simultaneous Spin-Echo Refocusing in conjunction with a PINS Refocusing Pulse
		Francesco Padormo[1], Rebecca Emily Feldman[1], and Priti Balchandani[1]
		[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York City, NY, United States
		We proposed a novel alternative to the Turbo Spin Echo. It combines ideas from the Simultaneous Spin-Echo Refocusing method with PINS pulse design to result in a low SAR acquisition.

4229	Computer 79	Rapid multi-inversion SMS-EPI integrated with gradient-echo, spin-echo and diffusion-weighted EPI acquisitions Daniel J Park[1], Thomas Witzel[1,2], Ilana Leppert[3], Yi-Fen Yen[1,2], Qiuyun Fan[1], Christine Tardif[3], and Jonathan Polimeni[1,2,4] *[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Montreal Neurological Institute and Hospital, McGill University, Montréal, QC, Canada, [4]Harvard-MIT Health Sciences and Technology, Institute of Medical Engineering and Science, Massachusetts Institute of Technology, Cambridge, MA, United States* Recently inversion-recovery techniques have been combined with EPI in an efficient scheme in which a non-selective inversion is merged with a slice reordering scheme, providing rapid quantitative T1 maps. Here we merge this approach with several recent EPI technologies, including SMS-EPI, and several image contrasts including T2-, T2*, and diffusion weighted acquisitions. Not only does this allow the efficient combination of multiple contrasts but it opens the door to a rapid, all-EPI examination.

4230	Computer 80	A Gradient Spoiled Spin-Echo Sequence for Simultaneously Measuring B1+, B0, T1, T2, T2*, and Velocity of a Two-Dimensional Slice Nicholas Dwork[1], Adam B Kerr[2], and John M Pauly[1] *[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford University, CA, United States* A single sequence is presented that quantifies several parameters simultaneously of a two-dimensional slice.

4231	Computer 81	Evaluating RF and gradient spoiling in MPRAGE and MP2RAGE using novel, efficient algorithms for 3D extended phase graph and ideal-spoiling models M. Dylan Tisdall[1] *[1]Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States* To optimize spoiling efficiency, we evaluate several design choices for RF- and gradient-spoiling in MPRAGE-type sequences. Optimization is performed using two efficient algorithms, one for the ideal-spoiling condition, and one for a 3D extended phase graph model that realistically captures spoiling effects. We used novel implementations of both algorithms, with publicly available source, that attempt to maximize computational efficiency. Our results suggest possible avenues for improving spoiling in MPRAGE-type sequences.

4232	Computer 82	Description of the off-resonance dependency in slice-selective FISP MRF Gregor Körzdörfer[1,2], Bartosz Guzek[1,3], Yun Jiang[4], Josef Pfeuffer[1], Bernhard Hensel[2], Peter Speier[1], and Mathias Nittka[1] *[1]Siemens Healthcare GmbH, Erlangen, Germany, [2]Max Schaldach-Stiftungsprofessur für Biomedizinische Technik, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [3]Georg-August-Universität Göttingen, Göttingen, Germany, [4]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States* In Magnetic Resonance Fingerprinting (MRF), quantitative parameter maps are generated by matching pseudo randomly generated MR signals with a precalculated dictionary. A common implementation of MRF is based on an unbalanced SSFP (FISP) sequence in combination with a slice-selective excitation. In this work, we demonstrate its sensitivity to off-resonances in specific configurations, investigate the underlying spin physics and derive according mitigation approaches.

4233	Computer 83	mGRE and TFE based cardiac SWI at 3.0 T Xiaoqi Wang[1] *[1]Philips Healthcare, Beijing, China* In this work, a 3.0 T multiple echo sequence was developed for cardiac scans, and a feasibility study was carried to assess whether susceptibility-weighted imaging (SWI) provides image contrast for the detection of myocardium disease. Currently collected images indicates that cardiac SWI at 3.0 T provides a prominent option for detecting myocardial abnormality, while further optimization to obtain sensitivity and accuracy is needed.

4234	Computer 84	Imaging cardiac fat by chemical shift encoded MRI application in CINE format at 3 T Xiaoqi Wang[1] *[1]Philips Healthcare, Beijing, China* Ectopic fat deposition impacts cardiac health, and non-invase quantification is required. In this work, a chemical shift encoded MRI is designed for cardiac applications. Images of Proton density fat fraction (PDFF) water (W) and fat(F), and T2* were generated for each frame of cardiac motion, formed CINE movies for cardiac cycles. The novel sequence was flexible in clinical applications with short acquisition time and made sensitive findings in this research.

4235	Computer 85	AC magnetic sensing using the SIRS effect combined with bSSFP at ultra-low field
		Bragi Sveinsson[1,2,3], Neha Koonjoo[1,2,3], Bo Zhu[1,2,3], Thomas Witzel[1,2], and Matthew Rosen[1,2,3]
		[1]Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Physics, Harvard University, Cambridge, MA, United States
		Direct detection of neuronal currents has long been a goal within MRI, with the aim of improving upon the spatial and temporal resolution of BOLD fMRI. So far, good results have been shown in phantoms but detection in vivo has proven difficult. A promising current detection technique is Stimulus-Induced Rotary Saturation (SIRS), but the BOLD signal can contaminate SIRS measurements, possibly explaining inconclusive in vivo results so far. A new sequence was developed and tested in an ultra-low-field (ULF) regime (6.5 mT) where paramagnetic effects such as BOLD are reduced and is more suited for SIRS measurements in vivo.

4236	Computer 86	Reducing Blurring while Controlling Contrast in Abdominal Imaging with Variable Flip Angle Single Shot Fast Spin Echo
		LI Zhao[1], Manuel Taso[1], Daniel V Litwiller[2], and David C. Alsop[1]
		[1]Radiology, Beth Israel Deaconess Medical Center & Harvard Medical School, Boston, MA, United States, [2]GE Healthcare, Global MR Applications and Workflow, New York, NY, United States
		Single-shot fast spin echo is used clinically to provide fast, motion-robust abdominal images. However, signal decay along the echo train results in blurred images. Our previous work on optimal variable flip angle design demonstrated improved SNR on brain imaging. Here, we extend this framework to show simultaneous T2 blurring and contrast control in abdominal imaging with single-shot fast spin echo.

4237	Computer 87	Fast Measurement of B1+ using the NO2RAGE pulse sequence
		Riccardo Metere[1], Tobias Lenich[1], Kerrin J. Pine[2], and Harald E. Möller[1]
		[1]NMR Unit, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

		The knowledge of the spatial distribution of the transmit field of the coil, B_1^+, is essential in a number of MRI applications, particularly at higher field strength. SA2RAGE is a recently developed technique for B_1^+ mapping, derived from the MP2RAGE scheme. The sensitivity to B_1^+ is obtained from a preparation pulse and optimized delays between block gradient acquisitions. Here, we propose a much faster (but otherwise comparable) method, referred to as NO2RAGE, where the B_1^+ sensitivity is obtained by omitting the preparation, nullifying the delays, and adjusting the other sequence parameters. The technique compares favorably against other in vivo methods.

4238	Computer 88	Efficient imaging of Rabi modulated trajectories using balanced Steady-State Driven Trajectory (bSSDT) imaging
		James C Korte[1], Bahman Tahayori[2,3], Peter M Farrell[4], Yasmin Blunck[1], and Leigh A Johnston[1]
		[1]Dept. Biomedical Engineering, University of Melbourne, Melbourne, Australia, [2]Dept. Electrical and Computer Systems Engineering, Monash University, Melbourne, Australia, [3]Dept. of Medical Physics and Biomedical Engineering, Shiraz University of Medical Sciences, Shiraz, Iran (Islamic Republic of), [4]Dept. Electrical and Electronic Engineering, University of Melbourne, Melbourne, Australia
		We propose an efficient technique to image localised steady-state trajectories, termed balanced Steady-State Driven Trajectory (bSSDT) imaging and implement the protocol to investigate the properties of Rabi modulated steady-state trajectories. In bSSDT imaging, a sequence of points on the voxel-wise steady-state trajectory is acquired. The resultant 4-D data offers a potentially rich source of information about the underlying tissue properties. The proposed imaging technique is a pseudo-continuous excitation version of balanced steady-state free precession (bSSFP) imaging, with relaxation of the magnetisation to the equilibrium steady-state in bSSFP replaced by control of the magnetisation to a steady-state trajectory in bSSDT.

4239	Computer 89	Fast BLADE with variable flip angle
		Yuyu Wang[1], Le Zhang[1], Muhammed Labeeb[1], and Dehe Weng[1]
		[1]SIEMENS Healthineers, Shenzhen, China
		An effective approach with variable flip angle to speed up BLADE acquisition is proposed for general MR imaging. It improved the efficiency of BLADE by enlarging the width of one blade. The image quality is comparable with that of conventional BLADE method.

4240	Computer 90	Velocity Sensitivity of Inner-Volume Cardiac Echo Planar Imaging

		Ahsan Javed[1], Terrence Jao[2], and Krishna S. Nayak[1,2]
		[1]Electrical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Biomedical Engineering, University of Southern California, Los Angeles, CA, United States
		Inner volume echo planar imaging (IV-EPI) is feasible and useful for cardiac diffusion tensor imaging and arterial spin labelling . IV-EPI inherently provides velocity-selective saturation caused by the crusher gradients around the 180º refocusing-pulse. In this study, we characterize this velocity-dependent effect on myocardial signal in systolic and diastolic cardiac phases. We find that a simple velocity distribution model fits the data well, and that the data from our experiments allows us to make recommendation for designing gradients to avoid myocardial signal loss for diastolic and systolic IV-EPI imaging.

4241	Computer 91	Improving Image Quality of A Spiral T1 Spin-Echo Sequence
		Zhiqiang Li[1], Melvyn B Ooi[1,2], Dinghui Wang[1], and James G Pipe[1]
		[1]Barrow Neurological Institute, Phoenix, AZ, United States, [2]Philips Healthcare, Cleveland, OH, United States
		Cartesian SE is widely used for T1 imaging, but is slow and often susceptible to flow artifacts. A spiral T1SE technique has been proposed for rapid T1 imaging with minimal flow artifacts. However, inconsistent through-plane signal has been observed with certain protocols. In this work we investigate the root causes and propose a combined RF/gradient chopping scheme to minimize this inconsistency, and improve the T1 contrast. The improvement was demonstrated with phantom and volunteer data.

4242	Computer 92	Optimized parameters for MP2RAGE images on 7-T MRI
		Uksu Choi[1,2], Hirokazu Kawaguchi[3], Yuichiro Matsuoka[1,2], Tobias Kober[4,5,6], and Ikuhiro Kida[1,2]
		[1]Center for Information and Neural Networks, National Institute of Information and Communications Technology, Osaka, Japan, [2]Graduate School of Frontier Biosciences, Osaka University, Osaka, Japan, [3]Siemens Healthcare K.K., Osaka, Japan, [4]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [5]Department of Radiology, University Hospital (CHUV), Lausanne, Switzerland, [6]LTS5, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland
		The MP2RAGE sequence at ultra-high magnetic fields can be advantageous for investigation of microstructural changes because of reduced B1 inhomogeneity and images with different contrasts (uniform (UNI), T1, and fluid and white matter suppression (FLAWS)). In this study, we used several evaluative methods to optimize the inversion times and flip angles for UNI, T1, and FLAWS images of the MP2RAGE sequence at 7 T. We found the optimized inversion times with flip angles for UNI and T1 images, but different parameters for FLAWS images. The results suggested that different parameters of MP2RAGE at 7 T should be applied for different contrast types.

4243	Computer 93	B1- and Fat-Corrected T1 Mapping Using Chemical-Shift Encoded MRI Nathan T Roberts[1], Timothy J Colgan[2], Xiaoke Wang[2,3], Diego Hernando[2,4], and Scott B Reeder[2,3,4,5,6] *[1]University of Wisconsin Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin Madison, Madison, WI, United States, [3]Biomedical Engineering, University of Wisconsin Madison, Madison, WI, United States, [4]Medical Physics, University of Wisconsin Madison, Madison, WI, United States, [5]Medicine, University of Wisconsin Madison, Madison, WI, United States, [6]Emergency Medicine, University of Wisconsin Madison, Madison, WI, United States* Spatially varying B_1 inhomogeneities and fat content are well known to be confounders of quantitative T_1 mapping that use multi flip angle techniques. Separate B_1 calibration maps can be acquired to correct flip angle errors cause by B_1 inhomogeneities, but this requires an additional acquisition. In this work we consider an alternative approach that acquires variable flip angles and variable repetition times, and simultaneously estimates B_1 inhomogeneity, T_1, fat-fraction and R_2*. The feasibility and noise performance of this approach are evaluated using theoretical Cramer-Rao Lower Bound analysis and simulations. Our results demonstrate that this approach is feasible, but suffers from relatively poor noise performance at typical acquisition parameters.

4244	Computer 94	T2 measurement in SE-WMRI fast spin echo imaging Edzer Lienson Wu[1], Po-Wei Cheng[2], Tzi-Dar Chiueh[2], and Jyh-Horng Chen[2] *[1]Imaging Center for Integrated Body, Mind and Culture, National Taiwan University, Taipei, Taiwan, [2]Electrical Engineering, National Taiwan University, Taipei, Taiwan* To investigate the contrast in SE-WMRI spin echo imaging, we measured five tubes of SPIO solution with various concentrations using standard and SE-WMRI Multi-Slice-Multi-Echo (MSME) sequence. T2 relaxation times were then calculated based on the 16 acquired images per scan. Results show that with a 1.4-fold acceleration, the T2 relaxation time of SE-WMRI MSME remains the same within the error bar as standard imaging.

4245	Computer 95	On the Analysis of EPI Phase Correction with Small Tip Angle Excitation to reduce minimum required TE: Application to Whole-Brain Submillimetre-Resolution fMRI at 3T Seong Dae Yun[1] and N. Jon Shah[1,2] *[1]Institute of Neuroscience and Medicine, Medical Imaging Physics (INM-4), Forschungszentrum Juelich, Juelich, Germany, [2]Faculty of Medicine, Department of Neurology, JARA, RWTH Aachen University, Aachen, Germany*

		EPI has been widely used for fMRI due to its relatively fast imaging speed. However, as one of its drawbacks, ghost artefacts need to be corrected. In the community, an approach that utilises three non-phase encoded navigator echoes is commonly used for the correction. Although this scheme is quite effective, as the matrix size increases for high-resolution imaging the navigator echoes constitute a significant contribution in increasing the minimum required TE. To overcome this issue, this work employs an alternative navigator echo scheme. Here, its performance was analysed and whole-brain submillimetre-resolution fMRI (0.75 × 0.75 mm^2) was demonstrated at 3T.

4246	Computer 96	Generation of Arbitrary Spectral Profiles using Orthonormal Basis Combinations of bSSFP MRI
		Michael Mendoza[1], Nicholas McKibben[1], and Neal Bangerter[1]
		[1]Electrical Engineering, Brigham Young University, Provo, UT, United States
		We present a technique for generating an arbitrary spectral profile by using multiple-acquisition bSSFP. Multiple phase-cycled bSSFP images with increasing TRs were acquired and Gram-Schmidt orthogonalization was applied to spectral basis functions to generate an orthonormal basis. This generated orthonormal basis was used to approximate an arbitrary spectral profile by using linear combinations of the calculated basis functions. A variety of spectral functions were simulated and used as a template to approximate spectral profiles in water and fat phantoms.

Electronic Poster

MR Fingerprinting

Exhibition Hall	Tuesday 14:45 - 15:45

4247	Computer 97	Simultaneous Observation of Two Paramagnetic MRI Contrast Agents via Dynamic T1 and T2 Mapping with Magnetic Resonance Fingerprinting: Initial In Vivo Results
		Christian E Anderson[1,2], Yuning Gu[2], Mette Johansen[3,4], He Hu[2], Yun Jiang[1], Michael Kavran[1], Bernadette Erokwu[1], Susann Brady-Kalnay[3,4], Nicole Steinmetz[1,2], Xin Yu[2,5], Mark Griswold[1,2], and Chris Flask[1,2,6]
		[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [3]Molecular Biology and Microbiology, Case Western Reserve University, Cleveland, OH, United States, [4]Neurosciences, Case Western Reserve University, Cleveland, OH, United States, [5]Physiology and Biophysics, Case Western Reserve University, Cleveland, OH, United States, [6]Pediatrics, Case Western Reserve University, Cleveland, OH, United States

		In this work simultaneous T1 and T2 mapping via MR Fingerprinting was used to observe the distribution of dysprosium and gadolinium MRI contrast agents in a mouse tumor model. Changes from baseline in T1 and T2 were observed using each agent alone and an increased effect was seen when agents were used in combination. Additionally, a decrease in the dysprosium dose lead to a reduction in the level of T1 and T2 enhancement observed. These results indicate that MRF might be able to be used to track multiple MRI contrast agents in vivo.

4248	Computer 98	Optimization of the Flow Encoding Pattern under Consideration of Spatio-Temporal Velocity Gradients in flow-MR Fingerprinting
		Sebastian Flassbeck[1], Simon Schmidt[1], Mark E. Ladd[1], and Sebastian Schmitter[1,2]
		[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany
		It has been shown that the quantification of blood flow velocities through the use of bipolar gradients is possible within the MRF framework, called flow-MRF. In this work, we investigate four different flow encoding patterns for flow-MRF and analyze their impact on flow quantification. Finally we present an optimized pattern.

4249	Computer 99	Time efficient whole-brain coverage in Magnetic Resonance Fingerprinting using echo-planar imaging, slice-interleaving and simultaneous multi-slice imaging
		Benedikt Rieger[1,2], Mehmet Akçakaya[2,3], Lothar Schad[1], and Sebastian Weingärtner[1,2,3]
		[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany, [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [3]Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN, United States
		Magnetic resonance fingerprinting (MRF) is a promising method for simultaneous multi-parameter quantification. However, spatial coverage is limited in the original method due to the rapid image readout and the balanced sequence design. The aim of this study is to enable time-efficient volumetric coverage in Cartesian MRF-EPI for whole-brain quantification in clinically acceptable scan times. A slice-interleaved acquisition is shown to offer quantification precision comparable to single-slice measurements in a fraction of the measurement time. By combining this with simultaneous multi-slice imaging, whole-brain coverage with 40 slices was achieved in one minute, resulting in high quality T_1 and T_2* maps.

4250	Computer 100	From phantoms to patients: Paving the way for MRF in clinical practice

		Marcel Gratz[1,2], Jasmin Jäger[3], Mathias Nittka[4], Stephan Kannengiesser[4], Josef Pfeuffer[4], Gregor Koerzdoerfer[4,5], Rainer Kirsch[4], Florian Meise[4], Harald H. Quick[1,2], Vikas Gulani[6], Mark Griswold[6], Michael Forsting[3], and Lale Umutlu[3]
		[1]Erwin L. Hahn Institute for MRI, University of Duisburg-Essen, Essen, Germany, [2]High Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany, [3]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Germany, [4]Siemens Healthcare GmbH, Erlangen, Germany, [5]Friedrich-Alexander Universität Erlangen-Nürnberg, Erlangen, Germany, [6]Case Western Reserve University, Cleveland, OH, United States
		This study puts the focus on estimating the stability of MRF data in phantoms, volunteers and patients and investigates the options to integrate MRF into routine clinical workflows. The phantom and in-vivo scans yielded consistent and reproducible results throughout different scan days. Thus, MRF enables a fast and reliable generation of quantitative data in vivo and, along with appropriate reference values, has the potential to improve diagnostics in neuroimaging.

4251	Computer 101	Doped Polyvinylpyrrolidone Solutions for Tunable T1, T2, and ADC in Multiparametric Phantoms
		Michael A Boss[1,2], Yun Jiang[3], Stephen E Russek[2], and Mark A Griswold[3]
		[1]University of Colorado Boulder, Boulder, CO, United States, [2]NIST, Boulder, CO, United States, [3]Case Western Reserve University, Cleveland, OH, United States
		A multiparametric phantom for quantitative MRI and magnetic resonance fingerprinting was developed. Solutions of PVP were used to tune the apparent diffusion coefficient (ADC), and then doped with Mn to control T_1 and T_2. The addition of Mn did not affect the ADC, but did significantly shorten T_1 and T_2, demonstrating the potential of independently tuning relaxation times and ADC.

4252	Computer 102	Diffusion Propagator Formalism in Bloch Equation Simulation of Magnetic Resonance Fingerprinting
		Shota Hodono[1], Yun Jiang[2], Naren Nallapareddy[3], Vikas Gulani[2], and Mark Griswold[2]
		[1]Physics and Astronomy, Ohio Northern University, Ada, OH, United States, [2]Radiology, Case Western Reserve University, Cleveland, OH, United States, [3]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

		By considering spin diffusion as a random walk process and introducing a Gaussian probability function to the Bloch equation, a diffusion propagator was developed, which allows diffusion to be accounted for in magnetic resonance fingerprinting (MRF) simulations. In this study, signal intensities generated by Bloch simulations with the diffusion propagator were compared with theoretical values for the diffusion-weighted spin echo sequence. Additionally, the diffusion propagator approach was applied to the MRF fast imaging with steady-state precession sequence and the resulting signal evolution was qualitatively compared with that generated by the Extended Phase Graphs method.

4253	Computer 103	Normative T1 and T2 relaxation times and measurement repeatability of abdomen organs at 3T using 2D MR Fingerprinting
		Sanjay Sridaran[1], Ananya Panda[2], Yong Chen[3], Jesse Hamilton[4], Shivani Pahwa[2], Katherine Wright[2], Yun Jiang[2], Joshua Batesole[2], Mark Griswold[2,4], Nicole Seiberlich[2,4], and Vikas Gulani[2,4]
		[1]School of Medicine, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, Case Western Reserve University, Cleveland, OH, United States, [3]Radiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [4]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States
		T_1 and T_2 mapping of abdominal organs provides valuable information for characterization of abdominal pathologies, but is limited by technical difficulties. Previous work has demonstrated the utility of MR Fingerprinting (MRF) for abdominal relaxometry. However, there are still limited normative data for different abdominal organs. In this study, 2D MRF was applied to 22 subjects to establish normative values for abdominal organs at 3T and assess repeatability. Our results demonstrated a good agreement with the literature and repeatability of the measurement. The values obtained in this study can also serve as a reference for future clinical studies.

4254	Computer 104	Dictionary free anatomical segmentation of Magnetic Resonance Fingerprinting brain data with Independent Component Analysis
		Rasim Boyacioglu[1], Dan Ma[1], Debra McGivney[1], Louisa Onyewadume[1], Ozden Kilinc[1], Chaitra Badve[1,2], Vikas Gulani[1,2], and Mark Griswold[1,2]
		[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, University Hospitals, Cleveland, OH, United States
		Magnetic Resonance Fingerprinting signal evolutions are sensitized to certain tissue properties during data acquisition. The matching step can be suboptimal due to dictionary limitations or tissue related constraints (e.g. partial volume, magnetization exchange). Here, we propose to apply Independent Component Analysis (ICA) to 4D MRF data after image reconstruction without explicit dictionary matching for tissue characterization, lifting the requirement for a relaxation model. ICA of whole brain MRF data segments the brain into multiple components with single tissue types such as gray matter, white matter and CSF for healthy subjects and also tumor in the case of glioblastoma patients.

4255	Computer 105	Prostate cancer tissue characterization with spatio-temporal analysis of Magnetic Resonance Fingerprinting data Rasim Boyacioglu[1], Ananya Panda[1], Yun Jiang[1], Debra McGivney[1], Vikas Gulani[1,2], and Mark Griswold[1,2] *[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, University Hospitals, Cleveland, OH, United States* Multiple tissue properties (T1, T2, diffusion, etc.) and system parameters can be acquired simultaneously with Magnetic Resonance Fingerprinting (MRF). The dictionary formation and matching steps may be confounded by the lack of certain tissue properties (e.g. magnetization exchange) in the dictionary and thus, the differentiation of tissues of interest may be suboptimal even though variable MRF signal evolutions set them apart. Here, as a dictionary-free alternative, spatio-temporal analysis of MRF time series is proposed for tissue characterization. Independent Component Analysis (ICA) based correlation analysis of prostate MRF data can distinguish between healthy and cancer tissue without explicit dictionary matching.

4256	Computer 106	Magnetic Resonance Fingerprinting (MRF) Can Reveal Microstructural Variations in the Brain Gray Matter Shahrzad Moeiniyan Bagheri[1], Viktor Vegh[1], and David C Reutens[1] *[1]Centre for Advanced Imaging, The University of Queensland, ST LUCIA, Australia* The importance of creating accurate anatomical maps of the human brain has motivated the development of in vivo, observer-independent and reproducible mapping methods that account for inter-individual variation. However, a) whole brain coverage and b) a multi-modal approach that accounts for the combined effects of all microscale tissue properties has yet to be developed. To bridge this gap, we propose a statistical feature-based residual analysis framework that makes use of unique tissue-specific MRF signals after taking account of T1 and T2* effects. In four cortical areas of six participants, this approach showed consistent similarity measurements between regions, indicating that MRF signals contain information about micro-level tissue properties.

4257	Computer 107	MRF-FrM: A Preliminary Study on Improving Magnetic Resonance Fingerprinting Using Fractional-order Models Haifeng Wang[1], Leslie Ying[2], Xin Liu[1], Hairong Zheng[1], and Dong Liang[1] *[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Biomedical Engineering and Department of Electrical Engineering, The State University of New York, Buffalo, NY, United States*

		Magnetic resonance fingerprinting (MRF) is an exceptional promise for simultaneous quantification of T1 and T2 maps, based on the traditional Bloch equation formalism of MR and numerous readouts. In this work, a Fractional-order model of the Bloch equations is applied to create the dictionary of the T1 and T2 maps used in MRF. The simulations show that the proposed method can improve the evaluation accuracy of the T1 and T2 maps comparing with the conventional MRF methods with the traditional first-order model of the Bloch simulation.

4258	Computer 108	Hybrid-State Free Precession for Measuring Magnetic Resonance Relaxation Times
		Jakob Assländer[1,2], Daniel K Sodickson[1,2,3], Riccardo Lattanzi[1,2,3], and Martijn Cloos[1,2]
		[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Dept. of Radiology, New York University School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Dept. of Radiology, New York University School of Medicine, New York, NY, United States, [3]Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States
		This work analyzes the spin physics in steady-state free precession sequences modified to smoothly vary sequence parameters, as suggested in MR Fingerprinting. We arrive at the conclusion that a transient state develops only in one direction, while the magnetization in the other two dimensions transitions adiabatically between steady states. We provide solutions of the Bloch Equations for this hybrid state and demonstrate the superior T_1- and T_2-encoding performance of the hybrid state compared to the steady state.

4259	Computer 109	DICTIONARY-FREE MR FINGERPRINTING PARAMETER ESTIMATION VIA INVERSE REGRESSION
		Fabien Boux[1], Florence Forbes[2], Julyan Arbel[2], and Emmanuel L. Barbier[1]
		[1]Grenoble Institut des Neurosciences, La Tronche, France, [2]Inria, Montbonnot, France
		MR Fingerprint requires an exhaustive search in a dictionary, which even for moderately sized problems, becomes costly and possibly intractable. In this work, we propose an alternative approach: instead of an exhaustive search for every signal, we use the dictionary to learn the functional relationship between signals and parameters. This allows the direct estimation of parameters without the need of searching through the dictionary. The comparison between a standard grid search and the proposed approach suggest that MR Fingerprinting could benefit from a regression approach to limit dictionary size and fasten computation time.

4260	Computer 110	Fast parameter mapping at 7T with SSFP MR Fingerprinting using 3D radial trajectories

		Guido Buonincontri[1,2], Pedro A Gómez[1,3], Matteo Cencini[1,4], Giada Fallo[1,4], Laura Biagi[1,5], Rolf F Schulte[6], and Michela Tosetti[1,5]
		[1]IMAGO7 Foundation, Pisa, Italy, [2]National Institute for Nuclear Physics, Pisa, Italy, [3]Technische Universitat Munchen, Munich, Germany, [4]University of Pisa, Pisa, Italy, [5]IRCCS Fondazione Stella Maris, Pisa, Italy, [6]GE Healthcare, Munich, Germany
		When using ultra-high field MRI scanners (UHF, B0>= 7T), quantitative imaging is challenging due to B0 and B1+ non-uniformities. Magnetic resonance fingerprinting (MRF) represents a great opportunity for quantitative imaging at UHF as it can estimate these effects at the same time of the parameters of interest. Here, we demonstrate in vivo at 7T a novel 3D MRF approach based on a three-dimensional radial k-space acquisition, estimating M0, T1, T2 and B1+ simultaneously in 5 minutes.

4261	Computer 111	MORE-MRF: Towards Motion Resolved Cardiac Multi-Parametric Mapping with Magnetic Resonance Fingerprinting
		Olivier Jaubert[1], Gastao Cruz[1], Torben Schneider[2], Rene Botnar[1], Daniel Rueckert[3], and Claudia Prieto[1]
		[1]Biomedical Engineering, King's College London, London, United Kingdom, [2]Philips Healthcare, London, United Kingdom, [3]Department of Computing, Imperial College, London, United Kingdom
		Magnetic Resonance Fingerprinting (MRF) estimates multi-parametric maps simultaneously with short acquisition times. Cardiac MRF has been recently proposed to quantify myocardial T_1 and T_2 maps for 2D single-phase cardiac imaging. This ECG-triggered breath–hold approach provides a single-phase cardiac image and uses a non-continuous (segmented) acquisition. Here we sought to investigate myocardial MRF at multiple cardiac phases from a continuous acquisition, which could simultaneously provide cardiac function and quantitative tissue characterisation. The proposed approach was evaluated in simulations and healthy subjects, considering eight cardiac phases per cycle.

4262	Computer 112	Unbalanced Steady-State Free Precession MR Fingerprinting with Simultaneous Fat Signal Fraction, T1, T2 and B0 Estimation
		Jason Ostenson[1,2], Bruce M. Damon[1,2,3,4,5], and E. Brian Welch[1,3,5]
		[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Program in Chemical and Physical Biology, Vanderbilt University, Nashville, TN, United States, [3]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States, [4]Molecular Physiology and Biophysics, Vanderbilt University, Nashville, TN, United States, [5]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States

		Unbalanced steady-state free precession MR fingerprinting (uSSFP-MRF) may be used to quantify fat signal as well as water T1 and T2, but is subject to off-resonance (B0) and blurring. We propose a variable echo time uSSFP and post-processing method that estimates fat signal fraction, water T1 and T2, and B0 within a single sequence. The method is tested in phantoms and in vivo. Preliminary results indicate the proposed method provides sharp fat fraction maps that account for chemical-shift and B0 effects that normally lead to blurring, as well as generate water-only T1 and T2 maps.

4263	Computer 113	Multiband Multi-slab Magnetic Resonance Fingerprinting Using Overlapping Slabs and Temporal-Sharing Reconstruction
		Di Cui[1], Hing-Chiu Chang[1], Queenie Chan[2], Xiaoxi Liu[1], and Edward S Hui[1]
		[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]Philips Healthcare, Hong Kong, Hong Kong
		Magnetic Resonance Fingerprinting (MRF) is a novel and rapid technique to quantify multiple MR parameters, and single-slab MRF was later developed for better slice coverage. In this study, we proposed a new method to extend single-slab MRF to multiband multi-slab acquisition. The slab boundary artifacts due to imperfect slab profile in multi-slab acquisition is overcome by a overlapping-slab acquisition strategy, and MRF reconstruction from the multiband multi-slab data can be obtained using our previously proposed temporal sharing reconstruction method.

4264	Computer 114	Influence of Off-resonance on FISP Magnetic Resonance Fingerprinting (FISP-MRF)
		Bartosz Guzek[1,2], Gregor Körzdörfer[1,3], Mathias Nittka[1], and Josef Pfeuffer[1]
		[1]Siemens Healthcare GmbH, Application Development, Erlangen, Germany, [2]Georg-August-Universität Göttingen, Göttingen, Germany, [3]Friedrich-Alexander Universität Erlangen-Nürnberg, Erlangen, Germany
		FISP-MRF is a robust method to acquire T1 and T2 maps. The unbalanced gradient in slice-selection direction should reduce the sensitivity of FISP-MRF on off-resonances. This work investigated the dependency of T1 and T2 values on field inhomogeneities in simulations and measurements on phantoms and in vivo by applying different spatial magnetic field offsets. Depending on the sequence implementation, the measured T1 and T2 values were altered in different ways by the off-resonances. Outcomes showed that the actual implementation of the dephasing moment strongly affects the results. Using a constant instead of variable TR further reduced the sensitivity to off-resonances.

4265	Computer 115	Balanced multi-shot EPI for accelerated Cartesian MR Fingerprinting: An alternative to spiral MR Fingerprinting

		Arnold Julian Vinoj Benjamin[1,2], Pedro A. Gómez[3,4], Mohammad Golbabaee[1], Zaid Mahbub[2], Tim Sprenger[4], Marion I. Menzel[4], Michael Davies[1], and Ian Marshall[2]
		[1]School of Engineering, Institute for Digital Communications, University of Edinburgh, Edinburgh, United Kingdom, [2]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom, [3]Computer Science, Technische Universität München, Munich, Germany, [4]GE Global Research, Munich, Germany
		This study shows the practical implementation of an accelerated Cartesian Magnetic Resonance Fingerprinting (MRF) scheme using a multi-shot Echo Planar Imaging (EPI) readout. Its performance is compared with conventional spiral MRF and the fast convergence of accelerated iterative reconstructions for this method is shown.

4266	Computer 116	Acceleration of the Cartesian acquisition of MR fingerprinting using the keyhole acquisition and view-sharing reconstruction
		Ryoichi Sasaki[1] and Yasuhiko Terada[1]
		[1]Institute of Applied Physics, University of Tsukuba, Tsukuba, Japan
		MR fingerprinting (MRF) is a promising approach that enables quantification of multiple tissue parameters at a single scan. MRF uses spiral sampling which requires a high fidelity of gradient hardware. Meanwhile, MRF with the Cartesian sampling is feasible for conventional scanners with the moderate hardware fidelity, but it comes at the cost of the elongation of the acquisition time. Here we propose an acceleration method for the Cartesian MRF acquisition that enables the 8-fold acceleration. The quantitative errors and undersampling artifacts in the T_1 and T_2 maps are alleviated by using the keyhole acquisition and view-sharing reconstruction.

4267	Computer 117	Bloch-Torrey Simulation to Quantify Diffusion Effects on Multi-Parametric Sequences with Application for MR Fingerprinting
		Inbar Seroussi[1], Nir Sochen[1,2], Noam Ben-Eliezer[2,3,4], and Ofer Pasternak [5]
		[1]Mathematics, Tel Aviv University, Tel Aviv, Israel, [2]Sagol School of Neuroscience, Tel Aviv university, Tel Aviv, Israel, [3]Biomedical engineering, Tel Aviv University, Tel Aviv, Israel, [4]Center for Advanced Imaging Innovation and Research, New York University, New York, NY, United States, [5]Psychiatry and Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

		Quantifying the effect of self-diffusion on multi-parametric sequences, such as those used for Magnetic Resonance Fingerprinting (MRF) is important to increase the accuracy of dictionary based parameter estimation. To quantify diffusion, we propose a signal simulation approach, which replaces the Bloch equation with the Bloch-Torrey equation, and accounts for protocol and scan dependent parameters. We apply this framework on a Multi Spin Echo (MSE) protocol and quantify the diffusion encoding introduced by the spoiler gradients in this sequence. We further show that increasing the spoiler strength would allow detecting diffusion by including the diffusion effect in the dictionary.

4268	Computer 118	High-dimensional and accurate dictionary fitting with B-spline interpolation and gradient-based optimization
		Willem van Valenberg[1,2], Stefan Klein[2], Frans M. Vos[1,3], Lucas J. van Vliet[1], and Dirk H.J. Poot[1,2]
		[1]Quantitative Imaging Group, Delft University of Technology, Delft, Netherlands, [2]Biomedical Imaging Group, Erasmus Medical Center, Rotterdam, Netherlands, [3]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands
		Dictionary matching in MR fingerprinting acquisitions quantifying many parameters, such as T_1 T_2, T_2', B_0, B_1^+, and PD, becomes prohibitively expensive due to the dense grid in each dimension of the dictionary that is required. In this work we propose B-spline interpolation of the dictionary to reduce the dictionary size and to enable efficient nonlinear least-squares fitting by gradient-based optimization methods. The experiments show that the method substantially reduces fitting error, especially when the SNR is high and dictionary resolution is the limiting factor for improving the precision of the quantitative parameters.

4269	Computer 119	Accelerated Magnetic Resonance Fingerprinting Using Convolutional Neural Network
		Ying Liao[1], Qiang Zhang[1], Di Cui[2], Edward Sai-Kam Hui[2], and Huijun Chen[1]
		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China, [2]Department of Diagnostic Radiology, The University of Hong Kong, Pokfulam, Hong Kong
		The purpose of this work is to accelerate the acquisition of Magnetic Resonance Fingerprinting (MRF) using Convolutional Neural Network (CNN). Compared with traditional MRF reconstruction using 1000 time points, our CNN model shows better reconstruction fidelity in T_2 and similar reconstruction fidelity in T_1 using 300 time points. Our study suggests that CNN-based method may be an effective tool in the acceleration of MRF reconstruction.

4270	Computer 120	Simultaneous Diffusion, PD, T1, and T2 Mapping with Optimized MR Fingerprinting EPI

		Ouri Cohen[1,2] and Matthew S. Rosen[1,2]
		[1]Radiology, MGH Athinoula A. Martinos Center/Harvard Medical School, Charlestown, MA, United States, [2]Physics, Harvard University, Cambridge, MA, United States
		MR Fingerprinting (MRF) is a recent technique for simultaneous acquisition of multi-parametric tissue maps. Beyond the proton density (PD), T1 and T2 maps routinely obtained with conventional MRF sequences, quantitative diffusion maps are of great clinical interest but are challenging to acquire due to long scan times and poor resolution. In previous work we've demonstrated an optimized MRF EPI sequence that allows short scan times. Here we characterize its diffusion sensitivity and demonstrate its potential for simultaneous mapping of PD, T1, T2 and diffusion.

Electronic Poster

RF Coils & Arrays

Exhibition Hall	Tuesday 16:15 - 17:15

4271	Computer 1	Multi-row and Loopole-type Self-decoupled RF Coils
		Xinqiang Yan[1,2], John C. Gore[1,2,3], and William A. Grissom[1,2,3]
		[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Department of Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States, [3]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States
		Self-decoupled coils that do not require additional decoupling treatments provide increased freedom for RF array design. However, only a single-row array was demonstrated in the initial work and it is not clear whether this design can be applied to multi-row arrays. Furthermore, the initial self-decoupled coil was fed in a horizontal conductor and thus its B_1 field was same as that of a conventional loop. If fed at a corner or in a vertical conductor, the self-decoupled coil may exhibit asymmetric currents and act as a "loopole" which can be used to improve transmit or receive performance. In this work, we proposed several solutions for multi-row arrays and also investigate loopole-type self-decoupled coils. We found that the self-decoupled coil design can be applied to multi-row arrays with a simple modification (fed at corner) or adding another decoupling method (such as overlapping). The self-decoupled method could also be used to improve transmit efficiency and SNR by optimizing the feed port's positions.

4272	Computer 2	A Split 8-channel 7T Knee Coil
		Xinqiang Yan[1,2], John C. Gore[1,2,3], and William A. Grissom[1,2,3]

[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Department of Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States, [3]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States

Split coil designs are attractive to provide easy access and tight-fitting for patients. A common split coil uses plug connectors to join the two halves together. But this requires additional mechanical design to ensure a robust and reliable connection. In this work, we propose a novel split array coil for 7T knee imaging where the two halves are electrically isolated from each other and do not need any geometrical constraints such as overlapping. The array comprises mixed self-decoupled loop coils and conventional loop coils, which can be split between the self-decoupled coils because they are intrinsically decoupled. This design also allows their distance to be slightly adjusted for different subjects and adapt to more of the population, while fitting tightly around the anatomy for higher sensitivity.

4273 | Computer 3

Application of Asymmetric Mode Ladder Resonators for Improved Efficiency of Individual Elements in Transceive Arrays

Adam Maunder[1], Fraser Robb[1,2], Madhwesha Rao[1], and Jim Wild[1]

[1]POLARIS, Academic Radiology, University of Sheffield, Sheffield, United Kingdom, [2]GE Healthcare Inc., Aurora, OH, United States

Conventional vest coil designs typically have less homogeneous excitation and higher SAR than volume resonators. Here we introduce a hybrid of a ladder resonator and transceiver array to provide the individual benefits of both. A network theory approach is presented for the calculation of tuning values. Simulation and measurement of a two ladder element transmit array with three loop sections each is demonstrated. Additionally, the six individual loop sections are employed as separate receive coil elements. Improved transmit homogeneity and lower specific absorption ratio is observed in simulation against a comparable transmit vest coil array. The tuning and transmit field homogeneity is verified through measurement of imaging performance.

4274 | Computer 4

8-channel whole-brain center-fed dipoles with quadrature frontal loops coil array

Jérémie Clément[1], Sandra Da Costa[2], Rolf Gruetter[1,3,4], and Özlem Ipek[2]

[1]LIFMET, EPFL, Lausanne, Switzerland, [2]CIBM-AIT, EPFL, Lausanne, Switzerland, [3]Department of Radiology, University of Lausanne, Lausanne, Switzerland, [4]Department of Radiology, University of Geneva, Geneva, Switzerland

		To achieve highly efficient whole-brain coverage, including cerebral cortex and cerebellum, a single-row 8-channel RF coil array, built with center-fed dipoles, was investigated. B_1^+ maps and anatomical images were acquired on the human brain for RF phases optimized over the whole-brain and high transmit field performances were shown in both cerebral cortex and cerebellum with good homogeneity. Functional MRI data was acquired on auditory cortices and demonstrated higher robustness compared to a commercial volume coil.

4275	Computer 5	Experimental and numerical evaluations of simultaneously excitable Eigenmodes in a 20-channel transmit RF array for 7 Tesla human MRI
		Tales Santini[1], Yujuan Zhao[1], Sossena Wood[1], Junghwan Kim[1], Nadim Farhat[1], Narayanan Krishnamurthy[1], Tiejun Zhao[2], and Tamer S. Ibrahim[1]
		[1]University of Pittsburgh, Pittsburgh, PA, United States, [2]Siemens Medical Solutions, Tarrytown, NY, United States
		The Eigenmodes of a 20-channel Tic-Tac-Toe RF array are presented and analyzed. The Eigenmodes were calculated for each excitation level in Z (static magnetic field) direction, resulting in 4 modes per level and 20 in total. FDTD simulations and in-vivo experiments were performed. Quadrature mode is the most efficient, and generally excites the center of the brain; Anti-quadrature mode excites the head periphery; and the Zero-phase mode excites the cerebellum. Up to 5 modes can be excited simultaneously which can potentially result in a homogenous B1+ pattern and low levels of Average/peak SAR.

4276	Computer 6	SNR Improvement of In Vivo 31P MRSI in Human Brain using Head-Shape Ultrahigh Dielectric Constant Material at 7T
		Byeong-Yeul Lee[1], Xiao-Hong Zhu[1], Sebastian Rupprecht[2], Maryam Sarkarat[3], Michael T. Lanagan[3], Qing X. Yang[2], and Wei Chen[1]
		[1]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota Medical School, Minneapolis, MN, United States, [2]Center for Nuclear Magnetic Resonance Research, Department of Radiology, The Penn State College of Medicine, Hershey, PA, United States, [3]Department of Engineering and Science and Mechanics, The Penn State College of Engineering, University Park, PA, United States
		Increased RF power (thus, higher SAR) and inadequate detection sensitivity (or SNR) even at high/ultrahigh field are the major challenges for X-nuclei MRS imaging (MRSI) for human applications. In this work, we demonstrate that using the ultrahigh dielectric constant material (uHDM) conformed to the human head incorporated into the RF head volume coil, improved detection sensitivity and reduced demand of RF transmit power were achieved across an entire object for testing phantom and human brain ^{31}P MRSI at 7T. Therefore, incorporating optimized geometry of uHDM with RF coil can significantly boost SNR and reduce SAR in X-nuclei MRS applications, ultimately, improve spatiotemporal resolution.

4277	Computer 7	High-accuracy SNR calculation for multi-channel receiver coils with electromagnetic simulation considering coil-component losses Kohjiro Iwasawa[1], Yosuke Otake[1], Hisaaki Ochi[1], Hideta Habara[2], Masayoshi Dohata[2], and Yoshihisa Soutome[1] *[1]Research & Development Group, Hitachi, Ltd., Tokyo, Japan, [2]Healthcare Business Unit, Hitachi, Ltd., Tokyo, Japan* Electromagnetic simulation is a powerful tool to evaluate optimal radio frequency (RF) coil design without costly prototypes. However, RF receiver coils have accessory circuits, such as decoupler circuits, that make it difficult to reflect accurate coil loss. This leads to calculation error which can be non-negligible even in high static magnetic fields, especially for small loop coils. We measured the coil-component losses and took them into account for the simulation to calculate the signal-to-noise ratio (SNR). The calculated SNR had less than 5% error when compared to SNR measured with a 1.5-T MRI scanner for 10-channel receiver-array coils, confirming high accuracy of multi-channel SNR simulation.

4278	Computer 8	A 16-channel Dense Array for Macaque Cortices Imaging at 7T Xiaotong Zhang[1,2,3], Yang Gao[1,2], Meizhen Qian[1,4], Yi Sun[5], and Anna Wang Roe[1,2] *[1]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou, China, [2]College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [3]Key Laboratory for Biomedical Engineering of Ministry of Education, Zhejiang University, Hangzhou, China, [4]School of Medicine, Zhejiang University, Hangzhou, China, [5]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China* To improve the SNR and time efficiency of monkey brain imaging, we designed a multi-channel dense receive array for use at 7T. It can be flexibly mounted over the monkey's head and can be used for studies in both awake and anesthetized conditions. The aim of the current design focuses on visualizing sub-millimeter tissue structure and probing neuronal activities in cortices of macaques, and as demonstrated in the experiment results, good SNR and tSNR are attained in cortical layers and up to ~1cm depth beneath the skull. The area of B1 sensitivity is large enough to encompass any area of the visual cortex.

4279	Computer 9	Evaluation of Egyptian axe dipole antenna as an array element for head imaging at 7T MRI Irena Zivkovic[1], Thomas O'Reilly[1], Wyger Brink[1], and Andrew Webb[1] *[1]Radiology Department, C.J. Gorter Center for High Field MRI, Leiden University Medical Center, Leiden, Netherlands*

		In this abstract we propose a new antenna design as a transmit array element for proton head imaging at 7T that combines a small feeding dipole that is capacitively coupled, as a so-called 'indirect' or 'passive' feed, to an 'Egyptian' axe dipole. B_1^+ and SAR efficiency of the proposed antenna have been compared numerically with a conventional dipole antenna of the same length. A head array consisting of eight antenna elements has been constructed and tested. This array element offers a large reduction in SAR compared to equally sized linear dipoles while maintaining their B_1^+ profile as well as reducing the impact of antenna loading on the resonance frequency.

4280	Computer 10	Marmoset coil arrays for functional imaging of awake monkeys at 9.4T and 3T
		Azma Mareyam[1], Jitendra Sharma[1,2,3], Mitul Desai[4], Christin Y Sander[1,2], Eric Frederick[5], Benjamin B Bartelle[4], Atsushi Takahashi[1,6], and Lawrence L Wald[1,2]
		[1]Department of Radiology, A.A Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Department of Brain and Cognitive Sciences, MIT, Cambridge, MA, United States, [4]Department of Bioengineering, MIT, Cambridge, MA, United States, [5]Bruker Biospin, Billerica, MA, United States, [6]McGovern Institute for Brain Research, MIT, Cambridge, MA, United States
		High-field functional MRI of non-human primates provides elevated BOLD contrast in a well-established neuroscience model but requires an optimized coil design to boost the SNR, facilitate image acceleration while maintaining mechanical and electrical stability during the awake primate experiment. In this work we have constructed and tested 4-channel 9.4T and a 5-channel 3T receive-only array optimized for high-resolution whole-brain imaging of the anesthetized and awake marmosets.

4281	Computer 11	One for all: Ultra-wideband (279-500MHz) self-grounded bow-tie antenna for ultrahigh-field and thermal MR
		Lukas Winter[1], Hana Dobšíček Trefná[2], Yiyi Ji[1], Till Huelnhagen[1], and Thoralf Niendorf[1,3,4]
		[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max-Delbrück Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [2]Department of Signals and Systems, Chalmers University of Technology, Gothenburg, Sweden, [3]Experimental and Clinical Research Center (ECRC), a joint cooperation between the Charité Medical Faculty and the Max-Delbrück Center for Molecular Medicine, Berlin, Germany, [4]MRI.TOOLS GmbH, Berlin, Germany
		A compact self-grounded ultra-wideband bow-tie antenna is presented that operates in a frequency range from 279 MHz (^{19}F at 7.0 T) up to 500 MHz (^{1}H at 11.7 T). The antenna is smaller and lighter than previous designs making it an excellent candidate for high density multi-channel transmit/receive arrays. It can be driven directly at 50Ω eliminating the need for a tuning/matching circuit and associated component losses and costs. The ultra-wideband antenna was tested successfully in-vivo at 7.0 T for ^{19}F and ^{1}H imaging. Its design supports high average power applications such as targeted RF heating or thermal MR.

4282	Computer 12	Development of a dedicated laryngeal surface coil for improved high resolution imaging in laryngeal cancer Thomas Ruytenberg[1], Berit Verbist[1], Jordi Vonk-Van Oosten[1], Paul de Bruin[1], Eleftheria Asteinidou[1], Elisabeth Sjogren[1], and Andrew Webb[1] *[1]Leiden University Medical Center, Leiden, Netherlands* A dedicated 4-channel larynx coil at 3T has been developed, allowing for high-resolution (1 mm isotropic) imaging of the larynx. The coil is flexible and can therefore be used on a radiotherapy mask to allow in-mask scanning of the larynx for radiotherapy planning purposes. Breathing and swallowing artefacts were eliminated using respiratory triggering and artefacts arising from pulsatile flow were suppressed using a saturation pulse. The improved image quality and resolution helps in assessing whether transoral surgical approaches on laryngeal tumors are possible.

4283	Computer 13	Improved transmit efficiency with Slotted Microstrip Transmission Line RF Coil Element for Ultra-high magnetic field MR Imaging Vijayaraghavan Panda[1], Siva Sai Krishna Puranam[1], Lance Delabarre[2], Gregor Adriany[1,2], and Anand Gopinath[1] *[1]Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN, United States, [2]Radiology, Center for Magnetic Resonance Research, Minneapolis, MN, United States* Slots are introduced to the standard microstrip transmission line RF coil element, to enhance the current density and obtain better improved transmit efficiency. A prototype of such a slotted microstrip element is compared with the standard microstrip element at 297.25 MHz for 7T MR scanner to show the feasibility of the design at higher magnetic fields. A 60% improvement in the transmit efficiency and increased penetration of field into the phantom are observed experimentally. The B_1^+ field distribution in both transverse and sagittal plane are shown for the comparison.

4284	Computer 14	Perfectly Conformal Coils: A Novel Method for Patterning Coils on Complex 3D Surfaces Karthik Gopalan[1], Ana C. Arias[1], and Michael Lustig[1] *[1]EECS, UC Berkeley, Berkeley, CA, United States*

		We describe a novel technique for fabricating coils on complex three dimensional surfaces. Conductors are printed on a planar sheet then vacuum formed to create arrays that perfectly conform to the body. We envision a process where a custom coil can be built to completion at the push of a button. Through a combination of 3D scanning, RF modeling, and mechanical simulation, coils could be rapidly manufactured for any body part. Here, we demonstrate the first steps toward our goal by building a 3 channel posterior head coil and scanning in vivo at 3T.

4285	Computer 15	A 3He/1H Switched Frequency High-Pass Birdcage Coil for Hyperpolarized 3He Imaging in Neonates at 1.5 T
		Ronald G Pratt[1], Randy O Giaquinto[1], Christopher M Ireland[1,2], Barret Daniels[3], Wolfgang Loew[1], Nara S Higano[4,5], Robert Thomen[6], Jason C Woods[4,7], and Charles L Dumoulin[1]
		[1]Imaging Research Center/Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [2]Department of Biomedical Engineering, University of Cincinnati, Cincinnati, OH, United States, [3]CanonUSA, Cambridge, MA, United States, [4]Pulmonary Imaging Research Center/Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [5]Department of Physics, Washington University in St. Louis, St. Louis, MO, United States, [6]Departments of Radiology and BioEngineering, University of Missouri-Columbia, Columbia, MO, United States, [7]Division of Pulmonary Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States
		We report details on the fabrication and performance of a transmit/receive $^{3}He/^{1}H$ switched frequency 16 rung high-pass birdcage coil for neonatal imaging at 1.5 Tesla. The coil enables collection of ^{3}He images of neonatal lungs inflated with hyperpolarized ^{3}He gas and ultra-short echo time (UTE) ^{1}H images. Rotation of a shaft in the coil housing shifts the coil between ^{3}He and ^{1}H operating modes. ^{3}He and UTE ^{1}H images of explanted lungs inflated with hyperpolarized ^{3}He gas collected using the coil demonstrate the excellent image quality achieved with the coil.

4286	Computer 16	Comparison of single-loop endoluminal receiver coils based on serial or parallel active decoupling circuits using controllable MEMS switches
		HAMZA RAKI[1,2], ISABELLE SANIOUR[1], FRASER ROBB[3], KEVIN TSE VE KOON[1], HENRI SOUCHAY[2], SIMON A. LAMBERT[1], and OLIVIER BEUF[1]
		[1]Univ. Lyon, INSA-Lyon, Université Claude Bernard Lyon 1, UJM-Saint Etienne, CNRS, Inserm, CREATIS UMR 5220, U1206, F-69000, LYON, France, [2]General Electric Healthcare, Buc, France, [3]General Electric Healthcare, Aurora, OH, United States

		Two prototypes of single-loop endoluminal receiver coils integrating serial and parallel active decoupling circuits using controllable MEMS switches were built and compared to a reference coil with PIN-diode circuit. Parallel MEMS coil had a significantly higher quality factor compared to the serial MEMS coil and the reference coil. The switching delays of both MEMS coils were about few microseconds (< 8μs). The characterization on 3.0T MRI system showed comparable signal intensity distribution for the different coil configurations.

4287	Computer 17	Wavelength independent λ/40 Composite Right/Left-Handed Transmission Line Coil
		Dongyean Koh[1], Jörg Felder[1], Chang-Hoon Choi[1], and N. Jon Shah[1,2,3]
		[1]INM-4, Forschungszentrum Jülich, Jülich, Germany, [2]Department of Neurology, JARA, RWTH Aachen University, Aachen, Germany, [3]INM-11, Forschungszentrum Jülich, Jülich, Germany
		A Dual Series (DS) Composite Right/Left Handed (CRLH) Microstrip Transmission Line (MTL) coil for MRI was designed and verified in a commercial 3T Scanner. According to metamaterial theory, we demonstrate the existence of the right-handed leaky mode to be in the UHF region. For design proposes we propose an equivalent circuit parameter extraction method and demonstrate that the phase velocity of the DS-CRLH MTL coil's guided mode is located in a fast wave region.

4288	Computer 18	A receive-only, double-tune coil using preamplifier decoupling
		YongHyun Ha[1], Chang-Hoon Choi[1], Jörg Felder[1], and N. Jon Shah[1,2]
		[1]Institute of Neuroscience and Medicine - 4, Forschungszentrum Jülich, Juelich, Germany, [2]Faculty of Medicine, Department of Neurology, JARA, RWTH Aachen University, Aachen, Germany
		In this work we describe two methods for the double-tuned receive only coil design using preamplifier decoupling. Both the *LC* trap and the lattice balun can be integrated into the receive line to isolate signals resonant at two different frequencies. It was found that the method using *LC* traps was more effective when the coils were tuned at a higher frequency (normally proton), while the lattice balun method provided higher blocking impedance for the X-nuclei coil.

4289	Computer 19	Anatomically adaptive coils for MR Imaging – A 6-channel Demonstrator Array study at 1.5 Tesla
		Bernhard Gruber[1] and Stephan Zink[2]
		[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Siemens Healthcare GmbH, Erlangen, Germany

		Many of today's MR coils are still somehow rigid and inflexible in their size. Even highly flexible arrays basically maintain only one specific body-part in a defined range. Anatomically adaptive coils potentially provide the necessary freedom to have a *one-size-fits-all* design for MRI in clinic. This would lower costs, improve the signal-to-noise ratio (SNR) and increase the patient comfort. To evaluate the potential SNR improvement of adaptive arrays, maintaining an optimal filling factor, a 6-channel Demonstrator array setup, comprised of stretchable loop elements at 1.5T with equal electrical properties as standard elements, was used.

4290	Computer 20	A 256-channel Cardiac Coil for accelerated Cardiac Imaging at 3 Tesla - Evaluation of a 32-channel Prototype
		Bernhard Gruber[1], Arjan D. Hendriks[1], Cezar Alborahal[2], Gustav J. Strijkers[3], Dennis W.J. Klomp[1,2], Tim Leiner[1], and Martijn Froeling[1]
		[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]MR Coils B.V., Zaltbommel, Netherlands, [3]Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands
		There is an urgent need for highly accelerated cardiac imaging to facilitate shorter examination times and increased patient comfort. The purpose of this study was to investigate if a large number of small surface coils can increase the maximal obtainable acceleration factor, by maximizing SNR and minimizing the g-factor. We demonstrate the potential of a high-density cardiac receive array for faster cardiac imaging compared to current available MR coils. Measurements with a 32-channel cardiac prototype at 3T show a 4-fold increase in acquisition speed at similar SNR. At the cost of a small SNR-drop, 30-fold acceleration factors are possible.

4291	Computer 21	Ophthalmic magnetic resonance imaging using a 7-channel receive-only phased array coil: Quantitative image evaluation of anatomical orbital structures at 3.0 T
		Kyu-Ho Song[1], Young Han Lee[2], Min Jung Kim[2], Jin-Suck Suh[2], and Bo-Young Choe [1]
		[1]Department of Biomedical Engineering and Research Institute of Biomedical Engineering, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea, [2]Department of Radiology, Research Institute of Radiological Science, Yonsei University College of Medicine, Seoul, Korea, Seoul, Republic of Korea
		The surface coil which yields a higher signal-to-noise ratio only in small area can improve with multi-channel that each channel SNR is combined with a sum-of-squares method. This processing achieves an overall higher SNR in the region of interest (or field of view). In the present study, a 7-channel orbit array coil was developed for ophthalmic imaging. Image quality evaluation by using the designed orbit array coil was examined for imaging the eye, optical nerve, and ocular muscles with orbit.

4292	Computer 22	Establishing MR angiography of the mouse eye Gangchea Lee[1], Kenneth Kim[2], and Thomas Neuberger[1,3] *[1]Bio Engineering, Pennsylvania State University, University Park, PA, United States, [2]Biology, Pennsylvania State University, University Park, PA, United States, [3]Huck Institutes of the Life Sciences, Pennsylvania State University, University Park, PA, United States* High field Magnetic Resonance Angiography on mouse eye can be used to investigate the vasculature near the mouse eye. One of the difficulties with using on mice is the induced moving artifact. To overcome this obstacle, a custom mouse restrainer containing both a tooth bar and ear bars was designed and constructed for mouse eye imaging. The restrainer, in combination with a rigid surface coil, enabled three-dimensional mouse eye images to be captured with 30 um isotropic resolution. A three-dimensional mouse angiography was created by segmenting ocular blood vessels from these images.

4293	Computer 23	A Slot Antenna Array for Body Imaging at 7T Leeor Alon[1,2], Karthik Lakshmanan[1,2], Jan Paska[1,2], Riccardo Lattanzi[1,2], and Chris M. Collins[1,2] *[1]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States, [2]Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States* Slot antennas have been shown to be promising for body imaging at Ultra High Field (7T). In this work, a 6-channel transmit-receive slot array was constructed, quantitative evaluation of the performance was conducted and practical design features are discussed.

4294	Computer 24	RF Shimming and Improved SAR Safety for 16-Channel Transmit/Receive RF Coil Arrays for Cardiac MRI at 7T Ibrahim A. Elabyad[1], M. R. Stefanescu[1], M. Terekhov[1], Frank Resmer[2], Titus Lanz[2], and L. M. Schreiber[1] *[1]Chair of Cellular and Molecular Imaging, Comprehensive Heart Failure Center (CHFC), University Hospital, Wuerzburg, Germany, [2]Rapid Biomedical GmbH, Rimpar, Germany*

		In this work, comprehensive high resolution EM-simulations were performed for three different 16-element transmit/receive (Tx/Rx) planar RF coil arrays loaded with the anatomical Duke human model to examine their performance in cardiac magnetic resonance imaging (cMRI) at 7T. An optimization routine has been developed in MATLAB to optimize the phases for B1+ field homogeneity with minimal local SAR values within the Duke human biological model. Before B1-shimming, all arrays demonstrated approximately the same B1+ field distributions with a pronounced higher field values near to the coil surface. With phase increments of 45° phase shift between each of the 8-element pairs, the arrays generate pronounced local SAR hot spots with maximum values of 10.3, 10.1, and 9.4 W/kg for design 1, 2 and 3, respectively. In accordance with IEC regulations, the calculated 10 g averaged SAR values were found to be within the limits and the relative hot spots were found to be below 11 W/kg. RF shimming improves the B1+ field homogeneity by 24%, 49% and 40% in the central sagittal slice for design 1, 2 and 3, respectively.

Electronic Poster

Dielectrics, Metamaterials & Field Control

Exhibition Hall	Tuesday 16:15 - 17:15

4295	Computer 25	Compact and adjustable metasurface-based resonator for in-vivo MRI
		Ekaterina A. Brui[1], Alena V. Shchelokova[1], Mikhail A. Zubkov[1], Irina V. Melchakova[1], Stanislav B. Glybovski[1], Anna E. Andreychenko[1], and Alexey P. Slobozhanyuk[1]
		[1]Nanophotonics and Metamaterials, ITMO University, Saint-Petersburg, Russian Federation
		We have numerically and experimentally approved that a compact metasurface-based resonator with miniaturized capacitive load may efficiently operate as a wireless surface coil in 1.5 T MR scanner. Our results show that for a properly adjusted metasurface eigenmode resonance frequency it is possible to substantially increase the signal-to-noise ratio that was confirmed both with the phantom and *in vivo* experiments.

4296	Computer 26	Dual-nuclei metamaterial implementation for sodium and proton acquisition at 3 T
		Rita Schmidt[1,2] and Andrew Webb[1]
		[1]Leiden University Medical Center, Leiden, Netherlands, [2]Neurobiology, Weizmann Institute of Science, Rehovot, Israel

		Several studies have shown proof-of-principle implementations of metamaterials for local RF transmit efficiency and sensitivity improvement. The most common implementations are based on set of split-rings or set of wires. To support a dual-band enhancement, the design here relies on a combination of the mentioned above two types of metamaterials. Whereas in the original study we focused on 7T $^{31}P/^{1}H$ dual-band implementation, in this work we were interested to examine the possibility to extend it to much lower frequencies, namely a dual-band metamaterial for 3T $^{23}Na/^{1}H$ local signal enhancement. The implementation was examined in EM simulations and in phantom experiments at 3 T.

4297	Computer 27	Metamaterial RF Shield with Reduced Specific Absorption Rate and Improved Transmit Efficiency for 9.4 T MRI
		Haiwei Chen[1], Lei Guo[1], Mingyan Li[1], Chunyi Liu[1], Shanshan Shan[1], Yaohui Wang[2], Ewald Weber[1], Feng Liu[1], and Stuart Crozier [1]
		[1]the University of Queensland, Brisbane, Australia, [2]South China University of Technology, Guangzhou, China
		A novel RF shield using metamaterial absorber was designed for 9.4 T MRI. This new design focuses on improving the transmit efficiency of RF coils and reducing the Specific Absorption Rate (SAR) in the subject. A new layered unit cell structure of metamaterial absorber was used for constructing the RF shield. Full-wave simulation results were presented and compared with a conventional copper RF shield; the results suggest that the proposed structure could achieve improved imaging performance.

4298	Computer 28	Metamaterial Bore Liners as High-Field Body Transmit Coils: Advantages Over Standard Birdcage Coils
		Navid Hosseini[1], Justin G. Pollock[1], Ashwin K. Iyer[1], and Nicola De Zanche[2,3]
		[1]Electrical and Computer Engineering, University of Alberta, Edmonton, AB, Canada, [2]Oncology, University of Alberta, Edmonton, AB, Canada, [3]Medical Physics, Cross Cancer Institute, Edmonton, AB, Canada
		Simulations are presented of a negative-permittivity metamaterial bore liner designed to perform volume excitation at 200 MHz. The liner offers performance comparable to that of birdcage coils in terms of both field homogeneity, sensitivity and SAR, while allowing operation at frequencies beyond those where birdcage coils operate reliably.

4299	Computer 29	Evaluation of Different Coupling Schemes for a Dielectric Resonator in Magnetic Resonance Imaging at 600 MHz- a Simulation Approach
		Gangchea Lee[1], Wei Luo[2], Michael Lanangan[3], and Thomas Neuberger[1,4]

		[1]Bio Engineering, Pennsylvania State University, University Park, PA, United States, [2]Material Research Institute, Pennsylvania State University, University Park, PA, United States, [3]Engineering Science and Mechanics, Pennsylvania State University, University Park, PA, United States, [4]Huck Institutes of the Life Sciences, Pennsylvania State University, University Park, PA, United States
		The TE01δ mode of the ring Dielectric Resonator (DR) is of interest to the high field MRI community for it generates highly homogenous fields over large volumes inside the DR. The ring DRs behave differently depending on the method of coupling. Six different coupling methods using the conducting wire were simulated three dimensionally. Differences in the electromagnetic field inside the DR, depending on the coupling method, were observed in the simulation. These results were interpreted to determine the mechanism producing the highest magnetic field using triple loop coupling.

4300	Computer 30	Double Facing Miniaturized Patch Antennas with High Permittivity Plugs
		Gangchea Lee[1], Navid Gandji[2], Seokwon Jung[3], Elena Semouchkina[2], Michael Lanangan[4], and Thomas Neuberger[1,5]
		[1]Bio Engineering, Pennsylvania State University, University Park, PA, United States, [2]Electrical and Computer Engineering, Michigan Tech University, Houghton, MI, United States, [3]Mechanical and Nuclear Engineering, Pennsylvania State University, University Park, PA, United States, [4]Engineering Science and Mechanics, Pennsylvania State University, University Park, PA, United States, [5]Huck Institutes of the Life Sciences, Pennsylvania State University, University Park, PA, United States
		Substituting the conventional Radio Frequency coil (RF coil) with a patch antenna has the potential to increase the magnetic field homogeneity in large Fields Of View (FOV). The homogeneity can be improved even more when two of these antennas are facing each other. The size of the patch antennas needed to be reduced to fit inside the scanner bore to use them as RF coils. This was done via inserting high dielectric material plugs. The two facing patch antennas system was also fabricated and tested.

4301	Computer 31	Possibilities for local SAR Reduction with uHDC Material & 2 Ch pTX
		Christopher Sica[1], Sebastian Rupprecht[1], Ryan Hou[2], and Qing Yang[1,3]
		[1]Radiology, Penn State College of Medicine, Hershey, PA, United States, [2]Penn State Harrisburg, Harrisburg, PA, United States, [3]Neurosurgery, Penn State College of Medicine, Hershey, PA, United States
		Variation of the RF transmit field polarization in conjunction with the application of a uHDC monolithic block was explored within the context of reducing local SAR, through RF field simulations and B_1^+ mapping. A linear polarization in conjunction with a discrete uHDC block was found to substantially reshape the null band in the electric field, which opens new possibilities for local SAR reduction.

4302	Computer 32	Evaluation of High-dielectric Pads for Macaque Brain Imaging at 7T: A Pilot Study Jie Zhao[1,2], Wei Luo[3], Meizhen Qian[1,4], Yi Sun[5], Ling Xia[2,6], and Xiaotong Zhang[1,2,6] *[1]Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy for Advanced Studies, Zhejiang University, Hangzhou, China, [2]College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [3]Materials Research Institute, Pennsylvania State University, University Park, PA, United States, [4]School of Medicine, Zhejiang University, Hangzhou, China, [5]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China, [6]Key Laboratory for Biomedical Engineering of Ministry of Education, Zhejiang University, Hangzhou, China* Non-human-primates are a valuable model for investigating the structure and function of the brain. The high-dielectric pads have been shown to increase B_1 sensitivity and enhance image SNR and contrast locally in the human brain at high and ultra-high field. In this study, our pilot experiment results suggest that high-dielectric pads can effectively enhance macaque whole brain imaging at 7T, and in the meantime, do not increase the receive array element coupling, nor have any deterioration over the B_0 homogeneity within the monkey brain.

4303	Computer 33	Low-loss high-permittivity blocks improves the signal-to-noise ratio of surface coils at 3 Tesla Thomas O'Reilly[1], Wyger Brink[1], and Andrew Webb[1] *[1]C.J. Gorter Center, Dept. Radiology, Leiden University Medical Center, Leiden, Netherlands* The performance of surface coils for proton imaging at 3 Tesla can be improved by placing low-loss high-permittivity blocks at the centre of the surface coil. The signal-to-noise ratio in a human calf of a coil with integrated dielectric block is 25% higher close to the coil and performs comparably well compared to a standard surface coil at depths exceeding 6 cm providing a simple and effective way of improving surface coil performance.

4304	Computer 34	An electrically conductive SLA resin used for the Design of Anthropomorphic Phantoms Sossena Wood[1], Tiago Martins[2], Tales Santini[3], and Tamer S Ibrahim[3,4] *[1]Bioengineering, University of Pittsburgh, Cranberry Twp, PA, United States, [2]University of Pittsburgh, Pittsburgh, PA, United States, [3]Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States, [4]Radiology, University of Pittsburgh, Pittsburgh, PA, United States*

		In this work, we have researched the possibility of using a conductive plastic that is suitable for the design of an anthropomorphic phantom for MR testing purposes. DSM Somos® provides a clear hydrophobic SLA resin that has constitutive parameters similar to the averaged electromagnetic properties of the fat, bone, and skin. The work of Wood et al.[1] highlighted these findings using numerical B1 analysis. To further examine the electrically conductive plastic SLA resin material, we performed temperature testing on areas of the plastic material where we estimated temperature rise using a TEM resonator at 7T.

4305	Computer 35	A Hilber Curve Based Metasurface for B1+-field Enhancement
		Elizaveta Motovilova[1] and Shao Ying Huang[1,2]
		[1]Engineering Product Development, Singapore University of Technology and Design, Singapore, Singapore, [2]Department of Surgery, National University of Singapore, Singapore, Singapore
		A novel metasurface field enhancer based on Hilbert curve is presented. Its resonance behavior was studied and the B1-field enhancement with field symmetry is successfully demonstrated at 7T. On a simple loop coil model, it is shown that higher orders of Hilbert curve can form metasurfaces that increase the coil sensitivity effectively.

4306	Computer 36	Improved Efficacy of Cerebellar fMRI at 7T with Dielectric Pads Extending the Imaging Region of a Commercial Head Coil
		Manushka V. Vaidya[1,2,3], Mariana Lazar[2], Cem M. Deniz[1,2], Gillian G. Haemer[1,2,3], Gang Chen[1,2,3], Mary Bruno[2], Daniel K. Sodickson[1,2,3], Riccardo Lattanzi[1,2,3], and Christopher M. Collins[1,2,3]
		[1]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [3]Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States
		To improve cerebellar fMRI using a commercial head coil at 7T, we arranged High Permittivity Material (HPM) pads against the inferior, posterior region of the head. We first simulated the change in Specific energy Absorption Rate (SAR) with HPM and then examined the effects on experimental Signal to Noise Ratio (SNR), flip angle maps, and measured fMRI activation throughout the brain (including the cerebellum) during a finger-tapping task in eight subjects. Both SNR and fMRI BOLD contrast were improved in the cerebellum with no potential safety detriments.

4307	Computer 37	Dielectric pads for high-field MRI at 7T: a simulation study

		Shubharthi Sengupta[1] and Alard Roebroeck[1]
		[1]Dept. of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands
		Dielectric pads have been shown to offer a solution to B1+ inhomogeneity at ultra-high fields. We show the transmit field effects and SAR values generated when using shape-optimised high permittivity dielectric pads for visual cortex imaging. Using a single loop coil and a single dipole, electromagnetic simulations were undertaken to validate the use of these methods using 3 different body voxel models, their B1+ distributions mapped and maximum SAR values recorded and compared.

4308	Computer 38	Improved performance of birdcage coils using a split-ring resonator magnetic shield.
		Carel C. van Leeuwen[1], Martijn F. J. Lunenburg[2], Stanislav Glybovski[3], Peter R. Luijten[1], Dennis W. J. Klomp[1], Cornelis A. T. van den Berg[1], and Alexander J. E. Raaijmakers[1,2]
		[1]Imaging Division, University Medical Center Utrecht, Utrecht, Netherlands, [2]Eindhoven University of Technology, Eindhoven, Netherlands, [3]Itmo University, St. Petersburg, Russian Federation
		Birdcage body coils make use of an RF shield that degrades B1 homogeneity of the birdcage and increases SAR levels in body parts close to the rungs. A magnetic conductor RF shield would solve this issue. A metamaterial structure of elongated split-ring resonators (SRR) was designed to achieve an artificial magnetic conductor. Simulations and measurements with planar SRR arrays over a dipole are performed. Increased B1+ penetration into phantoms is observed, indicating the shield behaves as a magnetic conductor. Additionally simulations of a birdcage antenna with such shield are performed, which show an improved B1 homogeneity with comparable SAR levels.

4309	Computer 39	Towards high resolution fMRI at 3T with a flexible composite ultra-high dielectric constant (uHDC) material pad
		Sebastian Rupprecht[1], Christopher T Sica[2], Jianli Wang[2], Gary Yang[2], Avery Wang[2], Michael T Lanagan[3], and Qing X Yang[2]
		[1]Radiology, Penn State College of Medicine, Hershey, PA, United States, [2]Radiology, The Pennsylvania State University College of Medicine, Hershey, PA, United States, [3]Department of Engineering Sciences and Mechanics, The Pennsylvania State University, State College, PA, United States
		We developed a novel flexible pad of uHDC material and characterized the RF fields in the visual cortex at 3T in a clinical 20- and 64-channel head coil with and without this pad. This pad was then utilized in an attempted to visualize optical dominance columns via high resolution fMRI images of the visual cortex in the 20-CH head coil and compared the results of with the results of an unenhanced 64-CH head coil.

4310	Computer 40	Initial Evaluation Utilizing Ultra-High Dielectric Constant (uHDC) Materials in Breast Imaging in 3T
		Avery Wang[1], Sebastian Rupprecht[1], Christopher T. Sica[1], Angela Choe[1], Susann Schetter[1], Julie Mack[1], and Qing X. Yang[1]
		[1]Radiology, The Pennsylvania State University College of Medicine, Hershey, PA, United States
		We explored the feasibility of using high dielectric constant materials to potentially further enhance signal-noise-ratio (SNR) in breast MRI. Through computer modelling at 3 Tesla (T), we showed that there can be great benefits of increasing sensitivity and specificity of breast MRI. As a side effect of using high dielectric constant materials, the RF safety can be improved by the largely increased transmit efficiency.

4311	Computer 41	Bloch-Siegert Shift Based Method for Mapping $$$B_1^+$$$ Magnitude of Arbitrary Multi-Transmit RF Configurations
		Omer F. Oran[1], L. Martyn Klassen[1], Hacene Serrai[1], and Ravi S. Menon[1,2]
		[1]Centre for Functional and Metabolic Mapping, The University of Western Ontario, London, ON, Canada, [2]Department of Medical Biophysics, The University of Western Ontario, London, ON, Canada
		Mapping B1+ magnitude fields for any arbitrary RF-configuration of interest is desirable and often required in parallel multi-transmit systems. Conventional mapping methods work by taking either the magnitude ratio or the phase difference of MRI images, and thus they fail in regions of low MRI-signal which can easily occur for an arbitrary RF-configuration. We propose a new BSS based method which always uses the CP-mode for excitation while the RF-configuration of interest is used only for the off-resonance RF-pulse. Through this approach, the proposed method works even if the RF-configuration of interest has very-low magnitudes within the imaging volume.

4312	Computer 42	16 Channel Coupled Network Analyzer for Characterizing pTX Systems at 3T
		Michael Twieg[1], Sherry Huang[2], and Mark A Griswold[1,2]
		[1]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

		Recent work has shown parallel RF transmit (pTX) chains with increasing channel counts and complexity. At the same time, methods of controlling and monitoring pTX chains must improve, especially when faced with nonlinearities in the RFPAs. However, characterizing multichannel nonlinear RF systems is a daunting task for standard laboratory instruments. Here we present a coupled network analyzer (CNA) containing 16 independent RF transceivers which are used simultaneously by a digital acquisition unit (DAQ). Additional DAQ channels can be used for monitoring power consumption or temperature. The system may also be interfaced with an MRI scanner to function as a pTX synthesizer.

4313	Computer 43	B1 vector field mapping through multi-orientation B1+ measurements
		Seung-Kyun Lee[1,2] and Sukhoon Oh[3]
		[1]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Republic of Korea, [2]IBS Center for Neuroscience Imaging Research, Suwon, Republic of Korea, [3]Bioimaging Research Team, Korea Basic Science Institute, Cheongju, Republic of Korea
		We present theory and experimental validation of reconstruction of all three components of RF vector magnetic field (B1 vector) in MRI. Using eight-orientation B1+ magnitude mapping, the magnitudes and relative phases of all Cartesian components of B1 vector can be unambiguously determined. The method is demonstrated on a phantom in a birdcage transmit coil with a standard B1+ mapping sequence at 3T. Our method can be used to validate assumptions in MR-based electrical properties tomography (MR-EPT) and specific absorption rate (SAR) modeling.

4314	Computer 44	Improved Transmit Field Homogeneity in Simultaneous EEG-fMRI at 7T by Increasing EEG Wire Resistance
		Thanh Phong Lê[1], Özlem Ipek[2], João Jorge[1], and Rolf Gruetter[1,3,4]
		[1]Laboratory of Functional and Metabolic Imaging, École polytechnique fédérale de Lausanne (EPFL), Lausanne, Switzerland, [2]Center for Biomedical Imaging - Animal Imaging and Technology, École polytechnique fédérale de Lausanne (EPFL), Lausanne, Switzerland, [3]Department of Radiology, University of Geneva, Geneva, Switzerland, [4]Department of Radiology, University of Lausanne, Lausanne, Switzerland
		Simultaneous EEG-fMRI offers rich multimodal information of brain activity. However, data quality is adversely affected by mutual interactions. Especially at higher magnetic fields, conductive scalp EEG components cause substantial transmit field disruption. Here, electromagnetic field simulations and MR measurements at 7T performed on a realistic design of the wiring of a 64-channel EEG cap showed that transmit field attenuation and inhomogeneity are significantly reduced when wires are split into smaller lengths by resistors, suggesting a cancellation of resonant antenna effects. This offers an effective and practical solution to avoid EEG-induced MRI data degradation, maximizing the sensitivity benefits available at 7T.

4315	Computer 45	Decomposition of off-resonance fields in brain MRI Pei-Yan Li[1], Pu-Yeh Wu[1], Yi-Tien Li[1,2], Ying-Hua Chu[1], and Fa-Hsuan Lin[1] *[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [2]Department of medical imaging, Taipei Medical University-Shuang Ho Hospital, New Taipei, Taiwan* We measured the off-resonance distributions from 31 subjects and decomposed these maps into orthogonal modes by Singular Value Decomposition. We found that the six SVD modes can account for the off-resonance up to 80%. Decomposed modes of off-resonance can be used for tailored shim coil design.

4316	Computer 46	Development of Multi-Coil B0 Technology with Computer-Aided Design Software Sebastian Theilenberg[1], Yun Shang[1], Sragvi Sesha Tirumala[1], and Christoph Juchem[1,2] *[1]Department of Biomedical Engineering, Columbia University in the City of New York, New York, NY, United States, [2]Department of Radiology, Columbia University in the City of New York, New York, NY, United States* The multi-coil (MC) technique proved to enable both B_0 shimming and spatial encoding for MRI. However, to eventually establish this technology for clinical use in human subjects, it has to evolve from a proof of concept level to a professional stage. Here we present the use of computer aided design (CAD) software to overcome increased engineering challenges that are associated with complex coil geometries and larger coil currents. A customized Add-in for SolidWorks was created to convert MC designs from the text-based Public MC Information Policy format to full CAD representations and vice versa, thereby providing improved field modeling and engineering capabilities.

4317	Computer 47	Novel crusher coils for elimination of surface MR signals Richard Bowtell[1] and Harry Ellis[1] *[1]SIr Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom*

		There are multiple applications of magnetic resonance imaging and spectroscopy for which it is useful to be able to attenuate the signal that arises from surface structures. Surface signal can be attenuated by using local coils which generate a spatially varying magnetic field that decays rapidly with distance from the surface. In previous work, crushing has been accomplished by using “meander-line” coils which the current flow is predominantly along one dimension. Here we design novel crusher coils in which the current equally flows along two orthogonal directions, and demonstrate via simulations and experiments at 3 T that these coils offer advantages for surface signal crushing.

4318	Computer 48	The Effect of Noise on B0 Shimming: Is There a "g-Factor" for Shim Coils?
		Assaf Tal[1]
		[1]*Chemical and Biological Physics, Weizmann Institute of Science, Rehovot, Israel*
		Active B_0 shimming involves setting currents through a set of shim coils to minimize spatial heterogeneity of B_0 over a prescribed region. This is often phrased as a least-squares problem, based on an acquired field map. Noise in the field map "propagates" and appears as spatially dependent noise in the shimmed field. We show that the shim coils can be characterized by a noise propagation matrix, which is an intrinsic property of the coils and plays an analogous role to the g-factor in sensitivity encoding. This provides a useful metric for investigating the effect of noise in active shimming.

Electronic Poster

Breast 1

Exhibition Hall	Tuesday 16:15 - 17:15

4319	Computer 49	Development of single-sided portable NMR methods for the sensing of mammographic density
		Patricia O'Gorman[1], Monique C Tourell[1], Tonima S Ali [1], Honor J Hugo [2], Thomas Lloyd [3], Erik W Thompson [2], and Konstantin I Momot[1]
		[1]*School of Chemistry, Physics and Mechanical Engineering, Queensland University of Technology, Brisbane, Australia,* [2]*School of Biomedical Sciences, Queensland University of Technology, Brisbane, Australia,* [3]*Radiology, Princess Alexandra Hospital, Woolloongabba, Australia*

		Single-sided NMR was used to investigate the ability of spin-relaxation time constants to distinguish between regions of low and high mammographic density in human breast tissue. Measurements were performed on breast slices obtained from women undergoing breast reduction surgery or prophylactic mastectomy. T_1 values in regions of high mammographic density were found to be significantly different to those measured in regions of low mammographic density. The findings suggest that portable NMR may be suitable for quantification of mammographic density in the breast tissue, presenting a promising and low-cost means of MD assessment in vivo without the use of ionising radiation.

4320	Computer 50	Repeatability of 3D MR Fingerprinting Measurements in Normal Breast Tissue
		Ananya Panda[1], Yong Chen[2], Satyam Ghodasara[3], Katherine Wright[1], Nicole Seiberlich[4,5], Mark Alan Griswold[1,4,5], and Vikas Gulani[1,4,5]
		[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, University of North Carolina, Chapel Hill, NC, United States, [3]Case Western School of Medicine, Cleveland, OH, United States, [4]Radiology, University Hospitals Cleveland Medical Center, Cleveland, OH, United States, [5]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States
		3D Breast Magnetic Resonance Fingerprinting (MRF) allows simultaneous breast tissue T_1 and T_2 mapping. In this study, same session repeatability of 3D MRF technique in normal breast tissue was evaluated (test/retest 10 minutes apart) and in two consecutive visits. The within subject coefficient of variance (wCV) for two visit scans was < 6% for T_1 and < 5% for T_2. The wCV for test-retest scan for T_1 was <5% and for T_2 was 6.5%. One-week repeatability of 3D MRF was good for both T_1 and T_2 (ICC T_1: 0.81 T_2: 0.88 at second visit). These variations are smaller than observed inter-subject variability. Thus breast MRF may be useful for longitudinal patient follow-up.

4321	Computer 51	Repeatability of Diffusion-Weighted Imaging Model Parameters within a Benign Breast Cancer Cohort Influences Optimal Model Choice
		Neil Peter Jerome[1,2], Igor Vidic[3], Liv Egnell[2,3], Torill E. Sjøbakk[1], Agnes Østlie[2], Hans E. Fjøsne[4,5], Pål Erik Goa[2,3], and Tone F. Bathen[1]
		[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology - NTNU, Trondheim, Norway, [2]Clinic of Radiology and Nuclear Medicine, St. Olavs University Hospital, Trondheim, Norway, [3]Department of Physics, Norwegian University of Science and Technology - NTNU, Trondheim, Norway, [4]Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology - NTNU, Trondheim, Norway, [5]Department of Surgery, St. Olavs University Hospital, Trondheim, Norway

		Diffusion-weighted MR imaging (DWI) is an essential tool in oncology. Diffusion models beyond monoexponential fitting attempt to capture non-Gaussian decay using additional data acquisition. Model repeatability and suitability is critical, but often neglected. We report findings from fitting multiple diffusion models in a benign breast cancer repeatability cohort, and show no clear dominance of diffusion models across voxels, patients, or scans. Repeatability of ADC, IVIM, and stretched exponential parameters are reported, and highlight the complexity of making inferences from DWI parameters.The potential of DWI in oncology is tempered by a need for critical appraisal of the model and parameter applicability.

4322	Computer 52	Are the thousands of images generated by each ultrafast dynamic contrast enhancement (DCE) MRI of breast cancer effectively summarized by color intensity projection (CIP) images?
		Keith S Cover[1], Katya M Duvivier[1], Pim de Graaf[1], Rianne Wittenberg[1], Ruth Smit[1], Joost PA Kuijer[1], Mark MB Hofman[1], Ben J Slotman[1], and Ruud M Verdaasdonk[1]
		[1]VU University Medical Center, Amsterdam, Netherlands
		Ultrafast dynamic contrast enhancement (DCE) is a MRI sequence that, when used standalone, can serially screen for breast cancer in 2 minutes. However, each acquisition generates thousands of 2D images in a 4D stack. Color intensity projections (CIP) images are 2 parameter color images that encode the time of arrival (ToA) of contrast agent in the hue (red, orange, yellow, green, cyan, blue) and the amount of contrast enhancement in the brightness. A CIP image of each ultrafast slice provides an informative summary to radiologists with the same sensitivity and specificity to malignancies as the ultrafast 4D stack.

4323	Computer 53	Ultrafast dynamic contrast-enhanced MRI of the breast: Correlations with prognostic factors of breast cancer.
		Ken Yamaguchi[1], Takahiko Nakazono[1], Ryoko Egashira[1], and Hiroyuki Irie[1]
		[1]Department of radiology, Saga university, Saga City, Japan
		• The purpose of our study is to determine the correlation between the parameters obtained from ultrafast dynamic contrast-enhanced (ultrafast DCE) MRI and prognostic factors of breast cancer. • Fifty five breast cancers were included in this study. Ultrafast DCE sequence was performed using higher than usual parallel imaging factor and obtained with 8.3 second temporal resolution. Kinetic parameters obtained from ultrafast DCE were compared with prognostic factors. • Mean maximum slope of invasive cancer (10.2) was significantly higher than that of DCIS (8.2). • Ultrafast DCE MRI is useful for differentiating DCIS and invasive breast cancer.

4324	Computer 54	3D MRI for Quantitative Analysis of Quadrant Percent Density (QPD): Correlation with Location of Breast Cancer Growing in Different Quadrants Jeon-Hor Chen[1,2], Siwa Chan[3], Yang Zhang[1], Dah-Cherng Yeh[4], and Min-Ying Su[1] *[1]Center for Functional Onco-Imaging, Department of Radiological Sciences, University of California Irvine, Irvine, CA, United States, [2]Department of Radiology, E-Da Hospital and I-Shou University, Kaohsiung, Taiwan, [3]Department of Radiology, Tzu-Chi General Hospital, Taichung, Taiwan, [4]Breast Center, Tzu-Chi General Hospital, Taichung, Taiwan* We applied an MR-based quadrant percent density (QPD) method to investigate the association between the occurrence of cancer and the amount of dense tissue. Computer-aided method was applied to segment the breast and dense tissue, and then a breast was divided into four quadrants using nipple, centroid, and chestwall as the anatomic landmarks. In a total of 206 women, 88 (42.7%) had cancer growing in the upper-outer quadrant. Only 42 (20.4%) women had cancer growing in the quadrant with the highest QPD, suggesting that the amount of dense tissue cannot explain the disproportional occurrence of breast cancer in different quadrants.

4325	Computer 55	Correlation of Breast Stiffness Measured by Ultrasound with Breast Density Measured on MRI Matched by Using a Prone-Supine Deformation Model Jeon-Hor Chen[1,2], Siwa Chan[3], Yang Zhang[1], Dah-Cherng Yeh[4], and Min-Ying Su[1] *[1]Center for Functional Onco-Imaging, Department of Radiological Sciences, University of California Irvine, Irvine, CA, United States, [2]Department of Radiology, E-Da Hospital and I-Shou University, Kaohsiung, Taiwan, [3]Department of Radiology, Tzu-Chi General Hospital, Taichung, Taiwan, [4]Breast Center, Tzu-Chi General Hospital, Taichung, Taiwan* We correlated breast tissue stiffness measured by US elastography with the MR-measured density from the whole breast and the tissue in the US stiffness measurement window. Twenty women were studied, and only the normal breast was analyzed. A finite element model was applied to deform the prone MRI to match with supine US images by using the inversed gravity loaded transformation to locate the corresponding tissue region. There were no correlation between breast stiffness and the whole breast percent density (r=-0.09) and the local percent density (r=-0.12), suggesting that breast density and stiffness may be independent cancer risk factors.

4326	Computer 56	The Added Utility of Diffusion Tensor Imaging for Differentiating Malignant and Benign Breast Lesions on 3T MRI: A Machine Learning Based Approach Jing Luo[1], Daniel S Hippe[1], Habib Rahbar[1], Sana Parsian[1], and Savannah C Partridge[1] *[1]Radiology, University of Washington School of Medicine, Seattle, WA, United States*

		Diffusion tensor imaging (DTI) may provide additional information on tissue characteristics over dynamic contrast enhanced (DCE) MRI, however there are conflicting results regarding its utility. Our study evaluated DCE and DTI features of histologically proven breast lesions on 3T MRI. Using a machine learning-based LASSO approach for multivariate regression and bootstrap-based internal validation, the model incorporating DCE and DTI parameters demonstrated significantly better performance in differentiating malignant and benign lesions compared to models using DCE or DTI parameters alone. These findings suggest that the addition of DTI sequences to DCE MRI may improve diagnostic performance.

4327	Computer 57	Diffusion-weighted Intravoxel incoherent motion (IVIM) MRI and dynamic 18F-FDG-PET imaging in breast cancer patients via simultaneous PET/MR
		Andrea Liu[1], Artem Mikheev[2,3], Eric Kim[4], David S Rigie[2,3], Sylvia Adams[5], Deborah Axelrod[6], Henry Rusinek[2,3], Alto Stemmer[7], Kimberly Jackson[2,3], Jean Logan[2,3], Linda A Moy[4], Amy N Melsaether[4], Sungheon G Kim[2,3], and Eric E Sigmund[2,3]
		[1]New York University School of Medicine, New York, NY, United States, [2]Bernard and Irene Schwartz Center for Biomedical Imaging, NYU Langone Medical Center, New York, NY, United States, [3]Center for Advanced Imaging and Innovation (CAI2R), NYU Langone Medical Center, New York, NY, United States, [4]Department of Radiology, NYU Langone Medical Center, New York, NY, United States, [5]Department of Internal Medicine, NYU Langone Medical Center, New York, NY, United States, [6]Department of Surgery, NYU Langone Medical Center, New York, NY, United States, [7]Imaging and Therapy Division, Siemens AG, Healthcare Sector, Erlangen, Germany
		Aggressive breast tumors possess heterogeneity that impacts successful diagnosis and treatment. Mapping this complexity with imaging biomarkers of different biologic specificity supports patient-specific management. We compare biomarkers from diffusion-weighted MRI (intravoxel incoherent motion (IVIM)) and ^{18}F-fluorodeoxyglucose (FDG) PET (dynamic pharmacokinetic modeling) in 10 breast cancer patients in a simultaneous PET/MR system. Voxelwise correlations were performed to study intralesion relationships between biomarkers. Intralesion correlations were observed, such as between PET plasma transfer rate K_1 and tissue diffusivity D_t, that also showed potential diagnostic value in tumor classification. This feasibility study establishes a workflow that enables more detailed investigation in larger cohorts.

4328	Computer 58	Attenuation Correction Map Calculation and Truncation Completion for Breast PET/MR Imaging using Deep Learning
		Jacob M Johnson[1], Roberta M Strigel[1,2,3], Leah C Henze Bancroft[1], Amy M Fowler[1,2,3], and Alan B McMillan[1]
		[1]Radiology, University of Wisconsin- Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin- Madison, Madison, WI, United States, [3]Carbone Cancer Center, University of Wisconsin-Madison, Madison, WI, United States

		While Positron Emission Tomography (PET) used jointly with Magnetic Resonance (MR) Imaging shows promise in breast imaging, unique constraints require novel solutions to achieve attenuation-corrected images. We propose an algorithm for producing a linear attenuation coefficient map and truncation completion created from MR images using deep learning.

4329	Computer 59	Time makes the difference: Comparison of ADC values obtained with OGSE and PGSE sequences for differentiation of human breast tumors
		Mami Iima[1,2], Masako Kataoka[1], Kanae Kawai Miyake[1], Maya Honda[1], Rena Sakaguchi[1], Ayami Ohno Kishimoto[1], Mizue Suzuki[1], Katsutoshi Murata[3], Thorsten Feiweier[4], Masakazu Toi[5], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [2]Hakubi Center for Advanced Research, Kyoto University, Kyoto, Japan, [3]Siemens Healthcare K.K., Tokyo, Japan, [4]Siemens Healthcare GmbH, Erlangen, Germany, [5]Department of Breast Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan
		The diffusion time dependence of ADC measurements has been investigated using OGSE and PGSE sequences in human breast tumors. Relative changes in ADC values corresponding to two diffusion times, in addition to ADC values for each diffusion time were calculated in malignant and benign breast lesions as well as in normal breast tissues. Significant differences of ADC changes, in addition to ADC values for each diffusion time, have been found among malignant and benign lesions and normal breast tissue. No ADC changes have been identified in a dedicated breast phantom. ADC maps corresponding to different diffusion times indicate that ADC changes might provide insight in revealing new tissue features like, for instance, intracellular structure of breast tumors.

4330	Computer 60	Quality assessment with a breast phantom and a volunteer for multi-institutional MRI trials including DWI
		Mami Iima[1,2], Masako Kataoka[1], Maya Honda[1], Yuta Urushibata[3], Ryosuke Okumura[4], Takashi Koyama[5], Kenji Uwakubo[6], Katsutoshi Murata[3], Mitsuyo Matsumoto[7], Yu Ueda[7], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [2]Hakubi Center for Advanced Research, Kyoto University, Kyoto, Japan, [3]Siemens Healthcare K.K., Tokyo, Japan, [4]Kitano Hospital, The Tauke Kofukai Medical Research Institute, Osaka, Japan, [5]Kurashiki Central Hospital, Kurashiki, Japan, [6]Shiga hospital, Japan Community Health care Organization, Otsu, Japan, [7]Philips Japan, Tokyo, Japan
		The novel method for quality control applicable for commonly used breast MR images (T1WI, T2WI and DWI) in terms of semi-quantitative and quantitative analysis was proposed. The scan was performed across multiple sites on both a breast phantom and a volunteer. The provided scores and apparent spatial resolution were comparable between a phantom and a volunteer. Quality of breast MR images across sites were variable, and standardization using a dedicated breast phantom is considered necessary to assure good diagnostic performance of breast MRI.

4331	Computer 61	The Effect of Intravenous Administration of a Gadolinium-Based Contrast Agent on Breast Diffusion Tensor Imaging: Qualitative and Quantitative Evaluation. Anabel M. Scaranelo[1,2,3], Hadassa Degani[4], Dov Grobgeld[4], Nancy Talbot[5], Karen Bodolai[5], and Edna Furman-Haran[4] *[1]Princess Margaret Cancer Centre, University Health Network, Toronto, ON, Canada, [2]Marvelle Koffler Breast Centre, Sinai Health System, Toronto, ON, Canada, [3]Toronto Joint Department of Medical Imaging, University of Toronto, Toronto, ON, Canada, [4]Weizmann Institute of Science, Rehovot, Israel, [5]Toronto Joint Department of Medical Imaging, University Health Network, Toronto, ON, Canada* We have investigated whether the values of the diffusion tensor imaging (DTI) parameters of breast normal tissue, as well as of benign and cancer lesions are affected by gadolinium-based contrast administration. Changes in the DTI parameters and consequently in DTI-based lesion size were evaluated pre and post dynamic contrast enhanced (DCE) MRI. Results indicated that scanning with DTI post DCE did not impact the diffusion parameters in breast normal tissue and benign lesions and the lesions' size but revealed a significant reduction of the diffusion coefficients in breast cancers, suggesting potential improvement of DTI diagnostic specificity post-contrast.

4332	Computer 62	Lactate concentration measured by multiple quantum coherence (MQC) MRS in whole human breast tumour is associated with tumour grading Sai Man Cheung[1], Ehab Husain[2,3], Yazan Masannat[3,4], Klaus Wahle[3,5], Steven D Heys[3,4], and Jiabao He[1] *[1]Aberdeen Biomedical Imaging Centre, University of Aberdeen, Aberdeen, United Kingdom, [2]Pathology Department, Aberdeen Royal Infirmary, Aberdeen, United Kingdom, [3]School of Medicine, University of Aberdeen, Aberdeen, United Kingdom, [4]Breast Unit, Aberdeen Royal Infirmary, Aberdeen, United Kingdom, [5]Strathclyde Institute of Pharmacy and Biological Sciences, Glasgow, United Kingdom* High level of aerobic glycolysis and an elevated lactate accumulation have been linked to tumour aggressiveness. However, current evidence, mainly based on small animal models or biopsy sections, remains controversial. Since lactate and lipid share the same spectral frequency, conventional MRS is inadequate in measuring lactate under overwhelming lipid signal. Multiple quantum coherence (MQC) MRS allows excellent suppression of lipid even in breast tissues. We applied MQC MRS to measure lactate concentration in grade II and III freshly excised whole human breast tumours to assess if there was a difference between the two groups.

4333	Computer 63	Enhanced Ellipsoid Mapping of Diffusion Tensor Breast MRI for Improved Lesion Conspicuity Myra Shapiro-Feinberg[1], Edna Furma-Haran[2], Dov Grobgeld[3], and Hadassa Degani[4]

		[1]Meir Medical Center, Kfar Saba, Israel, [2]Weizmann Institute of Sience, rehovot, Israel, [3]Weizmann Institute of Science, Rehovot, Israel, [4]Biological Regulation, Weizmann Institute of Science, Rehovot, Israel
		Ellipsoid mapping of the breast with a specific colorization mode has been developed as a visualization means for evaluating the entire information embedded in breast Diffusion Tensor Imaging (DTI) and improve breast cancer detection. The 3D ellipsoid maps were displayed at voxel resolution with their shape and orientation determined by a respective eigenvalue-eigenvector pair of the associated diffusion tensor, followed by colorizing the ellipsoids according to the values of each diffusion tensor parameter. The results show that the enhanced ellipsoid mapping with $\lambda 1$ colorization accentuating breast malignancy, may allow efficient differentiation of breast malignancy from normal breast tissue.

4334	Computer 64	Diagnostic Assessment of Breast Cancer in Non-Contrast MRI Images Through an Artificial Intelligence Machine Learning Algorithm
		Craig Neal Detheridge[1], Philip Saponara[1], Jaspreet Bhangu[1], Boris Nicholas Bloch[2], and Kevin Thomas[1]
		[1]Anatomy & Neurobiology, Boston University School of Medicine, Boston, MA, United States, [2]Radiology, Boston Medical Center, Boston, MA, United States
		Contrast-Enhanced Breast MRI is a common method for diagnosis of Breast Cancer. An Artificial Intelligence Machine Learning Algorithm was developed to analyze Non-Contrast Breast MRI scans and predict diagnoses. The algorithm was trained using MRI data that had pathological specimens to validate diagnoses, obtained from The Cancer Imaging Archive. The AI was found to be 95% accurate in classifying tissue as cancerous or benign. This algorithm could be used to assist diagnoses in clinical practice. Future work will assess the generalizability of the algorithm on data from other scan sites, and the potential for classifying specific subtypes of Breast Cancer.

4335	Computer 65	Towards Fully Automated Breast MR Exams using Deep Learning
		Kang Wang[1], Dawei Gui[2], James Holmes[3], Alan McMillan[3], Leah Henze Bancroft[3], Roberta Strigel[3,4,5], Frank Korosec[3,4], and Ersin Bayram[6]
		[1]Global MR Applications & Workflow, GE Healthcare, Madison, WI, United States, [2]MR Engineering, GE Healthcare, Waukesha, WI, United States, [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [4]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [5]Carbone Cancer Center, University of Wisconsin-Madison, Madison, WI, United States, [6]Global MR Applications & Workflow, GE Healthcare, Houston, TX, United States

		Breast MR exams can be challenging for inexperienced MR technologists. For example, breast MRI typically requires the prescription of two carefully positioned and sized shim volumes, one for each breast, to improve the local B0 homogeneity and fat suppression. Normally, this procedure is performed manually, which requires an experienced MR technologist and can be challenging for new technologists. The goal of this project is to use deep learning to automate breast MR prescription, including placing the two shim volumes and imaging volumes automatically, to improve breast MR prescription consistency, quality, and to shorten the exam time.

4336	Computer 66	Complementary value of End-to-end Deep Learning and Radiomics in Breast Cancer Classification on Diffusion-Weighted MRI
		Paul F. Jaeger[1], Sebastian Bickelhaupt[2], Frederik Bernd Laun[3,4], Wolfgang Lederer[5], Heidi Daniel[6], Tristan Anselm Kuder[4], Stefan Delorme[2], Heinz-Peter Schlemmer[2], Franziska Steudle[2], and Klaus Hermann Maier-Hein[1]
		[1]Division of Medical Image Computing, German Cancer Research Center, Heidelberg, Germany, [2]Department of Radiology, German Cancer Research Center, Heidelberg, Germany, [3]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [4]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany, [5]Radiological Practice, ATOS Clinic, Heidelberg, Germany, [6]Radiology Center Mannheim, Mannheim, Germany
		Two fundamentally different approaches have been proposed recently for the classification of breast lesions on diffusion-weighted MRI Images: “Radiomics” extracts quantitative parameters by fitting a biophysical model to the q-space signal and subsequently computes handcrafted features to feed a classifier. Convolutional neural networks on the other hand autonomously learn all processing components in an end-to-end training. To date it is unclear how the two methods compare with respect to overall performance, complementary value of features and combinability. We address these open research questions and propose a combined model that significantly outperforms the two standalone approaches.

4337	Computer 67	Whole-Tumor Histogram Analysis of Multiparametric MRI for Subtype Classification of Breast Cancer
		Tianwen Xie[1], Qiufeng Zhao[2], Robert Grimm[3], Caixia Fu[4], Yajia Gu[1], and Weijun Peng[1]
		[1]Department of Radiology, Fudan University Shanghai Cancer Center, Shanghai, China, [2]Department of Radiology, Longhua Hospital, Shanghai University of Traditional Chinese Medicine, Shanghai, China, [3]MR Application Predevelopment, Siemens Healthcare, Erlangen, Germany, [4]Application Development, Siemens Shenzhen Magnetic Resonance, Shenzhen, China

		Recently, several studies have shown the value of Magnetic Resonance Imaging (MRI) radiomics in non-invasive lesion subtype classification. In this study, we proposed the use of histogram texture features of multiparametric maps to differentiate subtypes of breast cancer. 34 different whole-tumor histogram features were analyzed. Classification was performed between ER-positive and Triple-negative groups resulted in AUROC of 0.94, while classification between ER-positive and HER2-positive groups, and classification between HER2-positive and Triple-negative yielded AUROC of 0.79, and 0.86, respectively.

4338	Computer 68	In silico Platform for Evaluation of Constrained Reconstruction in DCE-MRI
		Jorge E Jimenez[1], Leah C Henze Bancroft[2], Roberta Strigel[1,2,3], Kevin M Johnson[1], Scott B Reeder[1,2,4,5,6], and Walter F Block[1,2,4]
		[1]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Radiology, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States, [3]Carbone Cancer Center, University of Wisconsin-Madisonsin, Madison, WI, United States, [4]Department of Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [5]Department of Medicine, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States, [6]Department of Emergency Medicine, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States
		In this work, we show the value of a digital phantom to evaluate a dynamic reconstruction. We evaluated the fidelity of the reconstruction using SSIM measurements from simulations and three patients to support conclusions derived from the digital phantom. The highly configurative characteristics of the in-silico platform provide a tool for other researchers to test, evaluate and compare their own acquisition and reconstruction techniques.

4339	Computer 69	RF-Induced Potential False-Negative Lesion in Breast T2-weighted MRI at 3T: Exploration of a Single-Channel k_T-Points Solution
		Raphael Tomi-Tricot[1], Vincent Gras[1], Thu Ha Dao[2], Antoine Perrot[2], Franck Mauconduit[3], Nicolas Boulant[1], Pierre Zerbib[2], Alain Rahmouni[2,4], Alexandre Vignaud[1], Alain Luciani[2,4,5], and Alexis Amadon[1]
		[1]CEA/DRF/Joliot/NeuroSpin/UNIRS, Gif-sur-Yvette, France, [2]Department of Radiology, AP-HP, CHU Henri Mondor, Créteil, France, [3]Siemens Healthcare SAS, Saint-Denis, France, [4]Université Paris-Est Créteil Val-de-Marne, Créteil, France, [5]INSERM Unité U955, Equipe 18, Créteil, France
		Breast MRI can benefit from the improved signal-to-noise ratio brought by high-field systems to achieve finer spatial or temporal resolutions. However, dielectric resonance associated with the shorter RF wavelength provokes inhomogeneous excitation in the tissues. In this work, it was shown that such artefacts can induce hyperintensity in T2-weighted images, thus potentially misleading clinicians into excluding malignancy in a lesion. A solution is proposed to reduce the RF artefact on 3D T2w acquisitions using single-transmit-channel k_T-points, which could be used on any 3T scanner.

4340	Computer 70	Development and Validation of MR Radiomics Nomogram for Preoperative Prediction of Axillary Lymph Node Metastasis in Patients With Breast Cancer
		Mei Xue[1], Jing Li[1], Shunan Che[1], Liyun Zhao[1], Yuan Tian[1], Lizhi Xie[2], Bing Wu[2], Xiangfei Chai[3], Panli Zuo[3], and Chencui Huang[3]
		[1]Radiology Department, Cancer Hospital Chinese Academy of Medical Sciences, Beijing, China, [2]GE heathcare China, beijing, China, [3]Huiying Medical Technology Co, Beijing, China
		Axillary lymph node (ALN) status is an important prognostic factor for overall breast cancer survival. The number of axillary lymph node metastases is closely related to the risk of distant metastasis1. Accurate identification of axillary lymph node involvement in patients with breast cancer is crucial for prognosis and treatment strategy decisions. Axillary lymph node dissection (ALND) is currently the standard procedure for determining ALN status. Sentinel lymph node biopsy was used to determine whether axillary lymph node dissection was needed, which is invasive2. Image based non-invasive predictors of axillary lymph nodes are highly desirable, and currently face challenges. The aim of this study was to develop and validate a radiomics nomogram that incorporates both the radiomics signature and clinicopathologic risk factors for individual preoperative prediction of axillary lymph node metastasis in patients with breast cancer.

4341	Computer 71	Qualitative and Quantitative Assessment of Tumor Heterogeneity for the Differentiation of Molecular Subtypes in Breast Cancer
		Sunitha Thakur[1], Joao Vicente Horvat[2], Dilip Giri[3], Aditi Iyer[1], Manuela Durando[4], Elizabeth Morris[2], and Katja Pinker[2]
		[1]Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [3]Pathology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]A. O. U. Città della Salute e della Scienza di Torino, Turin, Italy
		Heterogeneity in breast cancer is related to aggressiveness and poor prognosis. In this study, we evaluated if qualitative visual evaluation and quantitative assessment with histogram analysis of tumor heterogeneity on diffusion weighted imaging (DWI) could be used to predict molecular subtype in invasive breast cancer. We retrospectively evaluated 91 patients with invasive ductal carcinoma. Two radiologists classified the imaging appearance of tumors on DWI according to heterogeneity. The lesions were also evaluated with histogram analysis on apparent diffusion coefficient maps. There was no statistically significant difference on heterogeneity among molecular subtypes on visual evaluation or histogram analysis.

4342	Computer 72	Fast intensity non-uniformity correction for breast MRI using sparse samples
		Linxi Shi [1], Steffi Liu Perkins[1], Catherine J Moran[1], Brian A. Hargreaves[1], and Bruce L. Daniel[1]

[1]Radiology, Stanford Universty, Palo Alto, CA, United States

The quantitative application of breast MRI is hindered by image non-uniformity artifact due to B0 and B1 variations. In this work, we developed an effective intensity non-uniformity correction algorithm for breast MRI with high computational efficiency. Compare to existing methods, the proposed method is readily implementable clinically as a software plug-in without modification of existing imaging protocols or hardware, and can potentially be applied to MR images of other anatomical sites.

Electronic Poster

Lung MRI

Exhibition Hall	Tuesday 16:15 - 17:15

4343 Computer 73

Examination of Lung Function among Older Smokers with and without COPD by Apparent Diffusion Coefficient (ADC) of 3He MRI

Yanping Sun[1], Jia Guo[2], Pallavi P Balte[1], Stephen M Dashnaw[3], Martin R Prince[3], Elizabeth C Oelsner[1], Christian M Lo Cascio[1], Mitchell S Albert[4], Jim Wild[5], Emlyn W Hughes[6], and R. Graham Barr[1]

[1]Department of Medicine, Columbia University Medical School, New York, NY, United States, [2]Department of Biomedical Engineer, Columbia University, New York, NY, United States, [3]Department of Radiology, Columbia University Medical School, New York, NY, United States, [4]Department of Chemistry, Lakehead University, Thunder Bay, ON, Canada, [5]Department of Infection, Immunity & Cardiovascular Disease, University of Sheffield, Sheffield, United Kingdom, [6]Department of Physics, Columbia University, New York, NY, United States

Chronic obstructive pulmonary disease (COPD) is defined as persistent airflow limitation by spirometry. However, some smokers with normal spriometry have significant respiratory symptoms. We used 3He apparent diffusion coefficient (ADC) to examine the lungs in older smokers with and without COPD (n=50). This study showed high ADC in both smokers with and without COPD. The difference in ADC between COPD and non-COPD was significant. ADC was correlated positively with percent emphysema and %FVC, and negatively with FEV1 to FVC ratio and, non-significantly with FEV1. 3He ADC may provide different information of lung microarchitecture from spirometry in smoking related pulmonary diseases.

4344 Computer 74

Lung cancer screening with MRI: characterization of nodules with different non-enhanced MRI sequences.

Michael Meier-Schroers[1], Rami Homsi[1], Hans Heinz Schild[1], and Daniel Thomas[1]

		[1]Radiology, University of Bonn, Bonn, Germany
		Due to increased interest in pulmonary MRI as a radiation free alternative to CT for lung cancer screening, we analyzed MRI characteristics of pulmonary nodules with different non-enhanced sequences.

4345	Computer 75	Clinical Feasible Breath-Hold Lung Imaging Using Zero Echo Time MRI
		Chien-Yuan Eddy Lin[1], Hsiao-Ling Lin[1], Charng-Chyi Shieh[1], Chia-Wei Li[2], and Wing P. Chan[2,3]
		[1]GE Healthcare, Taipei, Taiwan, [2]Department of Radiology, Wang Fang Hospital, Taipei Medical University, Taipei, Taiwan, [3]Department of Radiology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan
		A high resolution, rapid scanning in one breath-hold and three-dimensional zero-echo time protocol for lung imaging was established in this study. It successfully captured rapid-decaying lung signal and eliminated the motion artifact and consequently exhibit high quality of pulmonary anatomy, including the tortuous vessels architecture and bronchial wall in exceptional clarity and detail. Additionally, it provides the volume estimation of pulmonary tissue and shows somewhat comparable with the calculation result from computed tomography.

4346	Computer 76	Functional lung imaging with partially spoiled ultra-fast steady-state free precession at 1.5T and 3T
		Grzegorz Bauman[1,2], Orso Pusterla[1,2], and Oliver Bieri[1,2]
		[1]Division of Radiological Physics, Department of Radiology, University of Basel Hospital, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland
		In this work we propose an alternative acquisition framework for functional lung imaging using matrix pencil (MP) decomposition (a derivative of Fourier decomposition method) based on partially spoiled ultra-fast steady-state free-precession (ps-ufSSFP) imaging. We showed that MP decomposition is feasible in healthy volunteers using ps-ufSSFP at 1.5T and 3T. Hence, ps-ufSSFP can be a viable solution for the application of MP MRI at 3T where imaging with balanced ufSSFP can be problematic due to the occurrence of off-resonance artifacts.

4347	Computer 77	Quantification of Pulmonary Perfusion in Idiopathic Pulmonary Fibrosis: Preliminary Results
		Luis A Torres[1], Wei Zha[1], Mu He[2], Bastiaan Driehuys[3], and Sean B Fain[1]

		[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States, [2]Electrical and Computer Engineering, Duke University, Durham, NC, United States, [3]Radiology, Duke University, Durham, NC, United States
		IPF is a pulmonary disease with no validated biomarkers in current clinical use. Here, we compared pulmonary perfusion in an IPF subject versus healthy subject using Dynamic Contrast-Enhanced MRI (DCE-MRI). A decrease in PBF, PBV and an increase in MTT was seen in IPF compared to the healthy control. High spatial correlation of perfusion defects and fibrosis is seen when compared to the morphological images, suggesting DCE-MRI may prove to be a useful technique for evaluating IPF.

4348	Computer 78	Diffusion kurtosis imaging in solitary pulmonary nodules: comparison with quantitative dynamic contrast enhanced MR imaging in malignant and benign pulmonary nodule differentiation
		Shuchang Zhou[1], Liming Xia[1], and Xu Yan[2]
		[1]Radiology, Tongji Hospital of Huazhong University of Science and Technology, Wuhan, China, [2]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China
		Theoretically, DKI and quantitative DCE-MRI can provide more precise microstructure and perfusion information of tissues. However, the two methods had rarely been reported in solitary pulmonary nodules (SPNs) to date, so we collected 37 patients with SPNs underwent both DKI and DCE-MRI and measured relative parameters. The Kapp, Ktrans, Ve and iAUC values were significantly higher in lung cancer than in benignity. Kapp had best sensitivity and accuracy, and iAUC had best specificity. The combination of both methods can provide a robust way to discriminate SPNs before clinical management.

4349	Computer 79	Markov Model of Lung Cancer Screening Demonstrates Equivalent Lung Cancer Detection using either Lung MRI or Low-Dose CT Screening Strategies
		Bradley D Allen[1], Mark L Schiebler[2], Hans-Ulrich Kauczor[3,4], Jürgen Biederer[3,4,5], Timothy J Kruser[6], Nisha A Mohindra[7], David D Odell[8], James C Carr[1], and Gorden B Hazen[9]
		[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [3]Diagnostic and Interventional Radiology, University of Heidelberg, Heidelberg, Germany, [4]Translational Lung Research Center Heidelberg (TLRC), Member of the German Lung ResearchCenter (DZL), Heidelburg, Germany, [5]Radiologie Darmstadt, Darmstadt, Germany, [6]Radiation Oncology, Northwestern University, Chicago, IL, United States, [7]Medicine - Hematology and Oncology, Northwestern University, Chicago, IL, United States, [8]Surgery - Thoracic Surgery, Northwestern University, Chicago, IL, United States, [9]Industrial Engineering and Management Sciences, Northwestern University, Evanston, IL, United States

		Lung cancer screening with low dose CT (LDCT) has been shown to result in a 20% mortality reduction, but has relatively low specificity for lung cancer diagnosis, as well as concerns related to radiation dose and overdiagnosis. Lung MRI has similar sensitivity and improved specificity for lung cancer detection. In this study, we developed a Markov model of lung cancer screening to compare performance of LDCT and MRI. Based on our analysis, lung cancer screening with MRI could provide an equivalent number of lung cancer diagnoses, while dramatically reducing the number of false positive findings relative to LDCT.

4350	Computer 80	Robust Retrospective Respiratory Gating for Detection of Small Pulmonary Nodules with UTE MRI
		Naoharu Kobayashi[1], Abbie Begnaud[2], Tadashi Allen[3], Gregory J. Metzger[1], Robert Kratzke[4], and Michael Garwood[1]
		[1]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Division of Pulmonary, Allergy, Critical Care and Sleep, Department of Medicine, University of Minnesota, Minneapolis, MN, United States, [3]Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [4]Division of Hematology, Oncology and Transplantation, Department of Medicine, University of Minnesota, Minneapolis, MN, United States
		Retrospective respiratory gating using a 3D time series lung image reconstructed with sub-second temporal resolution is introduced to achieve accurate small pulmonary nodule detection with ultrashort echo time (UTE) MRI. Changes of the diaphragmatic level during free breathing were tracked using the 3D time series lung image. With the extracted respiratory motion, the data in exhalation were reconstructed to a high resolution image. The feasibility and robustness of the proposed retrospective gating method were tested by surveilling incident lung nodules in two UTE MRI examinations: a baseline scan and a follow-up scan in 10 weeks.

4351	Computer 81	A new diagnostic method for Pneumothorax:3D-UTE MRI
		Can HUANG[1], Yang FAN[2], and Tao JIANG[3]
		[1]Radiology Department, Beijing Chaoyang Hospital, Beijing, China, [2]GE Healthcare, Beijing, China, [3]Beijing Chaoyang Hospital, Beijing, China
		Radiation may has great impact on teenagers who are the high risk population for pneumothorax. Compared to X-ray and CT, MRI is a imaging modality without radiation. The purpose of this study is to examine the feasibility of using UTE MRI to diagnose the pneumothorax.

4352	Computer 82	Dynamic contrast-enhanced MRI for the evaluation of perfusion heterogeneity in idiopathic pulmonary fibrosis

		Nicholas David Weatherley[1], Helen Marshall[1], Paul Hughes[1], Jody Bray[1], David Capener[1], Matthew Austin[1,2], Laurie Smith[1,3], Stephen Renshaw[1], Stephen Bianchi[2], and Jim Wild[1]
		[1]University of Sheffield, Sheffield, United Kingdom, [2]Sheffield Teaching Hospitals, Sheffield, United Kingdom, [3]Sheffield Children's Hospital NHS Foundation Trust, Sheffield, United Kingdom
		Dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) produces metrics of lung perfusion at the capillary level. To date, little assessment of patients with idiopathic pulmonary fibrosis (IPF) has been reported with DCE-MRI. In fourteen patients with IPF, we found that regions of low flow and high transit times were associated with anatomical disease. Whole lung metrics of transit time and heterogeneity of blood volume demonstrated a relationship with pulmonary function tests. Such functional imaging strategies may be useful in quantifying functional changes in the pulmonary vasculature in IPF.

4353	Computer 83	Longitudinal assessment of changes in lung microstructure in idiopathic pulmonary fibrosis with hyperpolarized gas diffusion-weighted MRI
		Ho-Fung Chan[1], Nicholas D. Weatherley[1], Neil J. Stewart[1], Guilhem J. Collier[1], Stephen Bianchi[2], and Jim M. Wild[1]
		[1]Academic Unit of Radiology, University of Sheffield, Sheffield, United Kingdom, [2]Academic Directorate of Respiratory Medicine, Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom
		Apparent diffusion coefficient (ADC) calculated from hyperpolarized gas diffusion-weighted (DW)-MRI has been shown to be elevated in lungs afflicted with idiopathic pulmonary fibrosis (IPF). This work assesses the sensitivity of ^{3}He DW-MRI metrics to longitudinal changes in IPF patients by evaluating ^{3}He ADC and mean diffusive length scale (Lm_D) from the stretched exponential model at baseline, 6 and 12 months. ADC was not significantly different between visits, but a statistically significant increase of 13 µm in Lm_D was observed after 12 months suggesting multiple b-value DW-MRI is sensitive to progressive microstructural changes in the lungs in IPF.

4354	Computer 84	A Comparison of Hyperpolarized Helium-3 and Xenon-129 MR Fractional Ventilation Imaging
		Hooman Hamedani[1], Kai Ruppert[1], Yi Xin[1], Stephen Kadlecek[1], Faraz Amzajerdian[1], Ryan Baron[1], Ian Duncan[1], Luis Loza[1], Mehrdad Pourfathi[1], Sarmad Siddiqui[1], Harrilla Profka[1], Mary Spencer[1], Tahmina Achekzai[1], Maurizio Cereda[2], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA, United States

		In response to the global shortage of ^{3}He, we studied the feasibility and safety of performing a multi-breath wash-in MR imaging technique to measure fractional ventilation using hyperpolarized (HP) ^{129}Xe in the same manner as with ^{3}He.

4355	Computer 85	Deep Learning Lung Segmentation in Paediatric Patients
		Orso Pusterla[1,2], Simon Andermatt[2], Grzegorz Bauman[1,2], Sylvia Nyilas[3], Philipp Madörin[1], Tanja Haas[1], Simon Pezold[2], Francesco Santini[1,2], Philipp Latzin[3], Philippe Claude Cattin[2], and Oliver Bieri[1,2]
		[1]Division of Radiological Physics, Department of Radiology, University Hospital Basel, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland, [3]Division of Respiratory Medicine, Department of Pediatrics, Children's Hospital of Bern, Bern, Switzerland
		Automatic lung segmentation of MR images is challenging; especially in the presence of pathologies. In this work, we tackle lung segmentation of 2D and 3D ultra-fast steady-state free precession MRI in cystic fibrosis patients by using deep learning based on a neural network of multi-dimensional gated recurrent units.

4356	Computer 86	3D T1 mapping in the lungs during free breathing using asymmetrical cylindrical encoding
		Simon MF Triphan[1,2], Mark O Wielpütz[1,2], Hans-Ulrich Kauczor[1,2], and Bertram J Jobst[1,2]
		[1]Diagnostic and Interventional Radiology, University Hospital Heidelberg, Heidelberg, Germany, [2]Translational Lung Research Centre, Member of the German Centre for Lung Research (DZL), Heidelberg, Germany
		T1 in the lungs has been found to be interesting both for oxygen enhanced imaging and as a biomarker in COPD. In this work, T1 mapping in human lungs was implemented using a cylindrically encoded 3D measurement using asymmetric radial encoding in an inversion recovery experiment. Breathing was compensated by employing DC-gating with the MR signal, using a correction to cancel the influence of the inversion recovery. It is shown that using a segmented scheme for 3D phase encoding steps that spreads steps over k-space while minimizing leaps in T1-weighting improves gating performance and thus the resulting T1 maps.

4357	Computer 87	Automatic Segmentation of Lung Anatomy from Proton MRI based on a Deep Convolutional Neural Network
		Xue Feng[1], Nicholas J. Tustison[1], Renkun Ni[1], Zixuan Lin[1], John P. Mugler, III[1], Craig H. Meyer[1], Talissa A. Altes[1,2], Joanne M. Cassani[2], Y. Michael Shim[1], and Kun Qing[1]

		[1]University of Virginia, Charlottesville, VA, United States, [2]University of Missouri School of Medicine, Columbia, MO, United States
		With rapid development of pulmonary MRI techniques, increasingly useful morphological and functional information can be obtained, such as pulmonary perfusion, ventilation and gas uptake through hyperpolarized-gas MRI. Identification of lung anatomy is usually the first step for quantitative analysis. In the work, we proposed and validated a new approach for automatic segmentation of lung anatomy from proton MRI based on 3D U-Net structure. The new method had a relatively consistent performance in all subjects (dice overlap 0.90-0.97). Its future application for anatomical based analysis of structural and/or functional pulmonary MRI data needs further validation in larger number of data.

4358	Computer 88	Correction for Ventilation Quantification Errors due to Registration in Pulmonary Lung MRI Fourier Decomposition
		Filip Klimeš[1,2], Andreas Voskrebenzev[1,2], Marcel Gutberlet[1,2], Agilo Kern[1,2], Lea Behrendt[1,2], Till Kaireit[1,2], Alexander Rotärmel[1,2], Julius Renne[1,2], Christian Schönfeld[1,2], Frank Wacker[1,2], and Jens Vogel-Claussen[1,2]
		[1]Institute of Diagnostic and Interventional Radiology, Hannover Medical School, Hanover, Germany, [2]Biomedical Research in Endstage and Obstructive Lung Disease Hannover (BREATH), German Center for Lung Research (DZL), Hanover, Germany
		Ventilation-perfusion (V/Q) scan plays an important role in the assessment of lung function. Currently, Fourier Decomposition (FD), a method for simultaneous ventilation and perfusion measurement, uses fractional ventilation (FV) as a semi-quantitative measurement of lung ventilation. Just recently, a multi-echo spoiled gradient echo sequence method for regional alveolar ventilation (AV) measurement with FD was presented. This study demonstrates that both methods suffer from an artificial proton amount change during registration, which affects quantification. Correction factors are derived for both methods and used to compare AV and FV measurement. Additionally, the regional influence of T_2* correction is assessed.

4359	Computer 89	Multiparametric Approach by Quantitatively Assessed Dynamic First-Pass Contrast-Enhanced Perfusion MRI with FDG-PET/CT: Capability for Therapeutic Response Prediction in Non-Small Cell Lung Cancer After Conservative Therapy
		Yoshiharu Ohno[1,2], Masao Yui[3], Shigeharu Ohyu[3], Yuji Kishida[4], Shinichiro Seki[1,2], Katsusuke Kyotani[5], and Takeshi Yoshikawa[1,2]
		[1]Division of Functional and Diagnostic Imaging Research, Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan, [2]Advanced Biomedical Imaging Research Center, Kobe University Graduate School of Medicine, Kobe, Japan, [3]Toshiba Medical Systems Corporation, Otawara, Japan, [4]Division of Radiology, Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan, [5]Center for Radiology and Radiation Oncology, Kobe University Hospital, Kobe, Japan

		To the best of our knowledge, no studies have been reported of a direct comparison of dynamic CE-perfusion MRI with PET/CT for therapeutic effect prediction for NSCLC patients treated with chemoradiotherapy. We hypothesized that multiparametric approach of quantitatively assessed dynamic CE-perfusion MRI with PET/CT have potential for better therapeutic effect prediction than single parametric methods by both modalities in NSCLC patients treated with chemoradiotherapy. The purpose of this study was therefore to directly compare the capability for therapeutic response prediction by among quantitatively assessed dynamic CE-perfusion MRI, FDG-PET/CT and multiparametric approach by both modalities in NSCLC patients treated with chemoradiotherapy.

4360	Computer 90	Multi- and Sigle Parametric Approaches using Chemical Exchange Saturation Transfer (CEST) Imaging, Diffusion-Weighted Imaging and FDG-PET/CT for Pulmonary Nodule Diagnosis
		Yoshiharu Ohno[1,2], Masao Yui[3], Mitsue Miyazaki[4], Yuji Kishida[5], Shinichiro Seki[1,2], Katsusuke Kyotani[6], and Takeshi Yoshikawa[1,2]
		[1]Division of Functional and Diagnostic Imaging Research, Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan, [2]Advanced Biomedical Imaging Research Center, Kobe University Graduate School of Medicine, Kobe, Japan, [3]Toshiba Medical Systems Corporation, Otawara, Japan, [4]Radiology, UC, San Diego, La Jolla, CA, United States, [5]Division of Radiology, Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan, [6]Center for Radiology and Radiation Oncology, Kobe University Hospital, Kobe, Japan
		No major reports have been reported the capability for differentiating malignant and benign pulmonary lesions among multi- and single parametric approaches by CEST imaging, DWI and PET/CT. We hypothesized that multi parametric approach by all three techniques had better potential for diagnosis of pulmonary nodule than single parametric approach, when applied with CEST imaging, DWI and FDG-PET/CT. The purpose of this study was to directly and prospectively compare the capability for differentiating of malignant from benign pulmonary nodules between multi- and single-parametric approaches by CEST, DWI, and FDG-PET/CT.

4361	Computer 91	Quantification of Hyperpolarized 3He MRI Ventilation Heterogeneity in Asthmatics: Surface Area of Ventilation Clusters
		Andrew Westcott[1,2], Rachel L Eddy[1,2], Dante PI Capaldi[1,2], Heather M Young[1,2], David G McCormack[3], and Grace Parraga[1,2]
		[1]Robarts Research Institute, London, ON, Canada, [2]Medical Biophysics, Western University, London, ON, Canada, [3]Medicine, Division of Respirology, Western University, London, ON, Canada

		Ventilation heterogeneity measured using hyperpolarized noble-gas magnetic-resonance imaging (MRI), presents a significant challenge in terms of the need for imaging processing tools to generate rapid, reproducible, intuitive and clinically relevant biomarkers. In particular, new tools are needed to differentiate ventilation defects and patchy ventilation that likely represent different functional phenotypes. Therefore, here we developed a new way to quantify MRI ventilation heterogeneity using the surface area between ventilation clusters – the ratio of surface area to ventilation volume (SAVV) measured in units of mm^{-1}. MRI SAVV was significantly greater in severe asthmatics (n=24), as compared to mild-to-moderate asthmatics (n=16).

4362	Computer 92	Discovery and Verification of Lung Cancer Serum Biomarkers using Paired Tissue and Serum
		Leo L. Cheng[1], Isabella Dittmann[1,2], Li Su[3], Johannes Kurth[1,2], Andreas Schuler[1,2], Yannick Berker[1], Lindsey A. Vandergrift[1], Sarah S. Dinges[1,2], Piet Habbel[2], Eugene J. Mark[1], and David C. Christiani[3]
		[1]Pathology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Radiology, Charite Medical University, Berlin, Germany, [3]Environmental and Occupational Medicine, Harvard T. H. Chan School of Public Health, Boston, MA, United States
		A widespread, minimally-invasive method for early detection of lung cancer is urgently needed in the lung cancer clinic. Using high resolution magic angle spinning magnetic resonance spectroscopy, we measured paired tissue and serum samples from the same patients. We correlated serum and tissue results to discover and verify serum markers for lung cancer types and stages and predicted overall survival for early Stage I lung cancer. Measured from serum, prolonged survival is associated with relative overexpression of glutamine, valine, glycine, and relative suppression of glucose and lipids.

4363	Computer 93	Pulmonary Ventilation Imaging in Cystic Fibrosis Using Oxygen-enhanced MRI: Comparison with Hyperpolarized Helium-3 MRI
		Wei Zha[1], Robert V Cadman[1], Scott K Nagle[1,2,3], and Sean B Fain[1,2,4]
		[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [3]Pediatrics, University of Wisconsin-Madison, Madison, WI, United States, [4]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States
		Recent technical advances in oxygen-enhanced (OE) MRI using 3D radial UTE sequence support quantitative differentiation of diseased vs healthy lungs using ventilation defect percent (VDP). A cohort of cystic fibrosis (CF) subjects with different disease severities underwent spirometry, hyperpolarized (HP) 3He and OE-MRI and a subset of those returned for a repeat visit 1-2 weeks later. The results suggest global VDP measures from HP- and OE-MRI were correlated (ρ=0.80, p<0.0001) with comparable test-retest repeatability, showed similar correlation with spirometry. Moreover, UTE OE-MRI with isotropic spatial resolution provides both structural and functional evaluations of obstructed lungs.

4364	Computer 94	Pulmonary nodule detection using ultra-short TE (UTE) with a 3D variable-TE stack-of-spirals sequence
		Yu-Sen Huang[1], Emi Niisato[2], Mao-Yuan Marine Su[1], Alto Stemmer[3], Jin-Shing Chen[4], and Yeun-Chung Chang[1]
		[1]Department of Medical Imaging, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan, [2]Siemens Healthcare Limited, Taipei, Taiwan, [3]Siemens Healthcare GmbH, Erlangen, Germany, [4]Department of Surgery, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan
		UTE with 3D variable-TE stack-of-spirals sampling has been developed recently and allows shorter scan times by using undersampling in combination with an iterative, self-consistent parallel imaging reconstruction (SPIRiT). The goal of this study was to investigate the feasibility of this new technique in patients for detecting pulmonary nodules. The sequence was optimized for both free-breathing and breath-holding. Compared with CT images, the detection rate for pulmonary nodules in the UTE images was 92% for free-breathing and 75% for breath-holding. Our results suggest that the proposed UTE sequence has the capacity to detect pulmonary nodules under both free-breathing and breath-holding conditions.

4365	Computer 95	MR imaging of the lung with a respiratory-gated ultrashort echo time (UTE) sequence with spiral acquisition technique: A feasibility study in oncology patients
		Min Jae Cha[1], Hyun Jeong Park[1], Eun Sun Lee[1], Sung Bin Park[1], Yang Soo Kim[1], and Byung In Choi[1]
		[1]Department of Radiology, Chung-Ang University Hospital, Seoul, Republic of Korea
		We have demonstrated the feasibility of respiratory-gated ultrashort echo time sequence with spiral acquisition technique (spiral UTE; 1.5-mm isotropic resolution; echo time, 0.05 msec) of the lung for pulmonary nodule detection in oncology patients. Overall nodule detection rate was 86% (43 of 50 nodules) and the detection rate for nodules of ≥5 mm was 100 % (20 of 20 nodules). Mean acquisition time for spiral UTE was 327 seconds (range, 300 – 465 seconds). We think that spiral UTE could be a potential alternative to chest CT in oncology patients, who are in the risk of inevitable radiation exposure.

Electronic Poster

Prostate 1: Clinical

Exhibition Hall	Tuesday 16:15 - 17:15

4366	Computer 97	Texture Analysis in Magnetic Resonance Fingerprinting of the Prostate: Utility for Differentiation of Grade, and Cancer from Non-cancerous tissue.

		Samuel Frankel[1], Ananya Panda[2], Debra McGivney[2], Gregory O'Connor[1], Alice Yu[3], Mark Griswold[2,4,5], Chaitra Badve[1,2,4], and Vikas Gulani[2,4,5]
		[1]School of Medicine, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, Case Western Reserve University, Cleveland, OH, United States, [3]Johns Hopkins University, Baltimore, MD, United States, [4]Radiology, UH Cleveland Medical Center, Cleveland, OH, United States, [5]BME, Case Western Reserve University, Cleveland, OH, United States
		Prostate cancer and prostatitis can have considerable overlap on conventional MR imaging. Texture analysis on multiparametric MRI shows promise in characterization of prostate, but has not been used on quantitative prostate maps. Here we utilize texture analysis on magnetic resonance fingerprinting (MRF) maps of prostate for characterization of prostate lesions. Results show that texture features can differentiate cancer and non-cancerous transition zone and between grades of cancer in peripheral zone. This could add value to MRF-based relaxometry and conventional MRI to improve lesion characterization.

4367	Computer 98	Multiparametric MRI Radiomic Signatures: Individual Prediction for Prostate Cancer and Benign lesions with same imaging findings
		Min Xu[1], Xiangming Fang[1], Mengjie Fang[2], Di Dong[2], Jie Tian[2], and Zhongshuai Zhang[3]
		[1]Imaging Center, Wuxi People's Hospital, Nanjing Medical University, Wuxi, China, [2]CAS Key Laboratory of Molecular Imaging, Institute of Automation, Chinese Academy of Sciences, Beijing P.R. China; University of Chinese Academy of Sciences, Beijing P.R. China., Beijing, China, [3]Siemens Healthcare Ltd., Shanghai, China
		Quantitative Radiomic features based on multiparametric Magnetic Resonance Imaging have great clinical value in discriminating prostate cancer and benign lesions with same imaging findings. We extracted Radiomic features and compared the discrimination efficiency of the combined three types of images with each single type of images, then incorporated independent clinical risk factors and further developed an individual prediction model. The experimental results show that the individual prediction model achieved more accurate diagnosis results than only using Radiomic signatures or clinical factors

4368	Computer 99	MR texture analysis: potential imaging biomarker for prediction of chemotherapy response in patients with colorectal liver metastases
		Huan Zhang[1], Wenhua Li[2], Feixiang Hu[1], Yiqun Sun[1], Tingdan Hu[1], and Tong Tong[1]
		[1]Department of Radiology, Fudan University Shanghai Cancer Center; Department of Oncology, Shanghai Medical College, Fudan University, Shanghai, China, [2]Department of Medical Oncology, Fudan University Shanghai Cancer Center; Department of Oncology, Shanghai Medical College, Fudan University, Shanghai, China

		The aim of this study was to determine if pre-treated MR texture features of colorectal liver metastases (CRLMs) are predictive of chemotherapy response after the first-line chemotherapy. The results indicate that MR texture features on pre-treated T2 images seem to be a promising tool for predicting the chemotherapy response of patients with colorectal liver metastases.

4369	Computer 100	Evaluation the Feasibility of Integrating Computer-aided Diagnosis as a Second Reader into Prostate Multiparametric MRI Diagnostic Process
		Lina Zhu[1], Ge Gao[1], Xiaoying Wang[1], Jing Liu[1], Rui Wang[1], Kai Zhao[1], and Yuan Jiang[1]
		[1]Radiology, Peking University First Hospital, Beijing, China
		Computer-aided diagnosis (CAD) for prostate cancer (PCa) detection based on multiparametric MRI (mpMRI) has become an active field of research, which has shown good stand-alone performance. Before its widely use in daily clinical work, further study still should be done for CAD reading paradigm and the interaction between CAD and human reader. In this article, we implemented CAD in the real world practice, aiming to evaluate the feasibility of integrating CAD as a second reader into the clinical diagnostic process. The results showed this reading paradigm was feasible and CAD might help readers detect more patients with PCa.

4370	Computer 101	How often is the Dynamic Contrast Enhanced (DCE) score needed in PI-RADS version 2?
		Albert T Roh[1], Andreas M Loening[1], Richard E Fan[2], Geoffrey Sonn[2], and Shreyas S Vasanawala[1]
		[1]Radiology, Stanford University, Stanford, CA, United States, [2]Urology, Stanford University, Stanford, CA, United States
		The value of the Dynamic Contrast Enhanced (DCE) sequence in scoring a prostate lesion using PI-RADS version 2 is unknown. Our retrospective review of 213 patients who underwent prostate MRI and subsequent biopsy determined that the rate at which DCE was needed for obtaining the final PI-RADS score was 9%. This low rate raises the possibility of limiting the initial screening prostate MRI to an abbreviated non-contrast protocol, calling back the patient for the DCE sequence only if the initial exam is equivocal.

4371	Computer 102	Multi-parametric MRI features and pathologic outcome of wedge shaped lesions on T2-weighted images
		Aritrick Chatterjee[1], Sevil Tokdemir[2], Alexander J Gallan[3], Shiyang Wang[1], Ambereen Yousuf[1], Tatjana Antic[3], Gregory S Karczmar[1], and Aytekin Oto[1]

[1]Department of Radiology, University of Chicago, Chicago, IL, United States, [2]Department of Radiology, Bezmialem Vakif University, Istanbul, Turkey, [3]Department of Pathology, University of Chicago, Chicago, IL, United States

This study investigated the multi-parametric MRI features and pathologic outcome of wedge shaped lesions on T2-weighted images in 76 patients. A greater percentage of wedge shaped features were found to be malignant than shown previously. Malignant wedge shaped regions were primarily highly hypointense on ADC maps and showed early enhancement on DCE-MRI. Benign wedge shaped lesions were predominantly mildly hypointense on ADC maps and showed no early enhancement and pathologically outcome showed prostatitis, hemosiderin-laden macrophages, prominent blood vessels, intraluminal blood and atrophy. Malignant wedge shaped lesions were found to have significantly lower ADC compared to benign wedge shaped regions.

4372 | Computer 103

Differentiating prostate cancer from benign prostatic hyperplasia using multiparametric MRI

Aritrick Chatterjee[1], Alexander J Gallan[2], Dianning He[1,3], Xiaobing Fan[1], Devkumar Mustafi[1], Ambereen Yousuf[1], Tatjana Antic[2], Gregory S Karczmar[1], and Aytekin Oto[1]

[1]Department of Radiology, University of Chicago, Chicago, IL, United States, [2]Department of Pathology, University of Chicago, Chicago, IL, United States, [3]Sino-Dutch Biomedical and Information Engineering School, Northeastern University, Shenyang, China

This study investigates multiparametric MRI (mpMRI) appearance of different types of BPH and whether quantitative mpMRI is effective in differentiating between PCa and BPH in 60 patients. mpMRI and specifically quantitative ADC values can be used for differentiating PCa and BPH, improving PCa diagnosis in the transition zone. However, DCE-MRI metrics are not effective in distinguishing PCa and BPH. In contrast to previous understanding, glandular BPH has short T2 values (hypointense on T2-weighted images), demonstrates restricted diffusion, and may have similar quantitative mpMRI measurements to stromal BPH. Additionally, glandular and cystic BPH appear differently on mpMRI and are histologically different.

4373 | Computer 104

Diagnosis of Prostate Cancer using MRI derived quantitative Risk Maps

Aritrick Chatterjee[1], Dianning He[1,2], Xiaobing Fan[1], Tatjana Antic[3], Ajit Devaraj[4], Yulei Jiang [1], Gregory S Karczmar[1], and Aytekin Oto[1]

[1]Department of Radiology, University of Chicago, Chicago, IL, United States, [2]Sino-Dutch Biomedical and Information Engineering School, Northeastern University, Shenyang, China, [3]Department of Pathology, University of Chicago, Chicago, IL, United States, [4]Philips Research North America, Cambridge, MA, United States

		This study develops a new tool that estimates the risk map for prostate cancer using quantitative mpMRI metrics and investigates the feasibility of this tool in screening for PCa. Quantitative mpMRI parameters: ADC, T2 and DCE signal enchantment values were calculated and subsequently cancer presence was predicted based on estimated risk scores. The sensitivity, specificity, positive predictive value and negative predictive value for PCa detection using a sector based analysis were 75.0%, 88.6%, 84.7% and 80.8% respectively. The area under the curve in ROC analysis was 0.818. Importantly, all the index lesions were identified by the risk map tool.

4374	Computer 105	The effects of dutasteride on quantitative T2 and T2-weighted imaging in men on active surveillance for prostate cancer: results from a placebo-controlled, randomized clinical trial
		Francesco Giganti[1,2], Giulio Gambarota[3,4], Caroline M Moore[2,5], Neil McCartan[2], Mark Emberton[2,5], Clare Allen[1], and Alex Kirkham[1]
		[1]Radiology, University College London Hospital NHS Foundation Trust, London, United Kingdom, [2]Division of Surgery & Interventional Science, University College London, London, UK, London, United Kingdom, [3]INSERM, U1099, Rennes, France, [4]Université de Rennes 1, LTSI, Rennes, F-35000, France, [5]Urology, University College London Hospital NHS Foundation Trust, London, United Kingdom
		We investigated MRI changes in quantitative T2 parameters in lesions and healthy tissue in men on active surveillance (AS) for prostate cancer (PCa) taking dutasteride or placebo for six months. The protocol included a multi-echo sequence for quantification of the T2 relaxation times. A synthetic signal contrast (T2Q) between lesion and healthy tissue was assessed using quantitative T2 values. Signal contrast was calculated using T2-weighted sequence (T2W contrast). No differences for T2W contrast were observed. A significant correlation between T2Q and T2W contrast was shown. Dutasteride does not influence T2 contrast and relaxation in men on AS for PCa.

4375	Computer 106	Quantitative T2 values for Detection and Grading of Prostate Cancer
		Tobias Franiel[1], Julia Mai[1], Mohamed Abubrig[2], Thomas Lehmann[3], Felix Güttler[1], Elisabeth Weiland[4], Tom Hilbert[4], René Aschenbach[1], Friedrich-Carl von Rundstedt[5], Marc-Oliver Grimm[5], and Ulf Teichgräber[1]
		[1]Department of Radiology, University Hospital Jena, Jena, Germany, [2]Department of Pathology, Universitiy Hospital Jena, Jena, Germany, [3]Department of Statistics, University Hospital Jena, Jena, Germany, [4]Siemens Healthcare AG, Erlangen, Germany, [5]Department of Urology, University Hospital Jena, Jena, Germany

		Purpose: Determination of quantitative T2 values in prostate tissue and their evaluation for detection and grading of prostate cancer. **Methods:** 3T T2 maps and ADC maps of 75 patients with 857 prostate areas (378x normal, 177x cancer, 150x BPH, 119x prostatitis and 33x precancer) were determined. **Results:** T2 values differed significantly between cancer and normal (AUC=0.871), between cancer and BPH (AUC=0.827) and between cancer with GleasonScore 6 and ≥ 7 (AUC=0.742). T2 relaxivities decreased with increasing GleasonScore and correlated significantly with ADC-values (r=0.772). **Conclusion:** T2 values seem to be adequate for the differentiation between prostate cancer and normal tissue or BPH.

4376	Computer 107	Does Machine Learning, As An Independent Arbitrator Of MR Contrast-Ranking In Prostate Cancer Exams, Agree With PI-RADS version 2?
		Steve Patterson[1], Peter Lee[2], Chris V. Bowen[3,4,5], Jennifer Merrimen[6], Cheng Wang[6], Steven D. Beyea[3,4,5], and Sharon E. Clarke[3,4,5]
		[1]Steve Patterson, Nova Scotia Health Research Foundation, Halifax, NS, Canada, [2]Faculty of Computer Science, Dalhousie University, Halifax, NS, Canada, [3]Diagnostic Radiology, Dalhousie University, Halifax, NS, Canada, [4]Biomedical Translational Imaging Centre, Nova Scotia Health Authority, Halifax, NS, Canada, [5]Physics and Atmospheric Science, Dalhousie University, Halifax, NS, Canada, [6]Anatomical Pathology, Dalhousie University, Halifax, NS, Canada
		We show that a simple machine learning algorithm validated most, but not all, aspects of the Prostate Imaging Reporting and Data System (PI-RADS) version 2 formalism derived exclusively from clinical perspectives. Specifically, the value of diffusion-weighted imaging (DWI) and dynamic contrast-enhanced (DCE) sequences in the peripheral zone was confirmed. In contradistinction to PI-RADS, DWI was found to be more valuable in the transition zone than T2 weighted imaging; however, a T2 texture feature afforded a small but significant increase in classifier accuracy in this zone.

4377	Computer 108	Detection of Clinically Significant Prostate Cancer: Incremental Value of Deep Learning to PI-RADS V2
		Liang Wang[1]
		[1]Department of Radiology, Tongji Hospital,Tongji Medical College,Huazhong University of Science & Technology, Wuhan, China

		Deep learning has great potential in medical imaging. 168 patients underwent 3T mpMRI of prostate before mpMR-targeted biopsies plus systematic sampling. Two radiologists from two separate institutions, by using the Prostate Imaging Reporting and Data System (PI-RADS) V2 and a multimodal convolutional neural networks (CNN)-based deep learning, independently assessed prostate MRI examinations. Histopathologic findings were used as the reference standard. In detecting csPCa, both reviewers had significantly higher AUCs using CNN-based deep learning. Reviewer 2 benefited much more from CNN-based deep learning than did reviewer 1. Combined PI-RADS with CNN-based deep learning contribute significant incremental value in the detection of csPCa.

4378	Computer 109	Feasibility of USPIO enhanced 7 Tesla MRI for detecting lymph node metastases in prostate cancer
		Bart WJ Philips[1], Rutger CH Stijns[1], Sören Johst[2], Stephan Orzada[2], Ansje S Fortuin[1], Jelle O Barentsz[1], Marnix C Maas[1], and Tom WJ Scheenen[1]
		[1]Radiology and Nuclear Medicine, Radboud University Medical Centre Nijmegen, Nijmegen, Netherlands, [2]Erwin L. Hahn Institute for MR Imaging, University of Duisburg-Essen, Essen, Germany
		Ultrahigh field MRI offers opportunities for USPIO enhanced MRI for diagnosing lymph node metastases in prostate cancer, by improving resolution and increasing the sensitivity to USPIO particles. The assessment of lymph nodes based on size, shape and USPIO uptake can improve the differentiation between non-cancer and metastatic lymph nodes and may also lower the detection size limit for metastatic nodes. In this work we show the first results of USPIO enhanced MRI and computed echo time imaging of patients with high risk prostate cancer at 7 Tesla.

4379	Computer 110	Use of Texture Analysis to Predict Prostate Artery Embolization Outcomes with MR imaging
		Susanna E Kallioinen[1], Terence A Jones[1,2], James Harding[2], Manpreet Dhillon[2], Sachin Modi[3], Nigel Hacking[3], Drew Maclean[3], and Charles E Hutchinson[1,2]
		[1]Warwick Medical School, University of Warwick, Coventry, United Kingdom, [2]Radiology Department, University Hospitals Coventry & Warwickshire NHS Trust, Coventry, United Kingdom, [3]Radiology Department, University Hospital Southampton NHS Foundation Trust, Southampton, United Kingdom
		Pre-prostate artery embolization (PAE) magnetic resonance images (MRI) from patients with benign prostatic hypertrophy (BPH) were segmented and analysed using two different texture analysis software, qMaZda and TexRad. Percentage reduction in prostate volume and percentage reduction in the International Prostate Symptom Score (IPSS) were used as MRI based outcome measures to build models to be able to predict outcomes from PAE. MRI texture analysis using qMaZda with a linear regression model is able to somewhat predict the percentage prostate volume reduction three months after PAE but not the percentage reduction in IPSS.

4380	Computer 111	Utility of Multiparametric Prostate Magnetic Resonance Imaging for Prediction of Treatment Response Following Focal Laser Ablation
		Ely Felker[1], Leonard Marks[2], Fuad Elkhoury[2], David S Lu[3], Daniel Margolis[4], Shyam Natarajan[5], James Sayre[6], and Steven Raman[3]
		[1]UCLA, Los Angeles, CA, United States, [2]Urology, UCLA, Los Angeles, CA, United States, [3]Radiology, UCLA, Los Angeles, CA, United States, [4]Radiology, Cornell, New York, NY, United States, [5]Bioengineering, UCLA, Los Angeles, CA, United States, [6]Biostatistics, UCLA, Los Angeles, CA, United States
		We evaluated the utility of multiparametric prostate MRI, including T2-weighted imaging, diffusion-weighted imaging (DWI) and dynamic contrast-enhanced imaging, in predicting treatment response following focal laser ablation of prostate cancer in a multi-reader study. DWI appears to be the most useful sequence in response assessment, but inter-reader agreement was moderate at best.

4381	Computer 112	Preliminary Investigation of MR Elastography to Predict Lymph Node Metastasis in Prostate Cancer
		Jin Wang[1], TianHui Zhang[1], Ying Deng[1], Sichi Kuang[1], Bingjun He[1], Qungang Shan[1], Jun Chen[2], Phillip Rossman[2], Arvin Arani[2], Xin Gao[3], Ziying Yin[2], Meng Yin[2], Kevin J. Glaser[2], and Richard L. Ehman[2]
		[1]Department of Radiology, the Third Affiliated Hospital of Sun Yat-sen University(SYSU), Guangzhou, China, [2]Department of Radiology, Mayo Clinic, Rochester, MN, United States, [3]Department of Urology, the Third Affiliated Hospital of Sun Yat-sen University(SYSU), Guangzhou, China
		Prostate cancer(PCa) is one of the leading causes of cancer-related deaths in North American men. Nodal metastases occur in 3-42% of men with clinically localized prostate cancer and the presence of nodal metastases has a strong negative impact on survival. Lymph node staging plays an important role in planning initial management in nonmetastatic PCa. Early detection and resection are important for staging and for the prognosis. We evaluated the diagnostic performance of MR elastography (MRE) in patients with PCa. Results from 33 patients with PCa show that MRE at both of 60Hz and 90Hz has the potential to be a useful technique for predicting PCa lymph node metastases and to establish prognosis and treatment planning.

4382	Computer 113	Improvement of prostate cancer detection combining a computer aided diagnosis system to TRUS-MRI targeted biopsy.
		Martina Pecoraro[1], Riccardo Campa[1], Giovanni Barchetti[1], Isabella Ceravolo[1], Vincenzo Salvo[1], Elena Lucia Indino[1], Maurizio Del Monte[1], Carlo Catalano[1], and Valeria Panebianco[1]
		[1]Department of Radiology, Sapienza University, Policlinico Umberto I, Rome, Italy

		To validate the role of mpMRI combined to CAD system, to increase prostate cancer detection rate using TRUS-MRI guided biopsy. 167 individuals, with elevated PSA level and no previous positive biopsy were enrolled and 63 underwent targeted biopsy. Two radiologists evaluated the exams adopting PIRADSv2 and CAD system. Radiologists' evaluation proved better diagnostic performance compared to CAD. The highest detection rate for clinically significant cancer was obtained biopsying "target into target" lesions. CAD system proved to be useful in pinpointing the neoplastic area within MRI lesions, representing a valuable tool in identifying biopsy targets to improve CDR.

4383	Computer 114	Intravoxel Incoherent Motion Diffusion Weighted Imaging of Prostate Cancer
		Lei Qin[1], Daniel I Glazer[2], Pelin Aksit Ciris[2], Andriy Fedorov[2], Thiele Kobus[3], Fiona M Fennessy[1,2], Stephan E Maier[2], and Robert Mulkern[4]
		[1]Dana-Farber Cancer Institute, Brookline, MA, United States, [2]Brigham and Women's Hospital, Boston, MA, United States, [3]Raboud university medical center, Nijmegen, Netherlands, [4]Boston Children's Hospital, Boston, MA, United States
		Intravoxel Incoherent Motion (IVIM) DWI was acquired with 13 b-values, ranging from 0 to 250 s/mm^2. With such low b-values, a short TE results in a better signal-to-noise ratio. Monoexponential fitting was performed to obtain ADC, and biexponential fitting was performed to obtain diffusion D, perfusion fraction f, and perfusion related pseudo-diffusion coefficient D*. In a prostate cancer (PCa) patient cohort, we only found a significant difference between normal and tumor tissue for D, which was absent in ADC, f, and D*. This suggests that IVIM biexponential analysis can help remove perfusion component from diffusion, leading to a more accurate measurement in diffusion coefficient.

4384	Computer 115	3T Multiparametric MRI based detection of Prostate Cancer: features of detected and missed tumors base on PIRADS v2 in 429 patients- using whole mount histopathology reference
		Amirhossein Mohammadian Bajgiran[1], Sohrab Afshari Mirak[1], Ely Felker[1], Preeti Ahuja[2], Cleo Maehara[2], William Hsu[2], David Lu[1], Robert Reiter[3], Anthony Sisk[4], and Steve Raman[1]
		[1]Abdominal Radiology, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Radiology Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Urology Department, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [4]Pathology Department, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States
		We evaluated the performance of the 3 Tesla multiparametric MRI (mp-MRI) for detection of prostate cancer (PCa) based on Prostate Imaging Reporting and Data System (PI-RADS) Version 2 in 429 patients with 874 lesions. The overall and index tumor detection rate of 3T mp-MRI was 49.3% and 77.9% respectively. The tumor detection rate based on PIRADS v2 increased by size, grade, stage, solitariness and smaller prostate volume. Most missed lesions were small and low grade although a small proportion of large and high grade lesions were not detected.

4385	Computer 116	Clinical usage and impact of predictive models of prostate cancer on multiparametric MRI: a single-observer exploratory evaluation Ethan Leng[1], Benjamin Spilseth[2], and Gregory J. Metzger[1] *[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Department of Radiology, University of Minnesota, Minneapolis, MN, United States* A single-observer, experiential study was conducted to understand how predictive models of prostate cancer on multiparametric MRI can be used clinically, and to determine whether such models have the potential to improve observer performance. A radiologist experienced in prostate MRI was asked to interpret mpMRIs for 34 patients before and after viewing model-generated predictive maps. Results show that the radiologist generally had low confidence in the accuracy of the predictive maps. However, his performance was significantly improved in the cases where he judged the predictive maps to be helpful. A multi-reader iteration of the study is planned.

4386	Computer 117	Estimation of prostate cancer distribution on pathology slides via image analysis of IHC-stained slides. Ethan Leng[1], Jonathan C. Hendriksen[2], Jin Jin[3], Stephen C. Schmechel[2], and Gregory J. Metzger[1] *[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Department of Pathology, University of Washington, Seattle, WA, United States, [3]Department of Biostatistics, School of Public Health, University of Minnesota, Minneapolis, MN, United States* For the development of CAD systems of prostate cancer, manual annotation of cancer by experienced pathologists is the gold standard for establishing the ground truth. However, the process is tedious and has finite precision. Here, we describe a framework that uses quantitative analysis of IHC-stained slides to derive parameters, which in turn are used by a trained predictive model to estimate the spatial distribution of malignant epithelium. Thresholding of the results provides a reasonable map of cancer that is comparable to manual annotation.

4387	Computer 118	The RadPath Surfer: A Radiologic-Pathologic tool for visualizing prostate cancer histology Sean D McGarry[1], Sarah L Hurrell[2], Kenneth Jacobsohn[3], Kenneth A Iczkowski[4], Michael Griffin[2], Petar Duvnjak[2], Andrew Nencka[2], Mark Hohenwalter[2], and Peter LaViolette[2] *[1]Biophysics, Medical College of Wisconsin, Wawautosa, WI, United States, [2]Radiology, Medical College of Wisconsin, Wawautosa, WI, United States, [3]Urologic Surgery, Medical College of Wisconsin, Wawautosa, WI, United States, [4]Medical College of Wisconsin, Wawautosa, WI, United States*

		Prostate cancer is clinically defined by the Gleason Score (GS), based on the pattern of cells and glands. While imaging is useful for localizing prostate cancer, clinical diagnosis is based only on pathology; as such, tools which combine clinical imaging and pathology are highly useful as training tools. This study combines expert annotated histology aligned with clinical imaging to provide a visualization tool, allowing the user to select a region on the MRI and view the underlying pathology and Gleason annotation.

4388	Computer 119	Diagnostic performance of qualitative and quantitative 3T DCE-MRI parameters of prostate cancer lesions in transition and peripheral zone stratified by pathology Gleason score and PI-RADSv2 score
		Sohrab Afshari Mirak[1], Kyung Hyun Sung[2], Amirhossein Mohammadian Bajgiran[1], Nazanin Hajarol Asvadi[1], Ely R Felker[1], Preeti Ahuja[1], Anthony Sisk[3], Robert Reiter[4], and Steven Raman[1]
		[1]Radiology, David Geffen school of Medicine at UCLA, LOS ANGELES, CA, United States, [2]Radiological Sciences and Bioengineering, David Geffen school of Medicine at UCLA, LOS ANGELES, CA, United States, [3]Pathology, David Geffen school of Medicine at UCLA, LOS ANGELES, CA, United States, [4]Urology, David Geffen school of Medicine at UCLA, LOS ANGELES, CA, United States
		We investigated the diagnostic performance of qualitative and quantitative parameters of dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) of prostate cancer (PCa) in 238 patients with 303 lesions located in transition (TZ) and peripheral zone (PZ) stratified by pathology Gleason score (GS) and PI-RADSv2 score with whole mount histopathology validation. There was a significant difference in qualitative and quantitative values between low and high-grade tumors and PI-RADSv2 scores in PZ PCa lesions. However, for tumors located in TZ, only DCE curve type was significantly different between low and high-grade PCa.

4389	Computer 120	Diffusion-weighted Imaging and Dynamic Contrast-enhanced Imaging Distinguish Inflammation from Low Grade Cancer and Normal Tissue in the Peripheral Zone of the Prostate
		Natalie Korn[1,2], Olga Starobinets[1,2], Jeffry Simko[3], John Kurhanewicz[1,2], and Susan M Noworolski[1,2]
		[1]Radiology and Biomedical Imaging, University of California at San Francisco, San Francisco, CA, United States, [2]The Graduate Group in Bioengineering, Universities of California at Berkeley and San Francisco, Berkeley and San Francisco, CA, United States, [3]Pathology, University of California at San Francisco, San Francisco, CA, United States

		Inflammation can complicate the ability to distinguish normal tissue from cancer in the peripheral zone of the prostate. In this work, we show that a multiparametric MRI including dynamic contrast-enhanced imaging (DCE) and diffusion-weighted imaging can distinguish inflammation in the peripheral zone of the prostate from both low-grade prostate cancer and normal tissue. A depth-restricted decision tree built on the apparent diffusion coefficient (ADC) and maximal wash-in slope on DCE correctly classified 79.6% of regions of normal tissue, inflammation, and low-grade cancer in the peripheral zone of the prostate based on pathologist-detailed regions on whole-mount resected glands.

Electronic Poster

Simulations & Modeling

Exhibition Hall	Tuesday 17:15 - 18:15

4390	Computer 1	Exploring the performance of high density detector coil arrays at 10.5 Tesla
		Riccardo Lattanzi[1,2,3], Manushka Vaidya[1,2], Daniel K Sodickson[1,2,3], Kamil Uğurbil[4], and Gregor Adriany[4]
		[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States, [3]Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States, [4]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States
		We used a uniform sphere to model the human head and investigated the performance of receive loop arrays for brain imaging at 10.5T to evaluate the advantage of using a large number of detectors, both alone and in combination with high-permittivity materials (HPM). We show that the ultimate intrinsic signal-to-noise ratio in the central region could be approached with a relative small number of loop coils, whereas more elements are needed to maximize SNR near the surface and to achieve large acceleration factors. Superficial SNR at 10.5T could be considerably enhanced using HPM fairly easy to achieve in practice.

4391	Computer 2	Virtual Population Based Correlations between B1+, Whole-Body and Local SAR
		Manuel Murbach[1], Earl Zastrow[1], and Niels Kuster[1,2]
		[1]ITIS Foundation, Zurich, Switzerland, [2]Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

		Knowledge about the relationship between B1+rms and SAR is beneficial for the MRI RF safety community, consisting of academic investigators, MRI and implant vendors, and regulatory bodies. While implant manufacturers have already started to shift device-labelling form SAR to B1+rms, there is not yet available a systematic evaluation of their relationship. In this study, we aim to close this gap by presenting a systematic methodology for numerical estimations of an entire exposure-scenario matrix, including various human anatomical models, imaging positions, and MRI body-coil geometries.

4392	Computer 3	About the Ideal Receive Array for Human Head MRI
		Andreas Pfrommer[1] and Anke Henning[1,2]
		[1]High-Field MR Center, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Institute of Physics, Ernst-Moritz-Arndt University, Greifswald, Germany
		For the first time, we present a systematic framework to assess the intrinsic SNR performance of loop-only and dipole-only receive arrays in a realistic human head model. Thereby, we distribute generic current patterns on a helmet-like and a cylindrical coil holder. These current patterns form a basis set for any kind of receive element one could place on the holder. We demonstrate how to design an ideal receive array for human head applications by using complementary current patterns.

4393	Computer 4	Comparison of Electric and B1+ Fields for Heterogeneous and Homogeneous Anthropomorphic Phantoms and Anatomical Models: Numerical Simulations and Experimental Findings
		Sossena Wood[1], Tales Santini[2], Narayanan Krishnamurthy[3], Tiago Martins[3], and Tamer S Ibrahim[2,4]
		[1]Bioengineering, University of Pittsburgh, Cranberry Twp, PA, United States, [2]Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States, [3]University of Pittsburgh, Pittsburgh, PA, United States, [4]Radiology, University of Pittsburgh, Pittsburgh, PA, United States
		While numerical phantoms and detailed human tissue models have been available for some time in MR[1-5], the development of experimental phantoms has yet to fully evolve. The growth of rapid prototyping and mimicry of tissues through tissue engineering is making it more possible for realistic electromagnetic phantoms that mimic human anatomy to be available to MR researchers and their collaborators. Wood et al. [6] fabricated a realistic head model (shown in Figure 1A) that can be used for a wide-variety of MR purposes and builds on the work of Gradel et al.7. However, the argument can still be made as to how beneficial it is to have a heterogeneous anthropomorphic phantom in place of a homogeneous anthropomorphic phantom. We hypothesize that the differences will be greatest in the electric field intensities and distribution as opposed to the B1+ field. In this work, we perform numerical studies and experimental 7T measurements that highlight the differences in the electric field and magnetic field of an anthropomorphic phantom (computer model as well as 3D printed) filled with homogeneous and heterogeneous media in comparison to a 10-tissue segmented head model. The phantom uses a resin plastic material that approximates the electromagnetic constitutive properties of a combination fat, bone and skin.

4394	Computer 5	Platform for Validating pTx RF Coil Simulations Using Proton Resonance Frequency Shift MR Thermometry Hongbae Jeong[1], Matthew Restivo[2], Peter Jezzard[1], and Aaron Hess[3] *[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, University of Oxford, Oxford, United Kingdom, [2]Laboratory of Imaging Technology, Biochemistry and Biophysics Centre, NHLBI, NIH, Bethesda, MD, United States, [3]Department of Cardiovascular Medicine, British Heart Foundation centre of research excellence, University of Oxford, Oxford, United Kingdom* We propose a workflow to validate parallel transmission (pTx) RF heating patterns using Proton-Resonance Frequency shift (PRF)-based MR thermometry. An agar+polyethylene powder cylindrical phantom, with similar dielectric properties to the human brain at 297.2 MHz, was designed to assess an 8-channel dipole array. RF heating was evaluated and compared between PRF-based MR thermometry, fibre optic probe measurement, and thermal simulation. The PRF reconstruction procedure was optimized to reduce artefacts. Given the importance of RF safety in pTx applications, this method enables accurate validation of RF heating simulations with minimal additional hardware requirements.

4395	Computer 6	An improved 32-channel loop-dipole transceiver array design for body imaging at 7.0 Tesla: Simulation study M. Arcan Erturk[1], Xiaoping Wu[1], Gregor Adriany[1], Russell L Lagore[1], Kamil Ugurbil[1], and Gregory J Metzger[1] *[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States* An improved 32-channel transmit/receive (transceiver) body array (32LD) is designed by combining eight fractionated dipole elements with 24 loops, 3 each stacked lengthwise above each dipole. Performance of the 32LD is compared against a 16-channel loop-dipole (16LD) array through numerical modeling/simulations around the pelvis and torso of a male human model. The 32LD has ~10% SNR gain in deep centrally located tissues (prostate), >20% gain in medium-depth imaging targets (kidneys) and >30% near the surface. The 32LD has improved field-uniformity, higher transmit efficiency, comparable SAR to 16LD with phase-only RF shimming; and improved excitation fidelity with multi-band parallel transmit pulses.

4396	Computer 7	Exploring how modeling the head as a multi-layered vs. uniform sphere affects ultimate intrinsic signal-to-noise ratio and coil performance prediction Jonghyun Bae[1,2,3], Manushka V Vaidya[1,2], and Riccardo Lattanzi[1,2,3]

		[1]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [3]Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States
		We investigated differences in ultimate intrinsic SNR and simulated SNR for finite coils when modeling the human head as a single-layer uniform sphere with average brain electrical properties vs. a three-layer sphere that accounts also for skull and skin tissue. We show that the uniform sphere provides a good approximation of the head for simulations up to 3T, but becomes less accurate at ultra-high field strengths.

4397	Computer 8	Improving breast imaging B1+ homogeneity with B1 shimming at 1.5T: a modeling study
		Xin Chen[1], Xin Li[2], Danielle Kara[3], Mingdong Fan[3], Joseph Rispoli[2], Michael Steckner[1], and Robert Brown[3]
		[1]Toshiba Medical Research Institute USA, Mayfield Village, OH, United States, [2]Purdue University, West Lafayette, IN, United States, [3]Case Western Reserve University, Cleveland, OH, United States
		B1+ inhomogeneity is a challenge for breast imaging and B1 shimming is standard for all 3T clinical MRI applications. While B1+ homogeneity is typically better at 1.5T than 3T due to reduced wavelength effects, breast image quality is still challenged by B1+ inhomogeneity at 1.5T. This work shows B1 shimming can significantly improve B1+ homogeneity for breast imaging at 1.5T as compared to conventional quadrature drive.

4398	Computer 9	Feasibility exploration of constructing volume RF coil with coupled dipole antennas at 9.4T
		Shasha Yue[1], Chao Luo[2,3], Nan Li[2,3], Jo Lee[2,3], Qiaoyan Chen[2,3], Ye Li[2,3], and Xiaoliang Zhang[4,5]
		[1]Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [2]Lauterbur Imaging Research Center, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [3]Shenzhen Key Laboratory for MRI, Shenzhen, China, [4]Department of Radiology and Biomedical Imaging, University of California, San Francisco, CA, United States, [5]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco, CA, United States

		Dipole antenna, a simple resonator structure, has demonstrated a unique capability of achieving high resonant frequency and utility in MR imaging. Theoretically, this simple resonator structure could be advantageous for building non-array volume RF coil design for ultrahigh field MR imaging applications. In this work, we explore the feasibility of using dipole antenna as resonant element to design non-array volume coils for the ultrahigh field 9.4T MR imaging. The results show that the dipole antennas have sufficient coupling among the resonator elements to create multi-mode resonances and form uniform B1 field distribution within the volume coil at 400 MHz.

4399	Computer 10	Simulation study about New RF loop coil with homogenous 7T B1 field
		Seunghoon Ha[1], Adam Morris[1], and Jonathan Nass[1]
		[1]Philips Healthcare, Pewaukee, WI, United States
		A loop coil design with homogenous B1 field and competitive sensitivity for 7T MRI was presented. The proposed coil was able to align on ROI unlike the asymmetric segmented loop coil design. The calculated B_1 field uniformity and coil sensitivity of the proposed coil was superior to the asymmetric segmented loop coil as well as the loop coil with symmetrically distributed capacitors. The eight channels volume shaped loop array constructed by the proposed design loops was simulated. The proposed design will potentially help the construction of larger size loop arrays to cover more imaging volume at 7T and higher.

4400	Computer 11	Design and simulation of dual-band dipole antenna for 1H/31P at 9.4T MRI
		Suk-Min Hong[1], Chang-Hoon Choi[1], Jörg Felder[1], and N. Jon Shah[1,2]
		[1]Institute of Neuroscience and Medicine – 4, Forschungszentrum Jülich, Jülich, Germany, [2]Department of Neurology, Faculty of Medicine, RWTH Aachen University, JARA, Aachen, Germany
		The resonance frequency of a dipole antenna is defined by its length (λ/2). The use of LC traps at specific locations within the dipole antenna generates additional resonances. We designed a dual-band dipole antenna tuned to 400 MHz for ^{1}H and 160 MHz for ^{31}P with the aid of an LC trap. The length of the dipole antenna was shortened to 32 cm by introducing end meanders and this concept was also expanded to form a 4-channel array. The performance of the dual-band dipole antenna was simulated and the feasibility of using it as an antenna array is demonstrated.

4401	Computer 12	Fast Optimization Method for RF Coil Array Geometry in a Post-Processing Step
		Jan Paska[1,2], Amparo Ruiz[1,2], and Jose Raya[1,2]

		[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), NYU School of Medicine, New York, NY, United States
		In this work we propose a novel single-run simulation method for RF coil design spanning enough of the design space to provide a clear intuition on optimal coil design, offer a benchmark SNR, and predict coil losses and coupling. It is based on the combination of conductors and sources to emulate coil arrays in a post-processing step. We demonstrated our method's potential for the optimization of an RF coil array for imaging of the rat limb at 7T. We validated our method using electromagnetic (EM) field simulations.

4402	Computer 13	Validation of numerical simulation of susceptibility artifact and the consequences for artifact size calculation of the current ASTM standard F2119
		Tobias Spronk[1], Archana Chinnaiyan[1], Jakob Kreutner[1,2], and Gregor Schaefers[1,2]
		[1]MR:comp GmbH Testing for MR Satety & Compatibility, Gelsenkirchen, Germany, [2]MRI-STaR-(Magnetic Resonance Institute for Safety, Technology and Research GmbH), Gelsenkirchen, Germany
		The ASTM standard F2119 provides evaluation methods for the artifacts of medical implants in a well-defined test environment. In our work we had validated a numerical simulation of MR susceptibility artifacts according to this standard. Based on this simulation, the calculation methods of the artifact size in the ASTM standard were evaluated to show the limitation of the current methods.

4403	Computer 14	Simplifying the Numerical Human Model with k-means Clustering Method
		Kyoko Fujimoto[1], Leonardo M Angelone[1], Sunder S Rajan[1], and Maria Ida Iacono[1]
		[1]Center for Devices and Radiological Health, US Food and Drug Administration, Silver Spring, MD, United States
		Currently, the safety assessment of radio-frequency (RF) heating in computational modeling is limited by the available numerical models which are not patient-specific although RF-induced heating depends on the physical characteristics of the patient. The numerical model generation is difficult due to the highly time-consuming segmentation process. Therefore, having fewer types of segmented structures simplifies the generation of numerical models. In this study, we used the k-means clustering method to reduce the number of dielectric properties of an existing numerical model and investigated the resulting difference in SAR with respect to the number of clusters.

4404	Computer 15	Accelerating the Co-Simulation Method for Fast Design of Transmit Array Coils: An Example Study on a Degenerate Birdcage Coil

		Alireza Sadeghi-Tarakameh[1,2], Ehsan Kazemivalipour[1,2], Taner Demir[2], Umut Gundogdu[2], and Ergin Atalar[1,2]
		[1]Electrical and Electronics Engineering Department, Bilkent University, Ankara, Turkey, [2]National Magnetic Resonance Research Center (UMRAM), Ankara, Turkey
		The co-simulation method suffers local minima during the design of a transmit array coils. In this study, our purpose is to utilize an equivalent circuit model of the coil and analytical calculations to provide a proper initial guess for co-simulation method. For the proof of concept, we designed and constructed an eight-channel head-degenerate birdcage coil (DBC) for a 3T scanner using this method which decreased the optimization time by more than 6000 fold.

4405	Computer 16	SNR Evaluation for a high-permittivity dielectric helmet-shaped coil former for a 28 channel receive array
		Giuseppe Carluccio[1,2], Gillian Haemer[1,2], Manushka Vaidya[1,2], Sebastian Rupprecht[3], Qing Yang[3], and Christopher Michael Collins[1,2]
		[1]Radiology, Center for Advanced Imaging Innovation and Research (CAI2R), New York, NY, United States, [2]Radiology, Bernard and Irene Schwartz Center for Biomedical Imaging, New York, NY, United States, [3]Radiology, Pennsylvania State University College of Medicine, Hershey, PA, United States
		The performance of a high-permittivity helmet-shaped former is evaluated when used to improve the SNR in the head for a 28-channel receive array coil. Through simulations, it was found that the use of the helmet can dramatically increase the SNR in the head, up to more than 3 times the original value in some locations of the head, and about 50% increase overall in the brain.

4406	Computer 17	New optimization strategies for RF shimming at UHF MRI
		Tales Santini[1], Sossena Wood[1], Narayanan Krishnamurthy[1], Yutong Zhang[1], Nadim Farhat[1], Neilesh Vinjamuri[1], Minseok Koo[1], Howard Aizenstein[1], and Tamer S. Ibrahim[1]
		[1]University of Pittsburgh, Pittsburgh, PA, United States
		This work proposes four optimization strategies for the RF shimming in UHF MRI. The results show a minimum coefficient of variation of B1+ field distribution over the human head = 23%/17%/14% for the 4chTEM, 16chTTT, and 64chTTT respectively. For the maximum over minimum evaluation criteria of the B1+ field distribution, the best values were 6.70/2.92/2.23 for 4chTEM/16chTTT/64chTTT coils. For a fixed mean B1+ field over the human head, the best average SAR values were 2.09/1.28W/kg for the 4chTEM/16chTTT coils respectively. These strategies can be applied to any RF transmit array system, but are most beneficial for highly parallel systems.

4407	Computer 18	Evaluation of RF Shielding Effectiveness by Method of Moments
		Yihe Hua[1], Teck Beng Desmond Yeo[1], Thomas Foo[1], Dominic Graziani[1], Justin Ricci[1], Joseph Piel[1], and Keith Park[1]
		[1]GE Global Research, Niskayuna, NY, United States
		In MRI system, RF shielding is designed to isolate the RF coil from outside conductive objects. Usually simulation is done with only RF coil and RF shielding being included and the impact from outside objects could be qualitatively estimated by limiting the fringe field of the RF coil to a certain level. In this work, the impact from gradient coil to the RF coil can be examined quantitatively rather than qualitatively via the S-parameters of the RF coil being studied with Method of Moments. which is very useful for the RF shielding design.

4408	Computer 19	Development of an Asymmetrical Birdcage Design towards Homogeneous Volume Excitation for Hyperpolarized Xenon-129 Lung Imaging at 3T
		Wolfgang Loew[1], Christopher Ireland[1], Zackary Cleveland[2], Hui Wang[3], Peter van der Meulen[4], Randy Giaquinto[1], Ronald Pratt[1], Jason Woods[2], and Charles Dumoulin[1]
		[1]Imaging Research Center, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [2]Center for Pulmonary Imaging Research, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [3]Philips Healthcare, Gainesville, FL, United States, [4]Philips Healthcare, Best, Netherlands
		Hyperpolarized ^{129}Xe imaging is increasingly viewed as a viable tool for assessing lung structure and function. ^{129}Xe MRI requires that large flip angle and frequency selective RF pulses be applied homogeneously across the entire thorax. The transmit performance of three common multi-nuclear whole-body birdcage designs was assessed under a loaded condition at different locations inside the RF shield with electromagnetic field simulations. The acquired data was used to develop a novel, optimized birdcage design for which the transmit performance was analyzed and compared to the three common designs.

4409	Computer 20	Computer-aided design and simulation of a double-nuclear parallel transmit RF coil array for proton MRI and carbon-13 MRS of human extremities at 7T
		Omar Rutledge[1], Riccardo Stara[1], and Brian Rutt[1]
		[1]Radiological Sciences Laboratory, Department of Radiology, School of Medicine, Stanford University, Stanford, CA, United States

		^{13}C MR spectroscopy can offer important metabolic information in the musculoskeletal system without the use of ionizing radiation. In this work, we design and simulate a novel double-nuclear pTx RF coil array (8-channel per frequency) with ICE decoupling coils for proton MRI and ^{13}C MRS of human extremities. Coupling was compared between the RF coil array with and without ICE elements demonstrating the significant decoupling effect of the ICE coils. Calculated B_1^+ field maps for both the proton MTLs and the ^{13}C loops with ICE elements show sufficient transverse magnetization for MRI and MRS applications. Through the use of switch-tuned ICE decoupling elements, we have demonstrated the feasibility of dual-frequency pTx arrays for ^1H imaging and ^{13}C spectroscopy of human extremities at 7T.

4410	Computer 21	High Density Volume Array Strategies for SNR and Parallel MRI
		Scott B King[1] and Zhiyong Zhai[2]
		[1]Invivo, Gainesville, FL, United States, [2]Philips, Gainesville, FL, United States
		Most receive array coils are made of many various shapes of loop coils with different arrangements. In practice, the final goal for a good performance array coil is to find a combination of these loop coils such that improved optimal signal-to-noise ratio (SNR)1-3 and reduced parallel MRI g-factor3 can be achieved in the same time. Here we study four different loop coil arrangements for a head array coil. The simulation results shed some light on optimal loop arrangements and performance expectations.

4411	Computer 22	Combined EM simulations and measurements of birdcage coil B1+ for designing a 3T multichannel TMS /MRI head coil array
		Lucia I Navarro de Lara[1], Laleh Golestani Rad[1], Sergey Makarov[1,2], Jason P Stockmann[1], Lawrence L Wald[1], Thomas Witzel[1], and Aapo Nummenmaa[1]
		[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Worcester Polytechnic Institute, Worcester, MA, United States
		The multichannel TMS approach enables steering the stimulation “hot spot” electronically making the execution of concurrent TMS and fMRI experiments potentially more flexible. An integrated multichannel TMS/MRI system is currently under development and here we investigate how TMS coils influences the B_1^+ field of a birdcage coil. We compare detailed electromagnetic simulations with empirical data using a single three-axis TMS coil element as well as generate simulated data for 4x4 TMS coil array. Both simulations and empirical results indicate that an array of TMS coils should not distort the B_1^+ significantly at distances bigger than 2cm from the coil.

4412	Computer 23	Reverse Engineering of a 7T 16-Channel Dual-Row Transmit Array Coil

		Mikhail Kozlov[1], Nikolaus Weiskopf[1], Harald E. Möller[1], and Gunamony Shajan[2,3]
		[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom, [3]MR Coiltech Limited, Glasgow, United Kingdom
		We developed a reverse engineering numerical workflow that yielded a good match between measured and simulated scattering parameters of an inductively decoupled non-overlapped dual-row transmit array for MRI at 7T. We evaluated and compared the performance of different tuning conditions resulted in similar scattering parameters. For the circular polarization mode under-coupled, over-coupled, or mixed tuning conditions resulted in up to 65% variation of different coil losses but small variation of transmit efficiency. For comparisons of array transmit performance, consideration of array-internal losses as well as reflected and radiated power is very important, because their sum can be as high as 71% of the total transmit power.

4413	Computer 24	ASIC Model of SENSE to Accelerate MR Image Reconstruction
		Sohaib A Qazi[1], Faisal Siddiqui[1], J Jacob Wikner[2], and Hammad Omer[1]
		[1]COMSATS Institute of Information Technology, Islamabad, Islamabad, Pakistan, [2]Linkoping University, Linkoping, Linkoping, Sweden
		In Parallel MRI (pMRI), imaging process is accelerated by acquiring less data using multiple receiver coils and offline reconstruction algorithms (e.g. SENSitivity Encoding (SENSE)) are applied to reconstruct fully sampled data. We present a synthesizable high-description language (HDL) model of SENSE algorithm where the reconstruction can be performed within signal processing chain of MRI scanner. The proposed architecture is tested using simulated human brain data with 8 channel receiver coils and quality of reconstructed images is analyzed using artifact power. The results show that the proposed reconstruction model achieves 0.014 artifact power and is 700 times faster than the CPU based SENSE reconstruction.

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MR Engineering Beyond RF Coils

Exhibition Hall	Tuesday 17:15 - 18:15

4414	Computer 25	Holographic Computing for MRI-based Visualization and Interactive Planning of Prostate Interventions
		Cristina M. Mojica[1], Nikhil V. Navkar[2], Shidin Balakrishnan[2], Julien Abinahed[2], Walid El Ansari[2], Khalid Al-Rumaihi[2], Adham Darweesh[3], Abdulla Al-Ansari[2], Mohamed Gharib[4], Mansour Karkoub[4], and Nikolaos V. Tsekos[1]

		[1]Department of Computer Science, University of Houston, Houston, TX, United States, [2]Department of Surgery, Hamad Medical Corporation, Doha, Qatar, [3]Department of Clinical Imaging, Hamad Medical Corporation, Doha, Qatar, [4]Mechanical Engineering Department, Texas A&M University at Qatar, Doha, Qatar
		A platform is presented for holographic visualization and planning of image-guided prostate interventions. Its pipeline includes modules dedicated for MRI segmentation, structure rendering, trajectory planning for biopsy or brachytherapy needles, and the spatial co-registration of the outcomes of these modules for augmented reality holographic rendering. The interface was implemented on a HoloLens smart-glasses enabling gesture and voice activation for interactive selection of the input parameters of any module. The work is motivated by the potential of holographic augmented reality to offer true 3D appreciation of the morphology of the area of the procedure and interactive planning of access trajectories.

4415	Computer 26	Comparison of MRI subsystem performances for two models of MRI-guided radiotherapy: MRI-Cobalt-60 versus MRI-Linac
		Olga L Green[1], James Flock[2], Rajiv Lotey[3], Austen N Curcuru[1], Sasa Mutic[1], and H Michael Gach[1]
		[1]Radiation Oncology, Washington University in St Louis, St Louis, MO, United States, [2]ViewRay, Oakwood Village, OH, United States, [3]ViewRay, Mountain View, CA, United States
		The era of MRI-guided radiation therapy (MR-IGRT) began in January 2014 when the first patient was treated with ^{60}Co under real-time MRI guidance. In 2017, the first FDA-approved MRI-Linac began treating patients. Both systems incorporate a double donut magnet design with a 28 cm gap for the radiation beam. A rotating gantry carries either three shielded ^{60}Co heads or a 6 MV Linac with magnetic and RF shielding. In this study, we compare the MRI subsystem performance between the two systems.

4416	Computer 27	Simultaneous MR and Ultrasound Acquisition for Image Guided Radiation Therapy using an MR-compatible, Hands-free, Electronically Steerable Ultrasound Transducer
		Thomas Foo[1], Warren Lee[1], David Mills[1], David Shoudy[1], Heather Chan[1], Aqsa Patel[1], James Sabatini[1], Timothy Fiorillo[1], Eric Fiveland[1], Lowell Scott Smith[1], Bo Wang[1], Jhimli Mitra[1], Shourya Sarcar[1], Alan McMillan[2], James Holmes[2], Wes Culberson[2], Michael Bassetti[2], Charles Matrosic[2], Andrew Shepard[2], and Bryan Bednarz[2]
		[1]GE Global Research, Niskayuna, NY, United States, [2]University of Wisconsin-Madison, Madison, WI, United States

		A new approach is developed for intrafractional motion management in radiation therapy (RT) that accounts for respiratory-induced motion using a prior simultaneous MR-ultrasound acquisition to provide "virtual" real-time MR image guidance during the RT procedure. This proposed solution first acquires simultaneous MR and ultrasound to link MR images to different respiratory states that are determined from 4D ultrasound images. During the RT procedure, the hands-free 4D ultrasound determines the respiratory state from displacement of endogenous fiducial markers. MR images corresponding to each respiratory state are displayed to provide an indication of the tumor target relative to the radiation beam.

4417	Computer 28	A Novel Hybrid Method for Gradient Nonlinearity (GNL) Correction for MRI- Linac system
		Shanshan shan[1], Mingyan Li[1], Yaohui Wang[2], Fangfang Tang[1], Deming Wang[1], Haiwei Chen[1], Ewald Weber[1], Rafael Franco[1], Craig Freakley [1], Feng Liu[1], and Stuart Crozier[1]
		[1]The University of Queensland, Brisbane, Australia, [2]South China University of Technology, Guangzhou, China
		MRI-guided radiotherapy requires precise image geometric information to target a tumour without unnecessary radiation on healthy surrounding tissue. Due to the imperfections in the gradient system and engineering limitations, however, gradient non-linearity (GNL) inevitably occurs and causes image distortions if not properly accounted for. Here we propose a novel method to estimate the gradient field using stream function methods with a grid phantom. The estimated gradient field was then used for GNL distortion correction and image reconstruction. Initial simulations demonstrated that the image geometric distortion in a combined MRI and linear accelerator (MRI-Linac) system was effectively improved by the proposed method.

4418	Computer 29	High Resolution Tomographic Imaging with a 6.3 T/m Field Free Line Magnetic Particle Imager
		Elaine Yu[1], Bo Zheng[1], Zhi Wei Tay[1], Paul Keselman[1], Xinyi Y Zhou[1], Ryan Orendorff[1], Daniel W Hensley[1], R Matthew Ferguson[2], Amit P Khandhar[2], Scott J Kemp[2], Kannan M Krishnan[2,3], Patrick Goodwill[1,4], and Steven Conolly[1,5]
		[1]Department of Bioengineering, University of California, Berkeley, CA, United States, [2]Lodespin Labs, Seattle, WA, United States, [3]Department of Material Science and Engineering, University of Washington, Seattle, WA, United States, [4]Magnetic Insight, Inc., Alameda, CA, United States, [5]Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA, United States
		Magnetic Particle Imaging (MPI) is a novel, high-contrast, and quantitative imaging modality that directly detects superparamagnetic iron oxide nanoparticle (SPIO) tracers. In MPI, the imaging sensitive region is a field free region produced by a strong gradient selection field. There are two imaging formats in MPI: Field Free Point (FFP) and Field Free Line (FFL). The spatial resolution of our previous FFL imager was limited by the strength of the FFL gradient (2.35 T/m). Here we describe the hardware development of a high resolution 6.3 T/m FFL MPI system using water-cooled electromagnets and a laminated iron-core.

4419	Computer 30	A 3T Head Scanner Designing Stage: the HTS magnet and the 200mT/m Hyper-Vision Gradient Coil.
		Hector Sanchez Lopez[1,2] and Hidenao FUKUYAMA[3]
		[1]MRI Devices, Kyoto Future Medical Instrument Inc., Kyoto, Japan, [2]ARKFIELD PTY LTD, Brisbane, Australia, [3]Research and Educational Unit of Leaders for Integrated Medical Systems, Kyoto University, Kyoto, Japan
		This work presents the design stage of a 3T MRI head scanner aimed to register temporal physiological events in the scale below 1 sec while imaging brain structures below 0.5 mm of resolution. The hyper-vision gradient coil concept is capable to produce 200 mT/m and nearly 1900 T/m/s using a high end amplifier. The 3D folded coil exhibits shoulder cut of an aperture of 250 mm and a DSV of 250mmx210mm while keeping resistance, eddy currents, force and inductive decoupling with the HTS magnet under control. Details and characteristics of the coil and magnet are presented in this work.

4420	Computer 31	Laplacian-Inspired Design of a Highly-Homogeneous, RF Shielded Magnet for Low-Field TRASE MRI
		K.M. Smith[1], C.P. Bidinosti[2], and Scott B. King[3]
		[1]Physics & Astronomy, University of Manitoba, Winnipeg, MB, Canada, [2]Physics, University of Winnipeg, Winnipeg, MB, Canada, [3]Phillips, Gainesville, FL, United States
		We present a novel Laplacian design method for a finite length magnet with perfect field homogeneity. It will be used to study TRansmit Array Spatial Encoding (TRASE) MRI at low field. As TRASE does not require the application of switched B_0 gradients, we propose to build the magnet on an aluminum housing which acts both as a heat sink and effective low-frequency RF shield.

4421	Computer 32	Development of a Gradient and Shim Insert System for Marmoset Imaging at 9.4 T
		Justin Peterson[1], Ryan Chaddock[1], Brian Dalrymple[1], Frank Van Sas[1], Kyle M Gilbert[2], Martyn L Klassen[3], Joseph S Gati[3], William B Handler[1], and Blaine A Chronik[1]
		[1]The xMR Labs, Department of Physics & Astronomy, Western University, London, ON, Canada, [2]Centre for Functional and Metabolic Mapping, Robarts Research Institute, London, ON, Canada, [3]Medical Biophysics, Western University, London, ON, Canada
		A replacement gradient coil for a 9.4 T preclinical system (31-cm inner diameter magnet) has been designed and is currently under construction. The new gradient and shim system will allow for improved imaging performance on the 9.4 T system, and has been developed specifically for marmoset imaging studies. Efficiencies of 1.5 mT/m/A for an ROI of size 8.5 cm at 5% homogeneity were achieved. A 10-channel shim set (not including first-order gradient shims) is included, with minimized inductive coupling to the gradient axes.

4422	Computer 33	A true comparison of B0 shimming with a very high order spherical harmonic based setup and a multi-coil shim array
		Ali Aghaeifar[1,2], Paul Chang[1,2], Sahar Nassirpour[1,2], Martin Eschelbach[1], Anke Henning[1,3], and Klaus Scheffler[1,4]
		[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience, University of Tuebingen, Tuebingen, Germany, [3]Institute of Physics, Ernst-Moritz-Arndt University, Greifswald, Germany, [4]Department of Biomedical Magnetic Resonance, University of Tuebingen, Tuebingen, Germany
		In this work, a true experimental comparison between a very high order spherical harmonic based shim setup and a multi-coil shim array is presented. Each technique has its own cons and pros which are studied through several often-used sequences. All evaluations are performed by shimming of the human brain at 9.4T.

4423	Computer 34	Development of a small-car mountable MRI system for human extremities using a 0.2 T permanent magnet
		Katsumasa Tanabe[1], Mayu Nakagomi[1], Katsumi Kose[1], Yoshikazu Okamoto[2], Sodai Hoshiai[2], and Yasuhiko Terada[1]
		[1]Institute of Applied Physics, University of Tsukuba, Tsukuba, Japan, [2]Institute of Clinical Medicine, Department of Diagnostic and Interventional Radiology, University of Tsukuba, Tsukuba, Japan
		We developed a new, compact portable MRI system for imaging extremities using a 0.2 T permanent magnet. The system was sufficiently small in size and mountable on a small, standard-sized vehicle. The use of the open-geometry magnet enabled the easy patient positioning within the limited space in the vehicle. We showed that our portable MRI provides clinically relevant images. The portable system might be deployable during sport events or in resource-poor environments access to MRI systems, and allow mass screening, early diagnosis, and case finding.

4424	Computer 35	Switching Impedance Matching and Primary Coil Array Using RF MEMS switches for a Wireless Power Transfer System
		Kelly Byron[1], Fraser Robb[2], Shreyas Vasanawala[3], John Pauly[1], and Greig Scott[1]
		[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]GE Healthcare, Aurora, OH, United States, [3]Radiology, Stanford University, Stanford, CA, United States

		Wireless power transfer (WPT) inside the MRI bore, as part of completely wireless patient coils, should have minimal RF interactions and be a compact system that allows for flexible placement of the coils while maintaining power transfer efficiency. Changes in coil positions can drastically reduce power amplifier efficiency. Here we present a MEMS based auto-tuning approach to compensate for the varying load seen by the power amplifier. An array primary coils also using high-power RF MEMS devices to steer power to a local secondary coil is also demonstrated.

4425	Computer 36	Recording Electrophysiological Signals Through MR Receiver Coils During Concurrent fMRI
		Ranajay Mandal[1], Nishant Babaria[2], Jiayue Cao[1], and Zhongming Liu[1,2]
		[1]Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, United States, [2]Electrical and Computer Engineering, Purdue University, West Lafayette, IN, United States
		Simultaneous recording of fMRI and electrophysiological (EP) signals, e.g. electroencephalography (EEG), electrocorticography (ECoG), and local field potentials (LFP) holds significant potential to evaluate the brain dynamics and its underlying neural circuitry across various spatiotemporal scales. However methodological challenges associated with bio-potential recording within MRI still work as a bottleneck. Here we present a miniaturized, MR-compatible device that can adaptively learn the presence of electromagnetic artifacts and can perform high fidelity EP recording (ECG, LFP, SEP etc.) wirelessly through the MR-receiver coil. The low power device provides a cheap and simple solution for recording various electrophysiological signals during concurrent fMRI.

4426	Computer 37	Development of a field camera system for a customized 1.5 T compact MRI system
		Yuta Kobayashi[1], Katsumi Kose[1], and Yasuhiko Terada[1]
		[1]University of Tsukuba, Tsukuba, Japan
		We developed a field camera system for a 1.5T/280mm superconducting magnet system with unshielded gradient coils. K-space trajectories of a two-dimensional spiral scan were monitored using the field camera system and predicted based on a gradient impulse response function (GIRF). Image reconstruction with these trajectories was effective to recover artifact-free images, even in the presence of hardware imperfections. This result showed the validity of the system.

4427	Computer 38	Novel applicator design for MR guided RF hyperthermia in head and neck cancers: heating performance and RF coupling
		Margarethus Marius Paulides[1], Tomas Drizdal[1], Gerard Cornelis Van Rhoon[1], and Desmond Teck Beng Yeo[2]

		[1]Radiation Oncology, Erasmus MC Cancer Institute, Rotterdam, Netherlands, [2]GE Global Research, Niskayuna, NY, United States
		Clinical studies have established the clinical benefit of adjuvant mild hyperthermia in the head and neck, but further improvements are hampered by an inadequate temperature dosimetry. We designed a novel MR compatible hyperthermia applicator ("MRcollar") based on a previously developed antenna concept. Despite the tradeoffs faced when combining heating and imaging, good power focusing ability, i.e. hyperthermia quality, and MRI compatibility were demonstrated by simulations and a reduced scale experiment.

4428	Computer 39	Output Filter Design for Gradient Amplifier and Shimming Amplifier of MRI: an Overview
		Huijun Yu[1], Sebastian Littin[1], Feng Jia[1], Stefan Kroboth[1], and Maxim Zaitsev[1]
		[1]Department of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany
		Switch-mode gradient amplifiers are widely employed in magnetic resonance imaging systems to drive gradient coils with high current and voltage to provide fast slew rates. The pulse-width modulation control results in unavoidable current ripple and switching noise. Therefore an effective filter is required to attenuate the current ripple and switching noise to avoid image artifacts. Common methods include using single or two stages of LC low pass filter with a disadvantage of bulky size and low ripple attenuation at the switching frequency. Here we present four different filters as alternative designs that introduce a notch mode.

4429	Computer 40	Concurrent Excitation and Acquisition for the Ultimate MRI Experience: Silent, Implant Friendly, Nearly 100% Efficient
		Ali Caglar Özen[1,2], Burak Akin[1], and Michael Bock[1]
		[1]Dept.of Radiology, Medical Physics, Medical Center - University of Freiburg, Freiburg, Germany, [2]German Consortium for Translational Cancer Research Freiburg Site, German Cancer Research Center (DKFZ), Heidelberg, Germany
		Concurrent excitation and acquisition (CEA) allows detecting the MR signal during frequency-swept radio-frequency (RF) excitation without dead times. In our previous work, CEA was realized in a clinical MRI system using a fully automated analog cancellation unit to suppress the unwanted transmit signal leakage during signal reception. In this study, CEA MRI of human head was compared to a 3D UTE sequence; a very fast CEA protocol was demonstrated for 3D radial acquisition of a human ankle; finally rapid passage excitation of the CEA was compared to a hard pulse in terms of SAR.

4430	Computer 41	A Signal Loss Compensation Method in an RF switch matrix system in Ultra High Field MRI YunKyoung Ko[1], Chang-Hoon Choi[1], and N.Jon Shah[1] *[1]Institute of Neuroscience and Medicine - 4, Juelich, Germany* A crossbar switch matrix can be flexibly connected to any input and output paths via RF switches. However, this type of matrix creates open-stubs in the RF lines. Since the RF wavelength becomes shorter as the magnetic field increases, signal loss due to impedance variations in RF pathways becomes severe, thus degrading image quality. In this study, we propose an advanced compensation method and verify its performance in ultra-high field MRI with single and multi-channel array coils.

4431	Computer 42	Advancement in Dynamic Sensitivity Averaging for a Rotating RF Coil (RRFC) at 9.4T with Compressed Sensing Mingyan Li[1], Feng Liu[1], Jin Jin[1], Ewald Weber[1], and Stuart Crozier[1] *[1]School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, Australia* We have previously developed a practical imaging scheme for the rotating RF coil (RRFC) in Cartesian trajectories. This scheme employs dynamic sensitivity averaging (DSA) of multiple k-spaces during coil rotation, which eliminates the need of time-consuming, position-dependent sensitivity estimation for image reconstruction of the RRFC. As demonstrated in previous work, two extra complementary profiles are required to achieve efficient DSA, thus the scan duration is potentially extended. To further improve the efficiency of DSA, compressed sensing (CS) is implemented to the image reconstruction of the RRFC.

4432	Computer 43	Optimal Bazooka Balun Proportions Victor Taracila[1], Luke Smith[1], Ceara Stack[1], and Fraser Robb[1] *[1]GE Healthcare Coils, Aurora, OH, United States* In MRI, traditional RF coils have cables, which supply the on-coil electronics with power and carry the received signals out from the receive elements to further amplification, digitization and post-processing. The standard technique for blocking currents being induced on the cables uses RF traps, colloquially called bazooka baluns, which represent parallel resonant tanks coupled (magnetically) to the cable. Question: If the volume of the bazooka balun is fixed, what would be its diameter and length so that the impedance of the balun is maximized?

4433	Computer 44	Optimizing the combination of preamplifier input impedance and coil impedance for high-density receive arrays Ali Attaran[1], Kyle Gilbert[1], Blaine A. Chronik[1], and Ravi S. Menon[1] *[1]University of Western Ontario, London, ON, Canada* Low-profile preamplifiers were developed to be used in multichannel coil arrays. Optimizing the combination of preamplifier input impedance and coil impedance for high-density receive arrays indicates that the highest SNR is obtained when using high input-impedance preamplifiers connected directly to high-impedance coils.

4434	Computer 45	Design of a passive feed network to increase the transmit efficiency of dipoles at 7 Tesla Irena Zivkovic[1], Thomas O'Reilly[1], Wyger Brink[1], and Andrew Webb[1] *[1]Radiology Department, C.J. Gorter Center for High Field MRI, Leiden University Medical Center, Leiden, Netherlands* In this abstract, we presented a new way of feeding a dipole type antenna which increases the transmit efficiency (B_1^+ per square root maximum SAR). The main radiating antenna element was printed on one side of a dielectric substrate with capacitive coupling to a shorter straight dipole element used as the feed element printed on the opposite side. Indirectly (passively) and directly fed (conventional) meander antennas were fabricated and their performances were compared numerically and experimentally. The indirectly fed dipole antenna exhibited increase in transmit efficiency for straight and meandered dipoles.

4435	Computer 46	Automated data acquisition system for fMRI resting state de-noising Grace Li Haug[1], Domenic Cerri[1], Yen-Yu Ian Shih[1], and SungHo Lee[1] *[1]Biomedical Research Imaging Center and Department of Neurology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States*

		We have developed an automated system for collecting data from monitoring devices for animal functional MRI (fMRI) research to clean the effects of the physiological nuisance signal. Graphical user interface (GUI) is also provided to make a convenient environment for monitoring animal vital signs on one screen. To demonstrate the system's usefulness, we perform CBV-based resting-state fMRI and compare the changes of temporal signal-to-noise ratio (tSNR) in the striatum between the before and after end-tidal CO_2 ($EtCO_2$) signal correction using RETROICOR algorithm. The software automates the time synchronization among the collected data and will be expanded to automate the noise filtering process.

4436	Computer 47	FPGA processors of Parallelized 2D FFT suitable for real-time RARE image reconstruction
		Limin Li[1] and Alice M Wyrwicz[1,2]
		[1]Center for Basic Magnetic Resonance Research, Northshore University HealthSystem, Evanston, IL, United States, [2]Biomedical Engineering, Northwestern University, Evanston, IL, United States
		We report here a new parallelized 2D FFT algorithm suitable for real-time RARE image reconstruction and describe how to implement the algorithm on a Field-Programmable Gate Array (FPGA). We will present the design and testing of these FPGA processors, and demonstrate their utility in reconstructing RARE images.

4437	Computer 48	On the Properties of Additive Manufacturing Materials for Anatomy Specific 3D-Printed MRI Coils
		Bahareh Behzadnezhad[1,2], Bruce D Collick[2], Nader Behdad[1], and Alan B McMillan[2]
		[1]Electrical and Computer Engineering, University of Wisconsin-Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States
		Additive manufacturing provides a low-cost and rapid means to translate 3D design into the construction of a prototype. For MRI, this type of manufacturing can be used to construct various components including the structure of RF coils. In this abstract, we characterize the material properties (dielectric constant and loss tangent) of several common 3D-printed plastics, and utilize these material properties in full-wave electromagnetic simulations to design and construct a very low-cost subject/anatomy-specific 3D-printed receive-only RF coil that fits close to the body. We show that the anatomy-specific coil exhibits higher signal-to-noise ratio compared to a conventional flat surface coil.

Electronic Poster

Breast 2

4438	Computer 49	Breast Cancer Diagnosis: A Multiparametric Magnetic Resonance Imaging Model with Dynamic Contrast Enhanced and Diffusion Weighted Imaging
		Katja Pinker-Domenig[1], Michelle Zhang[1], Joao V Horvat[1], Blanca Bernard-Davila[1], Rosa Elena Ochoa-Albiztegui[1], Elisabeth A Morris[1], Sunitha Thakur[1], Pascal AT Baltzer[2], and Thomas H Helbich[2]
		[1]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria
		To develop a multiparametric MRI model incorporating the ACR BI-RADS recommended descriptors for DCE-MRI, T2-weighted and DW imaging biomarkers for accurate breast cancer diagnosis. A multivariate logistic regression analysis of multiparametric MRI data from 210 breast tumors was performed to determine parameters that jointly predicted malignancy. A multiparametric MRI model incorporating quantitative and qualitative for DCE-MRI [mass margins (p=0.0012), initial EH (p=0.422) and delayed enhancement (0.0065)] and DW imaging biomarkers [ADCmean (p=0.0031)] enables an accurate breast cancer diagnosis. Results indicate that to maximize diagnostic accuracy a multiparametric MRI approach with DWI and DCE sequences must be considered.

4439	Computer 50	Initial enhancement in breast ultrafast DCE-MRI as a marker for malignancy
		Federico Pineda[1], Ty O Easley[1], Hiroyuki Abe[1], David Schacht[1], and Gregory Karczmar[1]
		[1]Radiology, University of Chicago, Chicago, IL, United States
		59 patients with dense breasts and suspicious findings on mammography underwent pre-biopsy DCE-MRI including high-temporal-resolution (‘ultrafast’) imaging during the first minute post-contrast. Parameters descriptive of early enhancement (initial slope and initial area under the gadolinium curve) were significantly different between benign and malignant lesions. Ultrafast imaging allowed for measurement of kinetic parameters with respect to the bolus time-of-arrival in the breast; removing dependence on variables such as cardiac output. High-temporal resolution DCE allows accurate measurements of very early enhancement kinetics, when differences between benign and malignant lesions may be largest; this could aid in the evaluation of suspicious breast lesions.

4440	Computer 51	Lymph Node Multi-parametric MRI Is a Strong Predictor of Pathologic Response to Chemotherapy: ACRIN/I-SPY Trial
		Silu Han[1,2], Renee F. Cattell[1,2], James J. Kang[1], Thomas Ren[1], Pauline B. Huang[1], Haifang Li[1], Jules A. Cohen[3], Paul Fisher[1], Roxanne Palermo[1], and Tim Q. Duong[1]

		[1]Department of Radiology, Stony Brook University, Stony Brook, NY, United States, [2]Department of Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [3]Department of Medicine, Stony Brook University, Stony Brook, NY, United States
		MRI primary breast lesion volume has been shown to be a strong predictor in the response to chemotherapy for invasive breast cancer. However, the prediction accuracy remains low. In this study, we investigated the feasibility of using lymph node volume and signal enhancement ratio as predictors of the chemotherapy response. The result shows that the lymph nodes signal-enhancement ratio is a stronger predictor than lymph node volume and primary in-breast lesion volume.

4441	Computer 52	Combined Ultrafast and Steady State DCE-MRI Differentiates Invasive Breast Cancer Types and Is Associated with Pathological Complete Response to Neoadjuvant Chemotherapy
		Meredith Sadinski[1], Natsuko Onishi[1], Katherine Gallagher[1,2], Theodore Hunt[1], Amita Shukla-Dave[1,3], Danny Martinez[1], Brittany Dashevsky[1,4], Elizabeth A Morris[1], and Elizabeth Sutton[1]
		[1]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Lenox Hill Radiology, New York, NY, United States, [3]Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]Radiology, University of California, San Francisco, CA, United States
		132 patients with invasive breast cancer were imaged with our DCE-MRI protocol incorporating ultrafast, DISCO imaging of early wash-in phase with standard, steady state DCE-MRI. Heuristic and pharmacokinetic metrics were calculated from the DISCO and steady state images and compared between invasive lobular and invasive ductal carcinomas. Bolus Arrival Time was significantly higher in ILC than in IDC. Association of parameters with pathological complete response to neoadjuvant chemotherapy administered after the imaging exam was investigated for a subset of 25 patients. Heterogeneity-related parameters were significantly higher in the pCR group encouraging further investigation into imaging biomarkers predictive of treatment response.

4442	Computer 53	Characterize Tumor Cellularity in Breast Cancer with Diffusion MRI
		Zezhong Ye[1], Na Zhao[2], Joshua Lin[1], Qingsong Yang[2], Jeff Viox[1], Peng Sun[1], Jianping Lu[2], and Song-Kwei Song[1]
		[1]Radiology, Washington University School of Medicine, St. Louis, MO, United States, [2]Radiology, Changhai Hospital, Shanghai, China

		Recent consensus suggested breast MRI lacks necessary sensitivity or specificity to detect breast cancer. MRI may over-diagnose breast cancer and result in over-treatment. The novel diffusion MRI histology (D-Histo) method demonstrated its ability to accurately locate lesion and quantify cancer cellularity and afforded greater sensitivity and specificity than ADC did in distinguishing between tumor and benign tissues. D-Histo's improved diagnostic accuracy thus better guides treatment planning, and more accurately measures treatment efficacy.

4443	Computer 54	Intravoxel incoherent motion (IVIM) and non-Gaussian diffusion MRI of the lactating breast
		Mami Iima[1,2], Masako Kataoka[1], Rena Sakaguchi[1], Shotaro Kanao[1], Natsuko Onishi[1], Makiko Kawai[1], Katsutoshi Murata[3], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [2]Hakubi Center for Advanced Research, Kyoto University, Kyoto, Japan, [3]Siemens Healthcare K.K., Tokyo, Japan
		The effect of breastfeeding on IVIM and non-Gaussian diffusion MRI was investigated. ADC_0 and sADC values significantly decreased ($P < 0.001$ and $P < 0.001$) while K values significantly increased ($P < 0.05$) post-breastfeeding. fIVIM values significantly increased after breastfeeding ($P < 0.01$). No significant difference was found in D* values. There was significant heterogeneity in ADC_0 maps post-breastfeeding, both in retroareolar and segmental scores ($P < 0.0001$ and $= 0.0001$). IVIM and non-Gaussian diffusion parameters significantly changed between pre- and post-breastfeeding status, and care needs to be taken in interpreting DWI data in lactating breasts.

4444	Computer 55	Novel parameters of Ultrafast DCE MRI of the breast using a compressed sensing technique
		Maya Honda[1], Masako Kataoka[1], Natsuko Onishi[2], Shotaro Kanao[1], Hajime Sagawa[3], Mami Iima[1], Kanae Kawai Miyake[1], Dominik Nickel[4], Masakazu Toi[5], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Department of Radiology, Memorial Sloan Kettering Cancer Center, New York City, NY, United States, [3]Department of Radiology, Kyoto University Hospital, Kyoto, Japan, [4]Siemens Healthcare GmbH, Erlangen, Germany, [5]Department of Breast Surgery, Kyoto University Graduate School of Medicine, Kyoto, Japan
		We evaluated new parameters of breast ultrafast dynamic contrast-enhanced (UF-DCE) MRI using compressed sensing technique: the maximum slope (MS), time to enhancement (TTE) and the time interval between arterial and venous visualization (AVI). MS was higher, and TTE and AVI were shorter in malignant lesions compared to benign lesions, although there were discrepancies among these parameters and BI-RADS based delayed phase patterns. There seemed to be some relevance between these parameters and histopathologic findings.

4445	Computer 56	Effect of Contrast Dose on Diagnostic Performance in DCE-MR Breast Imaging Lawrence Dougherty[1], Elizabeth S. McDonald[1], Gamaliel Isaac[1], Thuy-My Thi Le[1], and Mark A. Rosen[1] *[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States* A retrospective reader study was performed to assess breast MRI diagnostic performance as a function of contrast dose. There was an increase in sensitivity for malignancy with increasing contrast dose with no significant decrease in specificity. Greater confidence in the lesion assessment was also shown by the inter-observer agreement, which increased at the higher doses. Diagnostic performance of DCE-MR breast imaging was greater when subjects received a higher gadolinium dose than the current standard of 0.10 mmol/kg.

4446	Computer 57	Diffusional Kurtosis Imaging for Differentiation of Additional Suspicious Lesions on Preoperative Breast MRI of Patients with Known Breast Cancer Vivian Youngjean Park[1], Sungheon G Kim[2], Eun-Kyung Kim[1], Hee Jung Moon[1], Jung Hyun Yoon[1], and Min Jung Kim[1] *[1]Radiology, Yonsei University College of Medicine, Seoul, Republic of Korea, [2]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States* We investigated the potential of diffusional kurtosis imaging (DKI) and conventional diffusion weighted imaging (DWI) for differentiation of additional suspicious lesions on preoperative breast MRI patients with known breast cancer. This study included 53 pathologically confirmed lesions larger than 10mm in 45 women with known breast cancer. DKI and DWI parameters were compared between lesions. Multiple DKI parameters showed a significant difference between benign vs. invasive breast lesions and a few differed between DCIS vs. invasive breast lesions, with high specificity. However, DKI and DWI could not distinguish DCIS from benign lesions and may have lower potential in this subgroup

4447	Computer 58	Effectiveness of 6 monthly MRI screening for breast cancer in women with a BRCA mutation – a numerical simulation. Keith S Cover[1], Joost PA Kuijer[1], Mark MB Hofman[1], Jeroen Veltman[2], Monique D Dorrius[3], Ritse M Mann[4], and Katya M Duvivier[1] *[1]VU University Medical Center, Amsterdam, Netherlands, [2]ZGT Hengelo, Hengelo, Netherlands, [3]University Medical Center Groningen, Groningen, Netherlands, [4]Radboud University Medical Center, Nijmegen, Netherlands*

		Currently, MRI screening for breast cancer in women with a BRCA mutation is annually. However, studies on tumour doubling times indicate that some tumours grow faster. To assess the value of more frequent screening we numerically simulated annual and 6 monthly screening based on reported tumour doubling times in women with the BRCA mutation. For annual screening, the simulation predicted 14% of cancers with poor prognosis (diameter > 2 cm), in line with clinical studies. For 6 monthly screening the simulation predicted 3% with poor prognosis. Therefore, 6 monthly screening should yield a substantial reduction in tumours with a poor prognoses .

4448	Computer 59	The Value of DKI and IVIM Quantitative Parameters in Differentiating Breast Lesions and Correlations with Histopathologic Factors: A Preliminary Study
		Chenglu Ke[1], Shunan Che[1], Jing Li[1], and Lizhi Xie[2]
		[1]National Cancer Center/Cancer Hospital, Chinese Academy of Medical Science and Peking Union Medical College, Beijing, China, [2]GE healthcare, Beijing, China
		The current study aimed to evaluate the application of diffusion kurtosis imaging (DKI) and intravoxel incoherent motion (IVIM) in the differential diagnosis of breast lesions. The association of DKI and IVIM derived parameters were compared with pathological types, histologic grade, and Ki-67 expression of primary breast cancers. The results indicated that MD, MK, D and f are capable of distinguishing benign from malignant breast lesions. Furthermore, significant correlations were observed between MD and different histologic grade and Ki-67 expression, repsectivley.

4449	Computer 60	Clinical Value of Reduced field-of-view Sagittal Delayed-Enhanced Breast MRI
		Xiuhua Lv[1], Feihan Jiao[1], Junqing Xu[1], and Hong Yin[1]
		[1]Department of Radiology Diagnostics, Xijing Hospital, Xi'an, China
		This study aimed to investigate the clinical value of reduced field-of-view (rFOV) sagittal delayed enhanced MRI in diagnosing of breast tumor. we assessed two groups with and without rFOV sagittal delayed enhanced scanning with a time interval of at least six months.In our study, the detection rate, specificity and positive predictive value of the test group with rFOV were significantly higher than that of the control group without rFOV. rFOV sagittal delayed enhanced scanning indicated clinical value in detecting and differential diagnosis of benign and malignant breast tumors.

4450	Computer 61	Quantitative evaluation of Diffusion tensor and Intravoxel incoherent motion (IVIM) magnetic resonance imaging in cyclic mastalgia in premenopausal young women
		Qiuju Fan[1], Hui Tan[1], Nan Yu[1], Yuxin Lei[1], Shaoyu Wang[2], and Yong YU[1]

		[1]Affiliated Hospital of Shaanxi University of Chinese Medicine, Xianyang, China, [2]Siemens Healthcare, Scientific marketing, Shanghai, China
		Severe breast pain may significantly affect activities related to life quality, while its aetiology is still poorly understand. DTI and IVIM can provide valuable information on tissue microstructure, microcirculation and pathophysiology that has been extensively used on the breast cancer [1].

4451	Computer 62	Breast Lesion Detection and Characterization with Contrast-Enhanced Magnetic Resonance Imaging: Prospective Randomized Intra-individual Comparison of Gadoterate Meglumine versus Gadobenate Dimeglumine at 3 Tesla
		Paola Clauser[1], Thomas H. Helbich[1], Panagiotis Kapetas[1], Maria Bernathova[1], Katja Pinker[1], and Pascal A.T. Baltzer[1]
		[1]Medical University of Vienna, Vienna, Austria
		The aim of our study was to compare a 0.075 mmol/kg dose of gadobenate dimeglumine, with a 0.15 mmol/kg dose of gadoterate meglumine for breast lesion detection and characterization at 3T-MRI. Patients included underwent two examinations, 24-72h apart, one with gadobenate and one with gadoterate administered in randomized order. Three readers evaluated the examinations and diagnostic performance was calculated and compared. 104 women with 142 histologically verified breast lesions (109 malignant, 33 benign) were included. Detection with gadobenate was comparable to gadoterate ($p>0.165$). Gadobenate demonstrated significantly higher specificity and accuracy ($p<0.007$). Multivariate analysis demonstrated reader-independent superior diagnostic accuracy with gadobenate.

4452	Computer 63	Quantitative Predictors of Response to Neoadjuvant Chemotherapy on Dynamic Contrast-Enhanced Breast MRI
		Hyung Won Choi[1], Melissa Joines[1], Anne Hoyt[1], Laura Doepke[1], Jane Dascalos[1], Cheryce Fischer[1], Nanette DeBruhl[1], Nazanin Yaghmai[1], Kara Lee Pool[1], Bo Li[1], James Sayre[1], and Stephanie Lee-Felker[1]
		[1]UCLA, Los Angeles, CA, United States
		In this IRB-approved, HIPAA-compliant retrospective study, 63 consecutive women with newly diagnosed breast cancer undergoing neoadjuvant chemotherapy with pre- and post- chemotherapy breast MRI on a 3.0 Tesla scanner prior to surgery at our institution between January 2013 and December 2015 were included for analysis. Decrease in tumor size, decrease in peak enhancement, increase in time to peak, decrease in wash in, and decrease in wash out on post-chemotherapy breast MRIs were predictive of pathologic complete response on surgical pathology, a surrogate for prognosis.

4453	Computer 64	Magnetization Transfer MRI of Breast Cancer Response to Neoadjuvant Therapy: Preliminary Results Jack Virostko[1], Anna Sorace[1], Chengyue Wu[1], Stephanie Barnes[1], Angela Jarrett[1], Debra Patt[2], Boone Goodgame[3], Sarah Avery[4], and Thomas E Yankeelov[1] *[1]University of Texas at Austin, Austin, TX, United States, [2]Texas Oncology, Austin, TX, United States, [3]Seton Hospital, Austin, TX, United States, [4]Austin Radiological Association, Austin, TX, United States* Magnetization transfer MRI (MT-MRI) may be sensitive to changes in the macromolecular content of tumors and the extracellular matrix that occur during neoadjuvant therapy for breast cancer. We demonstrate in a pilot population of breast cancer patients that the magnetization transfer ratio declines after the first cycle of chemotherapy in women who achieve response to therapy, while the magnetization transfer ratio increases in tumors that do not respond to therapy.

4454	Computer 65	Feasibility of multispectral spin echo breast quantitative susceptibility mapping: an alternative to post-biopsy mammogram after MR-guided breast biopsy Sarah Eskreis-Winkler[1], Katherine Simon[1], Youngwook Kee[1], Junghun Cho[1], Thanh Nguyen[1], Pascal Spincemaille[1], Michele Drotman[1], and Yi Wang[1] *[1]Weill Cornell Medicine, New York, NY, United States* During MR-guided breast biopsy, a titanium biopsy marker is deployed in the biopsy cavity to mark the spot. Conventional MR cannot distinguish between these markers and the pockets of air that are often introduced during the biopsy, necessitating a subsequent mammogram to confirm biopsy marker location. Our goal is to replace post-biopsy mammogram with a short MR protocol leveraging the difference in magnetic susceptibility between titanium and air in order to distinguish them as sources of MR signal voids. To this end, we generate quantitative susceptibility maps (QSM) using 3D fast spin echo acquired at four frequency offsets.

4455	Computer 66	Comparison of Radial and Cartesian Acquisitions for Visualization of the Axilla in Breast MRI: Reader Study Pingni Wang[1], Roberta M Strigel[1,2,3], Makiko Kawai[2], Ty A Cashen[4], Julia V Velikina[1], Kang Wang[4], Frank Korosec[2], Urvi A Tailor[2], Jillian A Karow[2], Kevin M Johnson[1], Andre Fischer[5], and James H Holmes[2] *[1]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [3]Carbone Cancer Center, University of Wisconsin-Madison, Madison, WI, United States, [4]Global MR Applications & Workflow, GE Healthcare, Madison, WI, United States, [5]Global Research Organisation, GE Healthcare, Garching bei München, Germany*

		Dynamic contrast-enhanced (DCE) MRI using conventional Cartesian sampling is used in routine clinical practice due to its high sensitivity for breast cancer. However, ghosting artifacts caused by cardiac motion can obscure the axilla, making interpretation of this area more difficult and potentially obscuring findings. Radial acquisitions are less motion sensitive due to more frequent sampling of the center of k-space and prior work has suggested these methods for breast MRI. In this study, we report results from a reader study to assess image quality of a 3D stack-of-stars radial acquisition compared with Cartesian imaging for breast MRI.

4456	Computer 67	One millimeter isotropic breast DWI combining readout-segmented EPI and super-resolution
		Maya DELBANY[1], Julie POUJOL[1], Aurélien BUSTIN[2], Isabelle THOMASSIN-NAGGARA[3,4], Jacques FELBLINGER[1,5], Pierre-André VUISSOZ[1], and Freddy ODILLE[1,5]
		[1]IADI, U947, Université de Lorraine, INSERM, Nancy, France, [2]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [3]Assistance Publique-Hopitaux de Paris (AP-HP), Hôpital Tenon, Service d'Imagerie, 4 rue de la Chine, Paris, France, [4]Sorbonne Universités, UPMC Univ Paris 06, Institut Universitaire de Cancérologie, Paris, France, [5]CIC1433, CHRU Nancy, INSERM, Université de Lorraine, Nancy, France
		High-resolution diffusion-weighted imaging (DWI) has the potential to improve the specificity of breast MRI. In this work a method is proposed for 3D isotropic DWI of the whole breasts. Three breast DWI datasets were acquired using a readout-segmented DW-EPI sequence (rs-EPI) with thick slices (3 mm) and 1mm-shifts in the slice direction. A high isotropic resolution (1x1x1 mm^3) DWI dataset was reconstructed using a super-resolution reconstruction (SRR) on the low-resolution anisotropic acquisiitons, with different regularization schemes (Tikhonov and Beltrami, an edge-preserving constraint). This study shows the benefit of this strategy compared to native acquisitions with 1 mm slice thickness. A quantitative SNR evaluation is presented.

4457	Computer 68	Addition of in-vivo proton MRS to DCEMRI increases the sensitivity of cancer detection in breast cancer patients especially in cases of indeterminate dynamic MRI findings.
		Naranamangalam R Jagannathan[1], Khusbhu Agarwal[1], Uma Sharma[1], Smriti Hari[2], Vurthaluru Seenu[3], Sandeep Mathur[4], Siddhartha D Gupta[4], and Rajinder Parshad[3]
		[1]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [2]Department of Radiology, All India Institute of Medical Sciences, New Delhi, India, [3]Department of Surgery, All India Institute of Medical Sciences, New Delhi, India, [4]Department of Pathology, All India Institute of Medical Sciences, New Delhi, India

		Potential of addition of in-vivo proton (^1H) MRS to DCEMRI data especially in indeterminate DCE findings was evaluated. MRS and DCEMRI data of 56 breast cancer patients were included in the analysis. 47/56 cases showed type III curve indicating cancer with a sensitivity of 83.9%. MRS showed true positive findings of cancer in 44/47 cases. Among 9 indeterminate DCE cases, MRS was positive for cancer in 6 cases, implying that 50/56 cases were true positive for cancer with 89.3% sensitivity. Addition of MRS to DCEMRI data increases the sensitivity of cancer detection especially in indeterminate DCE findings.

4458	Computer 69	Quantitative analysis of ultra-fast DCE-MRI to identify vascular inputs and outputs in breast tumors
		Chengyue Wu[1], Federico Pineda[2], Gregory Karczmar[2], and Thomas Yankeelov[1]
		[1]Department of Biomedical Engineering, the University of Texas at Austin, Austin, TX, United States, [2]Department of Radiology, University of Chicago, Chicago, IL, United States
		Identifying and characterizing vascular inputs and outputs in tumors would be useful in both the diagnostic and prognostic settings. In this contribution, we propose a novel methodology that combines vessel detection with analysis of ultra-fast DCE-MRI data to integrate both morphological and functional information of tumor associated vessels to identify those that serve as inputs and outputs to breast tumors.

4459	Computer 70	Comparison of 1.0M Gadobutrol and 0.5M Gadoteridol for Kinetic Parameters on Breast Dynamic Contrast Enhanced Magnetic Resonance Imaging at 3T
		Hajime Sagawa[1], Masako Kataoka[1], Shotaro Kanao[2], Natsuko Onishi[3], Maya Honda[2], Dominik Nickel[4], Masakazu Toi[5], Katsuhiko Ueda[1], and Kaori Togashi[2]
		[1]Division of Clinical Radiology Service, Kyoto University Hospital, Kyoto, Japan, [2]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan, [3]Department of Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]MR Application Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany, [5]Department of Breast Surgery, Kyoto University Graduate School of Medicine, Kyoto, Japan
		The contrast effects of 1.0M gadobutrol were compared to that of 0.5M gadoteridol in breast cancer at 3T using hybrid MRI protocol which combined conventional DCE (C-DCE) with ultrafast DCE (UF-DCE). The significant differences were observed only in UF-DCE, maximum enhancement ratio (MER) and maximum slope (MS). The slightly higher peak relative enhancement produced by gadobutrol compared with gadoteridol might help in the detection and evaluation of breast lesions in the earlier phases.

4460	Computer 71	Quantitative Analysis of Peri-Tumor Interface Fat and the Volumetric Fat Percentage and Contrast Enhancement in Three Peri-Tumoral Shells to Differentiate Molecular Subtypes of Breast Cancer

		Jeon-Hor Chen[1,2], Yang Zhang[1], Siwa Chan[3], Dah-Cherng Yeh[4], and Min-Ying Su[1]
		[1]Center for Functional Onco-Imaging, Department of Radiological Sciences, University of California Irvine, Irvine, CA, United States, [2]Department of Radiology, E-Da Hospital and I-Shou University, Kaohsiung, Taiwan, [3]Department of Radiology, Tzu-Chi General Hospital, Taichung, Taiwan, [4]Breast Center, Tzu-Chi General Hospital, Taichung, Taiwan
		A 3D morphological analysis method was developed to analyze the fat content on tumor boundary interface and in different peri-tumoral shells away from the tumor. A total of 114 mass type breast cancers were analyzed, including 87 HR(+), 13 HR(-)HER2(+), and 14 TN. The volumetric fat percentage in three shells surrounding the tumor: 150%-100%, 200%-150%, 250%-200% of the tumor convex hall were measured, also the mean contrast enhancement in fibroglandular tissue contained within three shells were measured. The peri-tumor fat content and contrast enhancement is the highest in the most aggressive TN tumors compared to other subtypes.

4461	Computer 72	Effectivity and correlation of parameters derived from diffusion kurtosis imaging and quantitative dynamic contrast-enhanced MRI in the breast imaging
		Ting Li[1], Siying Wang[2], Yun Xiong[3], and Kangan Li[1]
		[1]Shanghai General Hospital, Shanghai, China, [2]PhilipsHealthcare, Shanghai, China, [3]Fudan University, Shanghai, China
		The aim of this study is to evaluate the diagnostic efficacy of 3.0T MRI diffusion kurtosis imaging and quantitative dynamic contrast enhancement in benign and malignant breast lesions, and to explore the differential diagnosis ability of different pathological types and molecular subtype lesions. The results showed that 3.0T MRI diffusion kurtosis imaging and dynamic contrast-enhanced quantitative hemodynamic parameters are of great value in the differential diagnosis of benign and malignant breast lesions. The combination of both can significantly improve the diagnostic efficiency.

Electronic Poster

Hyperpolarised Compound Imaging

Exhibition Hall	Tuesday 17:15 - 18:15

4462	Computer 73	Highly Accelerated Dynamic Acquisition of 3D Grid-Tagged He-3 Lung Images Using Compressed Sensing
		William J Garrison[1], Kun Qing[2], Sina Tafti[3], John P Mugler[1,2], Y Michael Shim[4], Jaime F Mata[2], Gordon D Cates[2,3], Eduard E de Lange[2], Craig H Meyer[1,2], Jing Cai[5], and G Wilson Miller[1,2]

		[1]Department of Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Department of Radiology and Medical Imaging, University of Virginia, Charlottesville, VA, United States, [3]Department of Physics, University of Virginia, Charlottesville, VA, United States, [4]Department of Medicine, University of Virginia, Charlottesville, VA, United States, [5]Department of Health Technology and Informatics, Hong Kong Polytechnic University, Kowloon, Hong Kong
		Radiotherapy in the context of lung cancer can become less effective if lung biomechanics are not well-characterized. MRI of grid-tagged, inhaled hyperpolarized He-3 gas provides images with strong signal at the tag locations, allowing time-resolved tracking of regional lung motion that can be used to inform strategies for precision radiotherapy. The present work demonstrates rapid acquisition of high-quality 3D grid-tagged images obtained with 8-fold under-sampling and reconstructed using compressed sensing. The dramatic imaging acceleration inherent in this technique allows multiple 3D image sets to be acquired during a single breath-hold, effectively permitting 4D-MRI of lung motion during exhalation.

4463	Computer 74	High Ventilation Percent on Hyperpolarized Helium-3 MRI is Associated with Reduced One-Year Risk of Asthma Exacerbation
		David Mummy[1,2], Wei Zha[2], Shannon Kehoe[3], Guy Olson[4], Ronald Sorkness[5,6,7], Nizar Jarjour[6], Mark Schiebler[8], Loren Denlinger[6], Michael Evans[9], and Sean Fain[1,2,8]
		[1]Biomedical Engineering, University of Wisconsin -- Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin -- Madison, Madison, WI, United States, [3]Kinesiology, University of Wisconsin -- Madison, Madison, WI, United States, [4]Neurobiology, University of Wisconsin -- Madison, Madison, WI, United States, [5]Pharmacy, University of Wisconsin -- Madison, Madison, WI, United States, [6]Allergy, Pulmonary & Critical Care Medicine, University of Wisconsin -- Madison, Madison, WI, United States, [7]Pediatrics, University of Wisconsin -- Madison, Madison, WI, United States, [8]Radiology, University of Wisconsin -- Madison, Madison, WI, United States, [9]Biostatistics and Medical Informatics, University of Wisconsin-Madison, Madison, WI, United States
		We assessed the high ventilation percent (HVP) as well as the ventilation defect percent (VDP) on hyperpolarized (HP) ^{3}He MRI and found that both measures were associated with exacerbation in the year following imaging, with the HVP exhibiting the stronger association. Both measures were strong predictors relative to other measures of lung function. These findings suggest that HVP is sensitive to one-year risk of asthma exacerbation and is a potential biomarker of asthma instability.

4464	Computer 75	Bridging the gap between lung small conducting and acinar airways – combined in vivo lung morphometry with hyperpolarized 3He MRI and CT studies.
		Dmitriy A Yablonskiy[1], Alexander L Sukstanskii[1], James D Quirk[1], Chase Hall[1], Mario Castro[1], David S Gierada[1], Vanessa Curtis[1], Miranda Kirby[2], Eric A Hoffman[3], and Roger D Yusen[1]
		[1]Washington University in St. Louis, St. Louis, MO, United States, [2]UBC Center for Heart Lung Innovation, Vancouver, BC, Canada, [3]University of Iowa, Iowa City, IA, United States

		Air trapping (retention of inspired air during expiration) is usually associated with small conducting airways disease. However, limited information exists on integrity of acinar airways (i.e., alveolar ducts and sacs) in lung regions affected by air trapping. In this study we combine novel CT and MRI metrics to understand the sub-lobar level relationships between MR-derived acinar anatomy and CT-based air trapping metrics. We studied healthy non-smokers, smokers and COPD subjects and found significant associations between air trapping and acinar airways shallowing in upper and middle lungs in all groups but very little association in lower lung, except for COPD patients.

4465	Computer 76	Comparison of CT ventilation and Hyperpolarised Gas MRI: Effects of breathing manoeuvre
		Bilal A. Tahir[1,2], Helen Marshall[1], Paul J. Hughes[1], Guilhem Collier[1], Rob H. Ireland[2], and Jim M. Wild[1]
		[1]Polaris, University of Sheffield, Sheffield, United Kingdom, [2]Academic Unit of Clinical Oncology, University of Sheffield, Sheffield, United Kingdom
		Image registration of lung CT images acquired at different inflation levels has been proposed as a surrogate method to map lung ‘ventilation’. However, this technique requires validation against established ventilation imaging modalities such as hyperpolarized gas MRI. Variations in lung inflation may affect regional lung function as imaged with the two modalities. Here, we evaluate the impact of the lung inflation level during MRI when comparing gas MRI and CT ventilation for a cohort of 7 patients with asthma.

4466	Computer 77	Mapping of pseudo-compliance using hyperpolarized 129Xe morphometry in the rat lung
		Andras Lindenmaier[1,2], Brandon Zanette[1,2], Elaine Stirrat[1], Brian Kavanagh[1,3,4], and Giles Santyr[1,2]
		[1]Translational Medicine, Hospital for Sick Children, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Anesthesia, University of Toronto, Toronto, ON, Canada, [4]Critical Care Medicine, Hospital for Sick Children, Toronto, ON, Canada
		Performing 129Xe morphometry at multiple pressures allows for direct mapping of microstructural changes and micromechanical properties of the lung (eg. pseudo-compliance) in both health and disease. In the present study, the effects of posture and gravity on the linear portion of lung pseudo-compliance are investigated using this approach in healthy mechanically-ventilated rats. Spatial gradients in lung pseudo-compliance due to gravity and posture are shown to vary, consistent with the expectations that the lungs are denser dorsally due to the weight above. Scaled regional pseudo-compliance is shown to be in agreement with whole lung compliance measured using 1H MRI.

4467	Computer 78	Depiction of Gas Flow Patterns in Pulmonary Dynamic Hyperpolarized Gas MRI

		Sa Xiao[1,2], He Deng[1,2], Caohui Duan[1,2], Junshuai Xie[1,2], Xianping Sun[1,2], Chaohui Ye[1,2], and Xin Zhou[1,2]
		[1]State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, National Center for Magnetic Resonance in Wuhan, Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, China, [2]University of Chinese Academy of Sciences, Beijing, China
		Dynamic hyperpolarized gas MRI of lung is able to visualize the dynamic changes of pulmonary morphology during the ventilation process, which provides the important information about lung physiology and pathophysiology. However, there is a lack of an effective method to depict the gas flow patterns in the whole lung. In this work, we propose a motion field calculation method based on the pulmonary gas flow properties, which can acquire the velocity and direction of gas flow. The performance of the proposed method is investigated experimentally.

4468	Computer 79	An Interleaved Spiral-IDEAL Approach for Physiological Gas Exchange Imaging in Humans using a Single Breath-hold of Hyperpolarized 129Xe
		Brandon Zanette[1,2] and Giles Santyr[1,2]
		[1]Translational Medicine Program, Peter Gilgan Centre for Research and Learning, The Hospital for Sick Children, Toronto, ON, Canada, [2]Department of Medical Biophysics, Univeristy of Toronto, Toronto, ON, Canada
		Pulmonary disease involving lung injury (e.g. ventilator-induced lung injury, radiation-induced lung injury, interstitial lung disease) can lead to pulmonary dysfunction which may not be detectable using proton pulmonary magnetic resonance imaging or ventilation imaging with hyperpolarized noble gases. The solubility of ^{129}Xe in biological tissues and resultant chemical shifts allow for the quantification of physiological gas exchange which hold promise for the clinical evaluation of early pulmonary dysfunction. In this work we demonstrate an approach for dissolved-phase ^{129}Xe gas exchange imaging within a single breath-hold in healthy human volunteers.

4469	Computer 80	Clinical Translation of 3D Spiral-IDEAL for Single Breath-hold Imaging of Gas and Dissolved-Phase Hyperpolarized 129Xe in Human Lungs
		Brandon Zanette[1,2] and Giles Santyr[1,2]
		[1]Translational Medicine Program, Peter Gilgan Centre for Research and Learning, The Hospital for Sick Children, Toronto, ON, Canada, [2]Department of Medical Biophysics, Univeristy of Toronto, Toronto, ON, Canada

		Spiral-IDEAL is a fast and efficient technique for imaging dissolved-phase hyperpolarized ^{129}Xe in tissue/blood plasma (T/P) and red blood cell (RBC) compartments of the lung. Previously, spiral-IDEAL has been limited to pre-clinical rodent models using multi-breath techniques not suitable for human subjects. In this work we optimize and demonstrate clinical translation of spiral-IDEAL for single breath-hold ^{129}Xe imaging of human subjects. We compare and contrast several interleaved imaging strategies. Furthermore, we also demonstrate 3D spiral-IDEAL for simultaneous volumetric imaging of gas, T/P, and RBC compartments.

4470	Computer 81	Dynamic MRI of Hyperpolarized Xenon-129 Uptake in the Human Kidney Using a Dedicated Transmission-Only-Reception-Only Array at 3 Tesla
		Jorge Chacon-Caldera[1,2], Adam Maunder[2], Madhwesha Rao[2], Graham Norquay[2], Oliver I. Rodgers[2], Matthew Clemence[3], Claudio Puddu[2], Lothar R. Schad[1], and Jim M. Wild[2]
		[1]Computer Assisted Clinical Medicine, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany, [2]POLARIS, Unit of Academic Radiology, University of Sheffield, Sheffield, United Kingdom, [3]Philips Healthcare, Guildford, United Kingdom
		Dissolved hyperpolarized ^{129}Xe MRI is an emerging technique. Inhaled xenon dissolves in the blood in the lungs and with a long T_1 (8s) has the potential for imaging other organs that are well perfused such as the kidneys. An RF coil array was designed with an anatomically focused transmit field to avoid RF depolarization of dissolved xenon in its transit from the lungs whilst providing local sensitivity over the kidney. Dynamic imaging of dissolved ^{129}Xe in kidneys was performed in 2 healthy volunteers. The signal evolution in the cortex was obtained which might provide novel physiological insight into kidney physiology.

4471	Computer 82	Hyperpolarized 129Xe Gas Exchange Imaging of the Human Lung using IDEAL with Spiral k-space Sampling
		Ozkan Doganay[1,2], Mitchell Chen[2], Tahreema Matin[2], Marzia Rigolli[3], Julie-Ann Phillips[2], Anthony McIntyre[2], and Fergus V. Gleeson[1,2]
		[1]Department of Oncology, University of Oxford, Oxford, United Kingdom, [2]Department of Radiology, The Churchill Hospital, Oxford, United Kingdom, [3]Division of Cardiovascular Medicine, University of Oxford Centre for Clinical Magnetic Resonance Research, Oxford, United Kingdom
		This proof of concept study describes implementation and analysis of an IDEAL (Iterative Decomposition of water and fat with Echo Asymmetry and Least-square estimation) based imaging technique for imaging hyperpolarized Xenon-129 (HPX) gas ventilation and dissolved phase compartments in human lungs. The time-series IDEAL imaging approach was tested in a healthy subject corroborating with Bloch equations and a numerical gas-exchange model showing that HPX gas ventilation and dissolved phase compartment images can be obtained, and the gas-transfer dynamics can be measured, in a single breath-hold interval of 8 seconds using 1L of HPX gas with polarization of ~10%.

4472	Computer 83	Retrospective removal of gas-phase signal from pulmonary dissolved-phase Hyperpolarized 129Xe images Jeff Kammerman[1], Andrew D Hahn[1], and Sean B Fain[1] *[1]Department of Medical Physics, University of Wisconsin, Madison, Madison, WI, United States* Dissolved-phase hyperpolarized xenon-129 imaging provides regional information on gas exchange between the lung airspaces, parenchymal tissues, and blood stream. Current spectroscopic techniques require that the dissolved-phase 129Xe signal be acquired with no gas-phase excitation. However, the short T_2* of the dissolved-phase requires short RF pulses, limiting the spectral selectivity achievable. This, combined with the high spin density of the gas-phase relative to the dissolved-phase, leads to unwanted gas-phase excitation. In this work, we retrospectively remove contaminant gas-phase signal from both simulated and human subject images using a multi-echo acquisition with iterative estimation of the contaminant gas-phase signal.

4473	Computer 84	The Effect of Signal to Noise Ratio on Linear-binning and Adaptive k-means Quantification of Hyperpolarized ^{129}Xe Ventilation MRI Mu He[1], Fei Tan[2], Wei Zha[3], Leith Rankine[4], Sean Fain[3,5,6], and Bastiaan Driehuys[4,7,8] *[1]Department of Electrical and Computer Engineering, Duke University, Durham, NC, United States, [2]Biomedical Engineering Department, Duke University, Durham, NC, United States, [3]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [4]Department of Medical Physics, Duke University, Durham, NC, United States, [5]Department of Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [6]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [7]Department of Biomedical Engineering, Duke University, Durham, NC, United States, [8]Department of Radiology, Duke University, Durham, NC, United States* ^{129}Xe ventilation MRI lacks a reference standard. Here, we circumvent this problem in part by comparing and evaluating the robustness of two independent methods for quantifying ventilation – linear-binning and adaptive k-means - by adding MR noise to the source images until the algorithms fail. Results at different noise levels were compared to that quantified using the original high signal-to-noise ratio (SNR) ventilation image. We found that both methods provide robust quantification until SNR is less than 1.7 ± 0.8 for the linear-binning method, and 2.1 ± 1.2 for the uncorrected adaptive k-means method.

4474	Computer 85	Voxel-based mapping of lung microstructural parameters using hyperpolarized 129Xe dissolved-phase imaging in healthy volunteers and chronic obstructive pulmonary disease patients Agilo Luitger Kern[1,2], Marcel Gutberlet[1,2], Andreas Voskrebenzev[1,2], Filip Klimes[1,2], Alexander Rotärmel[1,2], Frank Wacker[1,2], Jens Hohlfeld[2,3], and Jens Vogel-Claussen[1,2]

		[1]Institute of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Biomedical Research in Endstage and Obstructive Lung Disease Hannover (BREATH), German Center for Lung Research (DZL), Hannover, Germany, [3]Department of Clinical Airway Research, Fraunhofer Institute for Toxicology and Experimental Medicine, Hannover, Germany
		Chemical shift saturation recovery (CSSR) spectroscopy is a method, which is able to assess lung microstructure using ^{129}Xe gas uptake and to discriminate between healthy volunteers and chronic obstructive pulmonary disease (COPD) patients. However, the absent spatial encoding of standard CSSR spectroscopy poses a limitation of the method for detecting early disease. A method for voxel-based mapping of lung microstructural parameters is proposed. Preliminary data from a study in healthy volunteers and COPD patients employing both CSSR mapping and spectroscopy are presented. Whole-lung median wall thickness and surface-to-volume ratio are highly reproducible and correlate significantly with global values from spectroscopy in COPD patients.

4475	Computer 86	Hyperpolarized 129Xe MR spectroscopy of the human lung in healthy volunteers and patients with chronic obstructive pulmonary disease (COPD): investigation of lung microstructure
		Agilo Luitger Kern[1,2], Marcel Gutberlet[1,2], Andreas Voskrebenzev[1,2], Filip Klimes[1,2], Frank Wacker[1,2], Jens Hohlfeld[2,3], and Jens Vogel-Claussen[1,2]
		[1]Institute of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Biomedical Research in Endstage and Obstructive Lung Disease Hannover (BREATH), German Center for Lung Research (DZL), Hannover, Germany, [3]Department of Clinical Airway Research, Fraunhofer Institute for Toxicology and Experimental Medicine, Hannover, Germany
		The NMR line shape in the lung parenchyma exhibits significant broadening due to numerous jumps in magnetic susceptibility. The purpose of this work was to extract this line shape from the ^{129}Xe dissolved-phase spectrum. Free induction decays were acquired in healthy volunteers and COPD patients and a model function including two resonances and a superimposed frequency distribution was fitted to the time-domain data. Both second moment and skewness of the fitted frequency distribution were significantly elevated in COPD patients. The ratio of ^{129}Xe in red blood cells and lung tissue was significantly reduced in COPD patients.

4476	Computer 87	Quantifying Changes in Time-Resolved Hyperpolarized ^{129}Xe Spectroscopy among Healthy Volunteers, Subjects with Idiopathic Pulmonary Fibrosis, and Subjects with Pulmonary Arterial Hypertension
		Elianna Bier[1], Scott Robertson[1], Geoff Schrank[1], Craig Rackley[1], Joseph Mammarappallil[1], Sudarshan Rajagopal[2], H. Page McAdams[1], and Bastiaan Driehuys[1]
		[1]Radiology, Duke University Medical Center, Durham, NC, United States, [2]Cardiology, Duke University Medical Center, Durham, NC, United States

		The temporal dynamics of ^{129}Xe spectroscopy were examined by collecting FIDs during inhalation, breath-hold, and exhalation. These FIDs were fit to a Voigt model to extract four spectral parameters (amplitude, chemical shift, linewidth, and phase) for the airspace, barrier, and RBC ^{129}Xe resonances. The RBC resonance parameters exhibited oscillations at the cardiac frequency which were quantified by peak-to-peak amplitudes. IPF subjects exhibited larger signal amplitude, chemical shift, and phase oscillations than healthy or PAH subjects. This indicates that ^{129}Xe transfer spectroscopy is differentially affected by cardiopulmonary dynamics such that the causes of gas exchange impairment can be distinguished.

4477	Computer 88	Repeatability of Pulmonary Functional Metrics of Gas-exchange Measured with Hyperpolarized Xenon-129 MRI
		Andrew Hahn[1], Jeff Kammerman[1], Michael Evans[2], Wei Zha[1], David Mummy[1], Robert V. Cadman[1], and Sean Fain[1,3,4]
		[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States, [2]Biostatistics and Medical Informatics, University of Wisconsin - Madison, Madison, WI, United States, [3]Radiology, University of Wisconsin - Madison, Madison, WI, United States, [4]Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States
		To advance hyperpolarized Xenon-129 MRI as a robust tool for probing pulmonary gas-exchange in lung diseases, establishing repeatability of quantitative ratios and regional metrics is critical. Repeatability was assessed using Bland-Altman analysis. Average inter-visit tissue-to-gas, red blood cell-to-gas (RBC-to-gas) and RBC-to-tissue ratios were highly repeatable; the primary source of variation was due to lung inflation volume variations, suggesting consistency of breath-hold coaching and dose delivery is important. Regional distribution of measures was also qualitatively well-matched between visits. Demographic factors may also influence these measures; our preliminary data indicate a significant relationship between RBC-to-tissue ratio and subject age.

4478	Computer 89	A Clinical-Scale Thermally Polarized ^{129}Xe Phantom for Quality Assurance in Multi-Center Hyperpolarized Gas MRI Trials
		Naomi Morales Medina[1,2], Ziyi Wang[2,3], Mu He[2,4], Geoffry Schrank[2,5], John Nouls[2,5], Elianna A. Bier[2,5], Scott H. Robertson[1,2], Ralph Hashoian[6], John Mugler[7], and Bastiaan Driehuys[1,2,3,5]
		[1]Medical Physics Graduate Program, Duke University, Durham, NC, United States, [2]Center for In Vivo Microscopy, Duke University Medical Center, Durham, NC, United States, [3]Department of Biomedical Engineering, Duke University, Durham, NC, United States, [4]Department of Electrical and Computer Engineering, Duke University, Durham, NC, United States, [5]Department of Radiology, Duke University Medical Center, Durham, NC, United States, [6]Clinical MR Solutions, Brookfield, WI, United States, [7]Department of Radiology, University of Virginia, Charlottesville, VA, United States

		Hyperpolarized ^{129}Xe-MRI is emerging as a promising method to quantify pulmonary function, but the transient nature of its signal makes routine quality assurance tasks challenging. With increasing interest in multi-center deployment of this technology, it is critical to develop tools to characterize ^{129}Xe imaging performance across sites and platforms. Here, we demonstrate a robust, portable, clinical-scale thermally-polarized ^{129}Xe phantom and integrated loader shell. Its utility is demonstrated for characterizing human lung imaging coils and enabling routine 2D- QA scans in one-minute. On longer timescales, 3D-imaging is feasible to evaluate ^{129}Xe coil sensitivity profiles.

4479	Computer 90	Assessing the Impact of Acid Aspiration with Hyperpolarized Xenon-129 Dissolved-Phase MRI
		Kai Ruppert[1], Hooman Hamedani[1], Faraz Amzajerdian[1], Luis Loza[1], Yi Xin[1], Ian F. Duncan[1], Harilla Profka[1], Sarmad Siddiqui[1], Mehrdad Pourfathi[1], Maurizio F. Cereda[1], Stephen Kadlecek[1], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States
		Acid aspiration frequently occurs in critically ill patients, and can give rise to severe acute lung injury. In this study, we investigated whether hyperpolarized xenon-129 dissolved-phase MRI provides the necessary sensitivity to assess acid aspiration and associated pneumonitis in a rabbit model. We observed changes that most likely corresponded to the formation of interstitial edema as part of an inflammatory response. In particular, perilesional areas of high xenon uptake may reflect tissue at risk of secondary ventilator-induced injury.

4480	Computer 91	Investigating Pulmonary Gas Transport Processes with Hyperpolarized Xenon-129 Dissolved-Phase MRI
		Kai Ruppert[1], Hooman Hamedani[1], Faraz Amzajerdian[1], Luis Loza[1], Yi Xin[1], Ian F. Duncan[1], Harilla Profka[1], Sarmad Siddiqui[1], Mehrdad Pourfathi[1], Stephen Kadlecek[1], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States
		Several hyperpolarized xenon-129 (HXe) MRI techniques have been developed for characterizing lung function through the observation of parenchymal xenon gas uptake, but these methods tend to provide only a snapshot of a steady-state distribution of the xenon signal within the lung parenchyma. In this study, we investigated the feasibility of extracting gas-transport maps from the relative signal changes between two dissolved-phase images captured with different acquisition parameters. We demonstrated how the acquisition parameters of a suitably-designed HXe MRI pulse sequence can be harnessed for tracing pulmonary gas transport processes, and potentially quantifying them at an unprecedented level.

4481	Computer 92	Using Regional Gas-Phase Saturation to Localize Hyperpolarized Xenon-129 Spectroscopy Measurements

		Kai Ruppert[1], Hooman Hamedani[1], Faraz Amzajerdian[1], Luis Loza[1], Yi Xin[1], Ian F. Duncan[1], Harilla Profka[1], Sarmad Siddiqui[1], Mehrdad Pourfathi[1], Stephen Kadlecek[1], and Rahim R. Rizi[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States
		Chemical Shift Saturation Recovery MR spectroscopy is becoming a powerful tool for quantifying alveolar gas exchange, but is currently predominantly used for whole-lung assessments. In this study, we investigated the feasibility of regional gas-phase saturation as a tool for coarse spatial localization, testing its utility in a rat model of radiation-induced lung injury. We found a large decrease in the ratio between the red-blood-cell and tissue / plasma peaks in the irradiated lung relative to the lungs in a healthy animal. Our approach might be particularly useful for assessing highly heterogeneous disease patterns (radiation-induced lung injuries, lung transplants, etc.).

4482	Computer 93	Linear binning maps for image analysis of pulmonary ventilation with hyperpolarized gas MRI: transferability and clinical applications
		Guilhem Jean Collier[1], Laure Acunzo[1], Laurie J Smith[1,2], Paul J Hughes[1], Graham Norquay[1], Ho-Fung Chan[1], Alberto M Biancardi[1], Helen Marshall[1], and Jim M Wild[1]
		[1]Academic Radiology, University of Sheffield, Sheffield, United Kingdom, [2]Sheffield Children's Hospital NHS Foundation Trust, Sheffield, United Kingdom
		This work applies a clustering method developed for image analysis of lung ventilation with hyperpolarized ^{129}Xe to data acquired in a different centre with ^{129}Xe and ^{3}He. Results show that the current method is not readily transferable using published reference values. A different normalization method that increases the reproducibility of ventilation categorization is proposed. After optimization, the technique was applied in groups of patients with chronic obstructive pulmonary disease and cystic fibrosis. Results show significant differences of ventilation distribution indices between patient and healthy control groups.

4483	Computer 94	Dynamic Hyperpolarized 13C CS-EPSI of Human Prostate Cancer – Initial Experience on 17 Patients Testing Acquisition & Quantitative Analysis Methods
		Hsin-Yu Chen[1], Peder E.Z. Larson[1], Jeremy W. Gordon[1], Robert A. Bok[1], Marcus Ferrone[2], Sue M. Noworolski[1], Mark van Criekinge[1], James B. Slater[1], Lucas Carvajal[1], Natalie Korn[1], Rahul Aggarwal[3], Sarah J. Nelson[1], Pamela N. Munster[3], John Kurhanewicz[1], and Daniel B. Vigneron[1]
		[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Department of Clinical Pharmacy, University of California, San Francisco, San Francisco, CA, United States, [3]School of Medicine, University of California, San Francisco, San Francisco, CA, United States

		New hyperpolarized-^{13}C MRI instrumentation and methods enabled phase II clinical studies on 17 prostate cancer patients using 3D dynamic CS-EPSI with $0.5cm^3$ spatial and 2s time resolution. New manufacturing processes for ^{13}C-pyruvate provided more consistent polarization levels, pyruvate concentrations, radical filtrations for reliable and safe patient injections. Improved quantitative methods were designed and implemented for reproducible kinetic modeling, correction for receiver profile, and peak detection, accounting for B_0 inhomogeneity and noise characteristics. These studies have shown the ability to detect high pyruvate-to-lactate conversion rates in biopsy confirmed prostate cancer.

4484	Computer 95	Rapid hepatic glycogen synthesis in humans using dynamic 13C MR spectroscopy
		Jae Mo Park[1,2,3], Stefan Stender[4,5], Craig Malloy[1,6], Jonathan Cohen[4], Ralph DeBerardinis[7], and Vlad Zaha[1,6]
		[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Electrical and Computer Engineering, University of Texas at Dallas, Richardson, TX, United States, [4]Molecular Genetics, University of Texas Southwestern Medical Center, Dallas, TX, United States, [5]Clinical Biochemistry, Rigshospitalet, Copenhagen, Denmark, [6]Internal Medicine, University of Texas Southwestern Medical Center, Dallas, TX, United States, [7]Children's Medical Center Research Institute, University of Texas Southwestern Medical Center, Dallas, TX, United States
		The development of hyperpolarized ^{13}C for human patients has refocused interest on radiofrequency (RF) coil design for optimal ^{13}C sensitivity. ^{13}C NMR spectra were acquired from the human liver using a clamshell transmit and 8-channel paddle receive array in a 3T MRI system. Following a baseline ^{13}C liver scan for 15-min, [1-^{13}C]glucose was ingested and ^{13}C MRS data were acquired for 1-3hrs. [1-^{13}C]glucose was observed immediately after ingestion in the stomach, and evolution of [1-^{13}C]glycogen was monitored with < 1min temporal resolution. ^{13}C chemical shift imaging data confirmed that the glycogen signals were localized in the liver.

4485	Computer 96	Acute kidney injury in diabetic rats assessed with hyperpolarized 13C MRI
		Per Mose Nielsen[1], Marie Mølmer[1], Rikke Nørregaard[1], and Christoffer Laustsen[1]
		[1]Clinical Institute, Århus N, Denmark
		In this study we investigate the metabolic alterations, injury and fibrosis development when combining type 1 diabetes and IRI. We find the anaerobic metabolism is highly upregulated in the diabetic kidney, but this elevation is severely reduced in the reperfusion phase. The reduced injury repair capability of the diabetic kidney leads to high injury induction and fibrosis, which in turn reduces kidney function. Therefore special care should be taken to animals or patients experiencing this combination to avoid renal failure.

Electronic Poster

Prostate 2: Technical

Exhibition Hall	Tuesday 17:15 - 18:15

4486	Computer 97	Restriction Spectrum Imaging-A Novel Diffusion-Based Technique for Detection and Characterization of Prostate Cancer
		Ely R Felker[1], Leonard Marks[2], Fuad Elkhoury[2], David Lu[1], Daniel Margolis[3], Sepideh Shakeri[1], Pooria Khoshnoodi[4], Lorna Herbert[2], Nathan White[5], David Karow[6], and Steven Raman[1]
		[1]Radiology, UCLA, Los Angeles, CA, United States, [2]Urology, UCLA, Los Angeles, CA, United States, [3]Radiology, Cornell, New York, NY, United States, [4]Pathology, University of Minnesota, Minneapolis, MN, United States, [5]UCSD, San Diego, CA, United States, [6]Human Longevity Institute, San Diego, CA, United States
		We evaluated the utility of restriction spectrum imaging (RSI), a novel diffusion-based technique to detect and to characterize prostate cancer among men enrolled in a national cancer institute-funded prospective clinical trial of magnetic resonance ultrasound fusion biopsy. RSI was statistically significantly associated with clinically significant prostate cancer.

4487	Computer 98	Reduced FOV EPI with Blip-up Blip-down Field Correction for Prostate DWI
		Roger C Grimm[1], Adam T Froemming[1], and Stephen J Riederer[1]
		[1]Mayo Clinic, Rochester, MN, United States
		Geometric distortion in echo planar imaging spin echo images caused by a non-uniform B_0 field remains an issue in clinical imaging. The purpose of this work is to combine the reduced-field-of-view echo planar pulse sequence with a blip-up blip-down correction in prostate DWI. We show reduced geometric distortion in prostate imaging and ADC maps with little or no additional acquisition time required over current protocols.

4488	Computer 99	Amide proton transfer-weighted (APTW) MRI as an in vivo molecular imaging biomarker to detect prostate cancer
		Xiaoxi Chen[1], Lianming Wu[1], Weibo Chen[2], Jinyuan Zhou[3], and Jianrong Xu[1]
		[1]Department of Radiology, Renji Hospital, Shanghai, China, [2]Philips Healthcare, Shanghai, China, [3]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States

		We explored the capability of using the amide proton transfer-weighted MR imaging as a molecular imaging biomarker to identify prostate cancer. Results showed that both the amide proton transfer ratio (APTR) and magnetization transfer ratio (MTR) in tumors were higher than in non-tumorous regions. APT-MR imaging may have great value in clinical treatment and prognosis of prostate cancer.

4489	Computer 100	MultiVane Diffusion-Weighted Imaging for Multiparametric Prostate Magnetic Resonance Imaging in Men with Hip Implants: A Preliminary Report
		Ali Pirasteh[1], Brian Johnson[2], Daniel N. Costa[3], Ananth J. Madhuranthakam[3], and Ivan Pedrosa[4]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Philips Healthcare, Gainesville, FL, United States, [3]Radiology, Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [4]Radiology, Advanced Imaging Research Center, Urology, UT Southwestern Medical Center, Dallas, TX, United States
		Diffusion-weighted echo-planar-imaging (DW-EPI) is the cornerstone of multiparametric MRI in evaluation of prostate cancer in the peripheral zone and can help in the detection of transitional zone tumors. However, DW-EPI suffers from significant image distortion and signal loss in men with hip arthroplasty, a population at risk for development of prostate cancer. We have implemented a DWI sequence with turbo spin-echo readout, MultiVane k-space trajectory, and short-tau inversion recovery fat-suppression that provides images without appreciable distortion and promising preliminary results in evaluation of prostate cancer in men with hip implants.

4490	Computer 101	Intra- and Inter-scanner Variability Evaluation of RR-VFA B1+ and T1 in the Prostate at 3T
		Xinran Zhong[1,2], Dapeng Liu[1], James Sayre[1], Holden H Wu[1,2], and Kyunghyun Sung[1,2]
		[1]Department of Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Physics and Biology in Medicine IDP, University of California, Los Angeles, Los Angeles, CA, United States
		Accurate T_1 estimation is critical for quantitative prostate DCE MRI. B_1^+ inhomogeneity can introduce significant error into the T_1 quantification, especially for variable flip angle method. Reference region variable flip angle (RR-VFA) method is a promising B_1^+ and T_1 estimation technique, which requires no separate scans for B_1^+ mapping and can reduce slice profile and position mismatch between B_1^+ and T_1 maps. In this study, we investigated both intra-scanner repeatability and inter-scanner reproducibility regarding B_1^+ corrected T_1 on two 3.0 T scanners to compare RR-VFA to a commercially available B_1^+ estimation technique. RR-VFA showed comparable intra- and inter-scanner variability to the saturated turbo FLASH based B_1^+ estimation technique.

4491	Computer 102	What combination of b-values is appropriate for ADC calculation in prostate DWI?

		Masamitsu Hatakenaka[1], Naomi Koyama[1], Naoya Yama[1], Maki Onodera[1], Koichi Onodera[1], Yurina Onuma[1], Ryo Taguchi[1], and Mitsuhiro Nakanishi[2]
		[1]Diagnostic Radiology, Sapporo Medical University, Sapporo, Japan, [2]Radiology and Nuclear Medicine, Sapporo Medical University Hospital, Sapporo, Japan
		In prostate cancer, although calculating ADC with b-value combination of 50-100 and 800-1000 sec/mm^2 is recommended by PI-RADS ver. 2, ADC calculated with b-values of 0 and 1500 sec/mm^2 may be superior with respect to repeatability and correlation with cancer aggressiveness.

4492	Computer 103	Synthetic 3D reconstruction
		Stephen J. Riederer[1], Eric A. Borisch[1], Adam T. Froemming[1], Soudabeh Kargar[1], Akira Kawashima[1], and Joshua D. Trzasko[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		A new method is described in which slice profile in 2D multi-slice acquisition is corrected for with k-space-based processing, restoring resolution along the slice select direction. When used with multiple multi-slice acquisitions the method may allow isotropic 3D resolution. The method is described, and preliminary results from phantom and prostate MRI exams are presented.

4493	Computer 104	Dynamic Contrast-Enhanced MRI of the Prostate with Single-Echo Dixon Fat Suppression
		Eric G. Stinson[1], Joshua D. Trzasko[1], Soudabeh Kargar[1], Eric A. Borisch[1], Adam T. Froemming[1], Akira J Kawashima[2], Phillip M. Young[1], and Stephen J. Riederer[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States, [2]Radiology, Mayo Clinic, Scottsdale, AZ, United States
		The purpose of this work was to adapt our current clinical DCE-MRI protocol to allow for single-echo Dixon fat suppression and maintain image update times <10s. Single-echo Dixon imaging with spatial resolution that matched our current clinical protocol was performed with sub-10s update times and near-optimal Dixon SNR by increasing the readout bandwidth from ±62.5 to ±83.3 kHz. Additionally, pharmacokinetic modelling results look similar to those produced from the standard DCE-MRI protocol. DCE-MRI of the prostate with single-echo Dixon fat suppression provides high spatial and temporal resolution dynamic imaging of contrast uptake without the presence of confounding fat signal.

4494	Computer 105	The repeatability of fully automated atlas-based prostate segmentation on T2-weighted MR images

		Mohammed R S Sunoqrot[1], Daniel C Billdal[1], Kirsten M Selnæs[1,2], Mattijs Elschot[1], and Tone F Bathen[1,2]
		[1]Department of Circulation and Medical Imaging, NTNU, Norwegian University of Science and Technolog, Trondheim, Norway, [2]St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway
		Computer-aided diagnosis (CADx) systems have been proposed to overcome the limitations of the radiological reading of multiparametric MRI. Fully automated segmentation of the prostate is a crucial step of CADx systems, which can be successfully performed by atlas-based segmentation of T2-weighted (T2W) MR images. For applications like treatment monitoring and active surveillance, the repeatability of automated segmentation method is highly important. In this work, we investigated the repeatability of several fully automated atlas-based prostate segmentation methods. We found that the repeatability of the investigated methods is excellent, which is promising for the further development of CADx systems following patients with multiple measurements over time.

4495	Computer 106	Multi-echo T2 modelling to predict PIRADS 2.0 score
		William Devine[1], Francesco Giganti[2], Edward Johnston[1], Eleftheria Panagiotaki[3], Shonit Punwani[1], Daniel C. Alexander[3], and David Atkinson[1]
		[1]Centre for Medical Imaging, University College London, London, United Kingdom, [2]Department of Radiology, University College London Hospital NHS Foundation Trust, London, United Kingdom, [3]Centre for Medical Image Computing, University College London, London, United Kingdom
		To investigate if Luminal Water Imaging (LWI), which models multi-compartment T2 decay, can predict the PIRADS 2.0 score of a region of interest (ROI). 52 patients were scanned using both standard mp-MRI and a 32-echo T2 sequence, ROIs were placed in areas of suspected lesion and suspected benign tissue and then these ROIs were each given a PIRADS 2.0 score. The results show that LWI can predict PIRADS 2.0 score as well as the Apparent Diffusion Coefficient (ADC).

4496	Computer 107	Two compartment fitting for Luminal Water Imaging: multi-echo T2 in Prostate Cancer
		William Devine[1], Francesco Giganti[2], Edward Johnston[1], Eleftheria Panagiotaki[3], Shonit Punwani[1], Daniel C. Alexander[3], and David Atkinson[1]
		[1]Centre for Medical Imaging, University College London, London, United Kingdom, [2]Department of Radiology, University College London Hospital NHS Foundation Trust, London, United Kingdom, [3]Centre for Medical Image Computing, University College London, London, United Kingdom

		This work aims both to show that using a constrained fitting method for Luminal Water Imaging with fewer echoes produces accurate parameter estimates and that this fitting method is feasible for detecting and grading Prostate Cancer. Simulated signals were produced and the mean LWF across multiple iterations was calculated for two models. Then 19 patients were imaged and the images were contoured in both cancerous and benign regions. The simulation showed that the proposed constrained method is accurate and the in-vivo imaging reinforced the idea that multi-echo T2 modelling shows promise in detecting and grading PCa.

4497	Computer 108	Accelerated 3D T2 mapping with dictionary-based matching for prostate imaging
		Elisa Roccia[1], Rohini Vidya Shankar[1], Radhouene Neji[1,2], Gastao Cruz[1], Rene Botnar[1], Claudia Prieto[1], Vicky Goh[1,3], and Isabel Dregely[1]
		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Siemens Healthcare Limited, Frimley, United Kingdom, [3]Cancer Imaging, King's College London, London, United Kingdom
		Quantitative T_2 mapping has potential for prostate cancer discrimination. However, current methods are typically 2D, require long scan times and may lead to inaccuracies if using an oversimplified exponential model. We propose rapid 3D T_2 mapping based on accelerated 3D multi shot T_2-prepared bSSFP acquisition combined with dictionary-based matching. The dictionary of signals was generated using a simulation framework taking into account the specifics of the acquisition, and was then matched to the acquired images to retrieve T_2 values. The proposed approach was tested in healthy subjects enabling the acquisition of 3D T_2 mapping of the whole prostate in 4min.

4498	Computer 109	High-resolution 3D T1 mapping of the prostate with an efficient inversion-recovery radial FLASH pulse sequence
		Zhitao Li[1], Ali Bilgin[1,2], Kevin Johnson[3], Hina Arif[4], Diego R Martin[4], and Maria I Altbach[4]
		[1]Electrical and Computer Engineering, The University of Arizona, Tucson, AZ, United States, [2]Biomedical Engineering, The University of Arizona, Tucson, AZ, United States, [3]Siemens Healthcare, Tucson, AZ, United States, [4]Department of Medical Imaging, The University of Arizona, Tucson, AZ, United States
		A 3D IR radial FLASH technique and a model-based iterative algorithm for the reconstruction of undersampled data are demonstrated for efficient high-resolution T_1 mapping of the prostate. The method is insensitive to B_1 inhomogeneity and provides full coverage of the prostate volume within the time constrains of a clinical examination.

4499	Computer 110	The Medical College of Wisconsin 39 (MCW39): A Magnetic Resonance Image Template of the Prostate to Facilitate Group Analysis
		Sean D McGarry[1], Matthew Budde[2], Sarah L Hurrell[3], Kenneth A Iczkowski[4], Michael Griffin[3], Petar Duvnjak[3], Kenneth Jacobsohn[5], William Hall[6], Mark Hohenwalter[3], Andrew Nencka[3], and Peter LaViolette[3]
		[1]Biophysics, Medical College of Wisconsin, Wawautosa, WI, United States, [2]Neurosurgery, Medical College of Wisconsin, Wawautosa, WI, United States, [3]Radiology, Medical College of Wisconsin, Wawautosa, WI, United States, [4]Pathology, Medical College of Wisconsin, Wawautosa, WI, United States, [5]Urologic Surgery, Medical College of Wisconsin, Wawautosa, WI, United States, [6]Radiation Oncology, Medical College of Wisconsin, Wawautosa, WI, United States
		The Medical College of Wisconsin 39 (MCW39) template provides a common space for the analysis of prostate cancer images. The template was generated through iterative spatial registration of T2-weighted images starting with manually drawn contours as a reference point. Expert annotations of Gleason Grade were transformed into the template space, and maps of tumor probabilities reveal the spatial localization of cancer across the cohort for each grade.

4500	Computer 111	Effect of Intravascular Contrast Agent on Diffusion and Perfusion Fraction Coefficients in the Peripheral Zone and Prostate Cancer
		Yousef Mazaheri[1], Andreas M Hötker [2], Amita Shukla-Dave[1], Oguz Akin[2], and Hedvig Hricak[2]
		[1]Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States
		We present a systematic approach to characterize differences in pre- and post-contrast diffusion and perfusion parameters. In addition to measuring ADC values before and after contrast injection, we extended the mono-exponential model to incorporate the contribution of pseudo-perfusion to the signal intensity and evaluated the impact of contrast injection on molecular diffusion (D) and perfusion fraction (f). We find in PCa, the coefficient D, like ADC, was significantly lower on post-contrast as compared to pre-contrast DWI, while the perfusion fraction coefficient was significantly higher on post-contrast acquisitions. In PZ, ADC and D did not differ significantly between post- and pre-contrast acquisitions, but f was significantly higher after contrast injection.

4501	Computer 112	Synthetic MRI of the Prostate using MAGiC: Clinical Feasibility and Preliminary Results
		Yousef Mazaheri[1], Maggie Fung[2], Duane A Nicholson[3], Amita Shukla-Dave[1], Hedvig Hricak[3], and Oguz Akin[3]

		[1]Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Application & Workflow Team, GE Healthcare, New York, NY, United States, [3]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States
		In this study, we evaluated a 2D combined simultaneous multi-contrast acquisition sequence, referred to MAGiC, which allows simultaneously obtaining images to generate, T1, T2, PD, STIR map with acceptable scan duration within a single acquisition. High quality T1- and T2-w images were synthetically generated using mathematical signal models. Prostate images obtained from patients and volunteers showed that T1 and T2 measured by MAGiC were within 16% of the values measured using conventional mapping techniques with reasonable spatial resolution.

4502	Computer 113	MR Fingerprinting and ADC Mapping for Characterization of Lesions in Transitional Zone of Prostate
		Ananya Panda[1], Yun Jiang[1], Seunghee Margevicius[2], Wei-Ching Lo[3], Mark Schluchter[2], Chaitra Badve[1,4], Mark Griswold[1,3,4], Lee Ponsky[5], and Vikas Gulani[1,3,4]
		[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Biostatistics, Case Western Reserve University, Cleveland, OH, United States, [3]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [4]Radiology, University Hospitals Cleveland Medical Center, Cleveland, OH, United States, [5]Urology, University Hospitals Cleveland Medical Center, Cleveland, OH, United States
		This study presents utility of MRF derived relaxometry, and ADC mapping for differentiating transition zone prostate cancers from non-cancerous lesions. Based on targeted biopsy correlation, T_1, T_2, ADC were compared between cancer, prostatitis and normal transition zone (NTZ). Mean T_1, T_2 and ADC were significantly different between cancer and NTZ. Mean T_1 and ADC were significantly different between prostate cancer and prostatitis. While ADC had an AUC of 0.821 for differentiating cancer and prostatitis, a combination of T_1 and T_2 mapping had an AUC of 0.875. Thus MRF can add significant value to ADC mapping in characterization of TZ lesions.

4503	Computer 114	Multicenter repeatability and reproducibility of MR Fingerprinting
		Wei-Ching Lo[1], Yun Jiang[2], Leonardo Kayat Bittencourt[3,4], Junichi Tokuda[5,6], Ravi Seethamraju[7], Clare Tempany-Afdhal[5,6], Ananya Panda[2], Katherine Wright[2], Mark Griswold[1,2], Nicole Seiberlich[1,2], and Vikas Gulani[1,2]
		[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Radiology, University Hospitals Cleveland Medical Center at Case Western Reserve University, Cleveland, OH, United States, [3]CDPI and Multi-Imagem Clinics, Rio de Janeiro, Brazil, [4]Department of Radiology, Universidade Federal Fluminense, Niterói, RJ, Brazil, [5]Department of Radiology, Harvard Medical School, Harvard University, Boston, MA, United States, [6]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [7]Siemens Healthineers, Boston, MA, United States

		MRF enables rapid collection of multiple tissue properties simultaneously. For clinical applications, the T_1 and T_2 values must be repeatable over time and on different MRI scanners so that any observed relaxivity difference can be assumed to be due to differences in physiology rather than scanner instability, differences in pulse sequence or map reconstruction implementations. This study evaluated multicenter repeatability and reproducibility of T_1 and T_2 estimates of MRF in the ISMRM/NIST MRI system phantom and normal prostate regions in patients. The intra-scanner variation was less than 2% for MRF T_1 and 4.7% for T_2 within the biological range.

4504	Computer 115	Histogram Analysis of monoexponential DWI, biexponential IVIM model and PI-RADS V2 for the Differentiation of Prostate Cancer from BPH in the Transition zone
		jie bao[1], ximing wang[1], zhongshuai zhang[2], su hu[1], xiaoxia ping[1], and chunhong hu[1]
		[1]the First Affiliated Hospital of Soochow University, Suzhou, China, [2]Siemens Healthcare Ltd., Shanghai, China
		In this study, we propose to evaluate histogram analysis of ADC derived by traditional DWI model, diffusion related parameters calculated by using intravoxel incoherent motion (IVIM) model and PI-RADS V2 for the detection of the prostate cancer (PCa) in the transition zone (TZ). Our results show that the highest classification accuracy was achieved by the mean ADC (0.841) and mean D (0.809, acquired by the IVIM model). Our findings suggest that Monoexponential DWI and biexponential IVIM model could potentially improve the accuracy of the pathological grading of prostate cancer in TZ.

4505	Computer 116	A study on Compressed SENSE(CSENSE) in prostate T2map at 3T.
		seiichiro noda[1], nobuyuki toyonari[1], yukari horino[1], kazuhiro katahira[1], masami yoneyama[2], and yasutomo katsumata[3]
		[1]kumamoto chuo hospital, kumamoto, Japan, [2]philips japan, tokyo, Japan, [3]pilips japan, tokyo, Japan
		We study on Compressed SENSE in prostate T2map at 3T The imaging sequence used spin echo type multi echo. In case of SENSE, increase Factor resulted in an artifact peculiar to parallel imaging and an error occurred in T2 value measurement of the prostate. However, in the case of CSENSE, artifacts were reduced and T2 value measurement was also possible. Prostate T2map can reduce imaging time using CSENSE.

4506	Computer 117	Characterization of Human Prostate Cancer Using Tissue Sodium Concentration Measured from Sodium MRI
		Nolan Broeke[1], Justin Peterson[1], Adam Farag[1], Aaron Ward[1], Stephen Pautler[2], Joseph Chin[2], Glenn Bauman[2], Robert Bartha[1,3], and Timothy Scholl[1,3,4]

		[1]Western University, London, ON, Canada, [2]London Health Sciences Center, London, ON, Canada, [3]Robarts Research Institute, London, ON, Canada, [4]Ontario Institute for Cancer Research, Toronto, ON, Canada
		Over-treatment of prostate cancer is a significant problem in men's healthcare. Development of non-invasive imaging tools for improved identification of prostate lesions can reduce over-treatment. We have built custom sodium MRI hardware to image and quantify tissue sodium concentration (TSC) in the human prostate. Sodium and multi-parametric MR images are co-registered to Gleason-graded post-prostatectomy histology, the current gold standard for prostate cancer lesion characterization. Our data shows a statistically significant, positive correlation of TSC with Gleason score. These data suggest that TSC measured by sodium MRI, in addition to multi-parametric MRI has utility for non-invasive characterization of prostate cancer.

4507	Computer 118	Quantitative T2 in ex vivo prostate: relationship to microstructure and VERDICT MRI parameters
		Colleen Bailey[1,2], Bernard Siow[3,4], Roger M Bourne[5], Edward William Johnston[6], Mrishta Brizmohun Appayya[6], Hayley Pye[7,8], Susan Heavey[7], Thomy Mertzanidou[1], Hayley Whitaker[7], Alex Freeman[9], Dominic Patel[9], Greg L Shaw[7], Ashwin Sridhar[7], David J Hawkes[1], Shonit Punwani[6], Daniel C Alexander[1], and Eleftheria Panagiotaki[1]
		[1]Centre for Medical Image Computing, University College London, London, United Kingdom, [2]Department of Physics, Ryerson University, Toronto, ON, Canada, [3]Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom, [4]Imaging, Francis Crick Institute, London, United Kingdom, [5]Discipline of Medical Radiation Sciences, University of Sydney, Sydney, Australia, [6]Centre for Medical Imaging, University College London, London, United Kingdom, [7]Division of Surgery and Interventional Science, University College London, London, United Kingdom, [8]Department of Urology, University College London Hospitals, London, United Kingdom, [9]Department of Research Pathology, University College London, London, United Kingdom
		Quantitative T2 and VERDICT diffusion MRI data were acquired in ex vivo prostate specimens, using a patient-specific mold to allow comparison with registered prostate images. Analysis indicated differences from *in vivo* T2 spectra, such as a single T2 component dominating the spectrum in most regions, but with longer T2 values where there was generally more lumen space. A small component with T2 of 10-20 ms was observed in some cancerous regions. The geometric mean of the T2 spectrum was inversely correlated with the intracellular fraction parameter from VERDICT and correlated with the diffusion coefficients of the Tensor component modelling the extracellular space.

4508	Computer 119	The diagnostic potential and repeatability of Relative Enhanced Diffusivity (RED) as a biomarker for prostate cancer
		Daniel Chen Billdal[1], Mohammed R S Sunoqrot[1], Kirsten Margrete Selnæs[1,2], Peter Thomas While[3], Brage Krüger-Stokke[1,3], Helena Bertilsson[4,5], Tone Frost Bathen[1,2], and Mattijs Elschot[1]

		[1]Department of Circulation and Medical Imaging, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [2]St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway, [3]Department of Radiology and Nuclear Medicine, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway, [4]Department of Cancer Research and Molecular medicine, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [5]Department of Urology, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway
		Relative Enhanced Diffusivity (RED) expresses the relative change in ADC between lower and higher b-value regimes. The purpose of this study was to investigate the diagnostic potential and repeatability of RED as a biomarker for prostate cancer (PCa). Ten (10) healthy volunteers and 28 high-risk patients diagnosed with PCa underwent diffusion-weighted MRI. For the healthy volunteers, the repeatability of RED was good to acceptable. For the patients, RED was able to discriminate tumors from healthy tissue in the peripheral zone using either b=50 or b=400 mm/s^2 as the intermediate b-value ($p < 0.001$).

4509	Computer 120	Evaluation of Fitting Uncertainties and Errors for Dispersion-Based Imaging of Prostate DCE-MRI
		KyungHyun Sung[1]
		[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States
		The MR dispersion imaging (MRDI) has shown great promise in prostate DCE-MRI, but there still exist practical limitations due to the complex model fitting. We evaluate fitting uncertainties and errors in parameter estimation for MRDI and recently proposed modified MRDI (mMRDI). We use the time-concentration curves derived from 94 prostate cancer lesions for fitting uncertainties and errors and assess the ability to delineate between cancerous and normal prostate tissues.

Electronic Poster

fMRI: Multimodal Approaches

Exhibition Hall	Wednesday 8:15 - 9:15

4510	Computer 1	Simultaneous fMRI and electrophysiology: measuring local field potential, multi-unit, and single unit activity
		Brittany M Katz[1], Tzu-Hao Chao[2], Mike Sorenson [3], You-Yin Chen[4], Yen-Yu Ian Shih[2], and SungHo Lee[2]

[1]Neuroscience Curriculum, University of North Carolina Chapel Hill, Chapel Hill, NC, United States, [2]Neurology, University of North Carolina Chapel Hill, Chapel Hill, NC, United States, [3]Engineering, Blackrock Microsystems, Salt Lake City, UT, United States, [4]Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan

The use of hemodynamic signals as a surrogate measure of neuronal activity presents a major challenge to any straightforward interpretation of fMRI data. In recognition of this caveat, this study describes a polyimide-based MR-compatible microelectrode array with a MR-compatible headstage preamplifier and demonstrates the feasibility in vivo for recording of BOLD, LFP, MUA, and single-unit activity simultaneously.

4511 | Computer 2

Neuropharmacological fMRI of MDMA – A Novel, Multimodal Analytical Approach Informed by PET

Ottavia Dipasquale[1], Pierluigi Selvaggi[1], Anthony Gabay[1], Mattia Veronese[1], Steve CR Williams[1], Federico Turkheimer[1], and Mitul Mehta[1]

[1]Department of Neuroimaging, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom

This study evaluates the degree to which resting-state fMRI (rfMRI) response indexes the action at drug target sites by testing whether haemodynamic response to MDMA mirrors receptor 5-HT density profiles measured with PET. We weighted the rfMRI BOLD signal using a high-resolution in vivo atlas of the serotonin system. Results show that an altered haemodynamic response to MDMA is detectable only in the maps related to MDMA serotonin targets. This study provides new evidence that rfMRI haemodynamic response to MDMA reflects the known binding profile of the drug and set the basis for a biologically-informed rfMRI analysis in drug challenges.

4512 | Computer 3

BOLD Hemodynamic Response Function Varies as a Function of Both Brain State and Brain Region

Russell Butler[1], Guillaume Gilbert[2], Maxime Descoteaux[1], Pierre-Michel Bernier[1], and Kevin Whittingstall[1]

[1]University of Sherbrooke, Sherbrooke, QC, Canada, [2]Philips Healthcare, Markham, ON, Canada

The BOLD signal is linked to neural activity through the canonical hemodynamic response function (HRF), often assumed to be static across both brain area and brain state. We employed simultaneous EEG-FMRI recordings to investigate the hemodynamic response to neural activity in the alpha, beta, and gamma frequency bands. We find that the shape of the HRF depends on both brain region, and brain state. Default mode network (DMN) BOLD signals are linked to alpha synchronization, while occipital BOLD signals are linked to alpha/beta desynchronization and gamma synchronization. Connectivity estimates assuming a canonical HRF may be biased by HRF differences across region and state.

4513	Computer 4	Automatic Electrodes Detection during simultaneous EEG/fMRI acquisition Mathis Fleury[1], Pierre Maurel[1], Marsel Mano[1], Elise Bannier[2], and Christian Barillot[1] *[1]Univ Rennes, INRIA, CNRS, INSERM, VISAGES-ERL U 1228, F-35000 Rennes FRANCE, Rennes, France, [2]Univ Rennes, INRIA, CNRS, INSERM, VISAGES-ERL U 1228, F-35000 Rennes FRANCE, University Hospital of Rennes Department Radiology, Rennes, France* Simultaneous EEG/fMRI acquisition allows to measure brain activity at high spatial-temporal resolution. The localisation of EEG sources depends on several parameters including the position of the electrodes on the scalp. The position of the MR electrodes during its acquisitions is obtained with the use of the UTE sequence allowing their visualisation. The retrieval of the electrodes consists in obtaining the volume where the electrodes are located by applying a sphere detection algorithm. We detect around 90% of electrodes for each subject, and our UTE-based electrode detection showed an average position error of 3.7mm for all subjects.

4514	Computer 5	Assessment of neural correlates of cortical communication of Alpha/Gamma bands between frontal and parietal-occipital regions in Situational Awareness task as well as in resting-state: An EEG informed fMRI approach Ardaman Kaur[1], Vijayakumar C[1], Swati Agrawal[1], Subash Khushu[1], Rishu Chaujar[2], and Suresh Sharma[2] *[1]Nuclear Magnetic Resonance Research Center, Institute of Nuclear Medicine & Allied Sciences,Defence Research and Development Organisation, Delhi, India, [2]Applied Physics, Delhi Technological University, Delhi, India* Cross frequency coupling of Alpha/Gamma oscillations between frontal and parietal-occipital cortex coordinates neuronal communication at higher frequency which often correlates with higher-order cognitions. The dynamics of cross frequency coupling and neuronal communication is often modulated by higher-order cognition tasks while comparing resting-state. The neural correlates and modulation of these cortical communication caused by reciprocal relationship of alpha/gamma band between frontal and parietal-occipital regions are poorly understood. Hence in this study, cortical functional correlation of alpha/gamma oscillation between frontal and parietal-occipital region for higher-order cognitive task such as Situational Awareness is assessed and its modulation from resting-state has been explored.

4515	Computer 6	Does Pre-task Resting state Absolute Alpha (PRAA) power and its Frontal Asymmetry Index (FAI) predict outcome of Situational Awareness task? Assessment through EEG informed fMRI approach. Ardaman Kaur[1], Vijayakumar C[1], Swati Agrawal[1], Subash Khushu[1], Rishu Chaujar[2], and Suresh Sharma[2]

		[1]Nuclear Magnetic Resonance Research Center, Institute of Nuclear Medicine & Allied Sciences, Defence Research and Development Organisation, Delhi, India, [2]Applied Physics, Delhi Technological University, Delhi, India
		One of the established hypotheses is that alpha-oscillation inhibits irrelevant stimulus processing during task, but correlates positively with emotional stability of individual in absence of predefined task. However, role of Pre-task Resting state Absolute Alpha rhythm (PRAA) and its frontal hemispheric difference estimated by Frontal Asymmetry Index (FAI) in predicting the outcome of individual's performance in higher-order cognitive task is poorly understood. Thus, in this study, correlation of PRAA and FAI with behavioral parameter pertaining to Situational Awareness (SA) task was studied. Further, to substantiate the emotional connectivity of PRAA and FAI index, their neural correlates in task-fMRI were estimated.

4516	Computer 7	Estimation of simultaneous BOLD and FDG metabolism activation using a coherent ICA method
		Shenpeng Li[1,2], Francesco Sforazzini[2], Sharna D. Jamadar[2,3,4], Philllip G.D. Ward[2,3,4], Jakub Baran[2], Malin Premaratne[1], Gary Egan[2,3,4], and Zhaolin Chen[1,2]
		[1]Department of Electrical and Computer System Engineering, Monash University, Clayton, Australia, [2]Monash Biomedical Imaging, Monash University, Clayton, Australia, [3]Australian Research Council Centre of Excellence for Integrative Brain Function, Monash University, Clayton, Australia, [4]Monash Institute of Cognitive and Clinical Neuroscience, Monash University, Clayton, Australia
		This abstract proposes a new joint fMRI and functional FDG-PET (fPET) ICA analysis method, coherent ICA, based on the simultaneously acquired dual-modality imaging data. It applies ICA on the spatiotemporal data sets from both modalities to obtain coherent activation maps and preserve their correspondent temporal information, which is not retained by existing methods. The preserved temporal information can potentially be used to investigate the interaction between BOLD signal and other metabolism change measured by fPET.

4517	Computer 8	Delayed fMRI timing in the human auditory cortex in lexical processing is correlated with increased EEG power in beta band
		Hsin-Ju Lee[1], Hui-Chuan Chang[1], Ying-Hua Chu[2], Wen-Jui Kuo[1], and Fa-Hsuan Lin[2]
		[1]Institute of Neuroscience, National Yang Ming University, Taipei, Taiwan, [2]Institute of BIomedical Engineering, National Taiwan University, Taipei, Taiwan
		Using fast fMRI (whole-brain 10 Hz sampling), we revealed the left hemisphere's BOLD signal is more delayed by 500 ms when engaging a lexical discrimination task than a non-lexical discrimination task. EEG study on the same subjects suggested such BOLD signal delay is related to the oscillatory power in the beta band.

4518	Computer 9	Level of TMS-evoked activation in anterior cingulate cortex depends on timing of TMS delivery relative to frontal alpha phase Golbarg T. Saber[1], James R. McIntosh[2], Jayce Doose[1], Josef Faller[2], Yida Lin[2], Hunter Moss[1], Robin I. Goldman[3], Mark S. George[4,5], Paul Sajda[2], and Truman R. Brown[1] *[1]Department of Radiology and Radiological Science, Medical University of South Carolina, Charleston, SC, United States, [2]Department of Biomedical Engineering, Columbia University, New York, NY, United States, [3]Center for Healthy Minds, University of Wisconsin-Madison, Madison, WI, United States, [4]Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina, Charleston, SC, United States, [5]Ralph H. Johnson VA Medical Center, Charleston, SC, United States* To test whether the level of activation of the anterior cingulate cortex (ACC) following a TMS pulse delivered to the dorsolateral prefrontal cortex depends on precise timing of its delivery relative to an individual's alpha rhythm, we developed an integrated EEG-fMRI-TMS instrument capable of acquiring simultaneous EEG-fMRI while delivering TMS pulses in the scanner. We found a statistically significant effect of BOLD signal change in ACC dependent on individual subject frontal alpha phase just prior to TMS delivery. Specifically, TMS-evoked BOLD response in the ACC increased when TMS pulse was synchronized to the rising slope of the frontal alpha oscillation.

4519	Computer 10	Improving Sensitivity of Task-fMRI Signals by Use of Time Delayed Systemic Regressors: A Comparison of Probe Regressors from Peripheral NIRS Recordings and BOLD-fMRI Sinem Burcu Erdogan[1], Yunjie Tong[2], Lia Maria Hocke[3], Kimberly P. Lindsay (Dec.)[4], and Blaise DeBonneval Frederick[5] *[1]Medical Engineering, Acibadem Mehmet Ali Aydinlar University, Istanbul, Turkey, [2]College of Engineering, Purdue University, West LaFayette, IN, United States, [3]Department of Radiology, University of Calgary, Calgary, Alberta, Canada, [4]Department of Psychiatry, Harvard University Medical School, Belmont, MA, United States, [5]Department of Psychiatry, Harvard Medical School, Belmont, MA, United States* A fundamental problem with fMRI measurements is the strong presence of low frequency systemic physiological noise (<0.15 Hz), which significantly corrupts detection power for hemodynamic variations caused by task induced neuronal activation. In this study, we propose a novel noise removal strategy for task-fMRI studies by taking into consideration a relatively new established property of systemic low frequency oscillations (sLFOs): their dynamic propagation within cerebral vasculature causing voxel-specific arrival delays. We compare the performance of dynamic noise modelling regressors obtained from i) BOLD data and ii) a fingertip HBO signal of non-neuronal origin concurrently recorded with near infrared spectroscopy (NIRS).

4520	Computer 11	Multimodal Correlation and Connectivity Analysis on Simultaneously Recorded MR-PET data

Ravichandran Rajkumar[1,2], Elena Rota Kops[3], Jürgen Scheins[4], Lutz Tellmann[4], Christoph Lerche[4], Karl-Josef Langen[4,5], Hans Herzog[4], N. Jon Shah[4,6,7,8], and Irene Neuner[2,4]

[1]Institute of Neuroscience and Medicine (INM-4), Forschungszentrum Jülich GmbH, Jülich, Germany, [2]Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH Aachen University, Aachen, Germany, [3]Forschungszentrum Juelich GmbH, Institute of Neuroscience and Medicine - 4, Jülich, Germany, [4]Institute of Neuroscience and Medicine 4 (INM4), Forschungszentrum Jülich GmbH, Jülich, Germany, [5]Department of Nuclear Medicine, RWTH Aachen University, Aachen, Germany, [6]Institute of Neuroscience and Medicine 11, Forschungszentrum Jülich GmbH, Jülich, Germany, [7]Department of Neurology, RWTH Aachen University, Aachen, Germany, [8]Monash Biomedical Imaging, School of Psychological Sciences, Monash University, Melbourne, Australia

On a simultaneously recorded resting state MR-PET data, the functional connectivity metrics (namely ReHo, fALFF, and DC) from fMRI and the glucose metabolism from FDG – PET are calculated and correlated in the default mode network (DMN) regions of the brain. Results shows high connectivity of the DMN hubs is coupled with a high glucose consumption. Further investigations in patients are necessary to explore the potential of simultaneous imaging as a biomarker for disease staging, treatment response and monitoring

4521 Computer 12

Improved cardioballistic artifact waveform for artifact correction with direct cardiac cycle detection from EEG-fMRI data

Chung-Ki Wong[1], Qingfei Luo[1], Vadim Zotev[1], Raquel Phillips[1], Kam Wai Clifford Chan[2], and Jerzy Bodurka[1,3]

[1]Laureate Institute for Brain Research, Tulsa, OK, United States, [2]University of Oklahoma-Tulsa, Tulsa, OK, United States, [3]Stephenson School of Biomedical Engineering, University of Oklahoma, Norman, OK, United States

In simultaneous EEG-fMRI, cardioballistic (BCG) artifact removal algorithms require the detection of artifact occurrence time to form subtraction template for artifact correction. The artifact occurrence time can be estimated by an average delay following the R-peak of electrocardiogram (ECG) recording, or directly measured from the BCG component in the EEG data. Here we compared the BCG artifact waveform evaluated by artifact cycles measured from the BCG and ECG data. We found that direct BCG cycle detection from EEG data provides better BCG waveform for the artifact correction and eliminates the need for independent ECG recording.

4522 Computer 13

Correlation between the Scaling Exponent of the Power Spectral Density Function of Local Field Potentials and the BOLD signal

Xiaodi Zhang[1], Wen-Ju Pan[1], and Shella Keilholz[1]

		[1]Department of Biomedical Engineering, Emory University/Georgia Institute of Technology, Atlanta, GA, United States
		In this abstract we proposed a new method to assess whether changes in the power spectral density (PSD) function of local field potential (LFP) are correlated with the BOLD signal using a single parameter that describes the relative distribution of activity across frequencies (the power scale exponent). The correlation maps obtained using the scaling exponent exhibit strong, localized correlations at the locations near the electrodes in some scans, similar to those obtained from the LFP power time course method.

4523	Computer 14	Silent Simultaneous EEG-fMRI using Looping-Star.
		Beatriz Dionisio[1,2], Michael Czisch[3], Victor Spoormaker[3], Philipp Saemann[3], Darius Burschka[1], Marion Menzel[2], Axel Haase[1], Florian Wiesinger[2], and Ana Beatriz Solana[2]
		[1]TUM (Technical University of Munich), Munich, Germany, [2]GE Healthcare, Munich, Germany, [3]Max Planck Institute of Psychiatry, Munich, Germany
		This work presents a novel technique for silent simultaneous EEG-fMRI, combined with a slow gradient switching fMRI method called Looping-Star. In comparison to the conventional setup with Gradient-Echo EPI, the silent technique improves the EEG quality while maintains fMRI quality characteristics. The inaudible scanning offers higher sensitivity to auditory stimuli, resulting in enhanced evoked response potentials (ERPs).

4524	Computer 15	EEG/MEG Source Imaging using fMRI Informed Time-variant Constraints
		Jing Xu[1], Jingwei Sheng[1], Tianyi Qian[2], Zihui Su[3], and Jia-Hong Gao[1]
		[1]Center for MRI Research, Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [2]Siemens Healthcare, MR Collaborations NE Asia, Beijing, China, [3]Department of Anatomy and Cell Biology, McGill University, Montreal, QC, Canada
		The accuracy of fMRI-constrained EEG/MEG source imaging may be degraded by potential spatial mismatches between the locations of fMRI activation and electrical source activities. To address this problem, we propose a novel fMRI informed time-variant constraint (FITC) method. Simulations were performed to compare the source estimates produced by L2-minimum norm estimation (MNE), fMRI-weighted minimum norm estimation (fMNE), FITC and depth-weighted FITC (wFITC) algorithms with various spatial mismatch conditions. In conclusion, the proposed FITC method is able to better resolve the spatial mismatch problems encountered in fMRI-constrained EEG/MEG source imaging.

4525	Computer 16	Spatiotemporal coupling between dopamine neurotransmitter release and BOLD signaling in the ventral striatum nan li[1], Lili Cai[1], and Alan P Jasanoff[1,2] *[1]Biological Engineering, MIT, Cambridge, MA, United States, [2]Brain and Cognitive Sciences, MIT, Cambridge, MA, United States* As the most commonly used fMRI technique for human brain study, BOLD functional MRI is not detecting neuronal activity directly and the mechanism is not clear. Here we demonstrate, for the first time, to directly explore the relationship between the regional DA neurotransmitter release and the co-localized BOLD signaling in vivo by combing molecular – level dopamine-sensitive MRI technique and BOLD fMRI. Our result demonstrated nonlinear and spatially-heterogeneity relationships between neurotransmitter activity and the hemodynamic responses in the same region. We expect the result will facilitate a better understanding and explanation of human fMRI results.

4526	Computer 17	Hand-related Auditory and Visual Stimulation on BOLD fMRI and EEG in Children with Autism Spectrum Disorder Shijun Li[1], Yi Wang[1], and Lin Ma[1] *[1]Chinese PLA General Hospital, Beijing, China* By using Blood oxygen level dependent (BOLD) magnetic resonance imaging (MRI) method with hand-related pictures and sound stimulating on Autism Spectrum Disorder (ASD) children, the difference was found in the border of temporal lobe and occipital lobe in ASD and NC contrast. And these findings may help guide the precise intervention or treatment in ASD.

4527	Computer 18	Hyperacusis and hearing loss induce increased causal flow from auditory cortex to mesolimbic pathway after long-term dynamic functional remodeling Ying Luan[1] *[1]Radiology, Zhongda Hospital, Southeast University, Nanjing, China* Hyperacusis is a common hearing disorder with reduced loudness perception tolerance and hypersensitivity to ordinary environmental sounds, often co-exist with hearing loss and tinnitus. Hyperacusis and hearing loss are often associated with accelerated cognition decline and affection disorders.This study aimed to utilize behavioral and fMRI techniques in combination with Granger causality analysis to investigate dynamic functional connectome remodeling in hyperacusis and hearing loss rat models which could be the neural mechanisms of cognition and emotion deficits .

4528	Computer 19	BOLD-MRI imaging for the evaluation of hepatic warm ischemia-reperfusion injury and the effect of Lipo-PGE1 intervention in rabbit models Qian Ji[1], Jingyao Li[2], Tianyi Qian[3], and Jinxia Zhu[3] *[1]Department of Radiology, Tianjin First Central Hospital, Tianjin, China, [2]First Central Clinical College of Tianjin Medical University, Tianjin, China, [3]Siemens Healthcare, Beijing, China* This study aimed to determine the feasibility of using BOLD MRI to diagnose liver ischemia-reperfusion injury and the effect of Lipo-PGE1 intervention in rabbits. Seven groups of rabbits with liver ischemia-reperfusion injury induced using various means were examined using a 3T clinical MR scanner and followed by biochemical and histopathological analysis. The R2* values were significantly positively correlated with alanine aminotransferase, aspartate aminotransferase, and lactate dehydrogenase. These results suggest that BOLD MRI is suitable for quantitatively assessing the degree of ischemia and the effect of Lipo-PGE1 in rabbits.

4529	Computer 20	Comparison of fMRI and fNIRS mapping and systemic influences using a specifically designed multimodal probe for ultrahigh-resolution mapping Lia Maria Hocke[1], Kenroy R Cayetano[1], Yunjie Tong[2], and Blaise deB Frederick[1] *[1]McLean Hospital, Harvard University, Belmont, MA, United States, [2]Purdue, West Lafayette, IN, United States* fMRI is the gold standard of human functional brain imaging, although functional near-infrared spectroscopy (fNIRS) is easier to administer and lower in cost. Therefore studies have tried to compare the two techniques. However results have been variable, partly due to only rough spatial correspondence between fMRI and fNIRS, and systemic physiological noise influences. In the current study we use a previously described multimodal fNIRS/fMRI probe with optodes directly integrated into the coil structure. We characterize the spatial and temporal overlap between task-evoked fMRI and fNIRS signal, as well as their systemic physiological influences with high spatial and temporal correspondence.

4530	Computer 21	Alterations of functional connectivity in the rat brain induced by NMDA receptor antagonists Traxoprodil and Lanicemine Robert Becker[1], Natalia Gass[1], Lothar Kußmaul[2], David Schnell[2], Cornelia Dorner-Ciossek[2], Wolfgang Weber-Fahr[1], and Alexander Sartorius[1,3]

		[1]RG Translational Imaging, Department Neuroimaging, Central Institute of Mental Health, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany, [2]Boehringer Ingelheim Pharma GmbH & Co. KG, Ingelheim, Germany, [3]Department of Psychiatry and Psychotherapy, Central Institute of Mental Health, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany
		Since ketamine has been found to act antidepressant, NMDA receptor antagonists are investigated regarding their potential use in therapy of depression. In this study we investigated the effects of traxoprodil and lanicemine on resting state functional connectivity in the rat brain. Both drugs significantly altered hippocampal-prefrontal (Hc-PFC) connectivity with more pronounced effect of traxoprodil. Interestingly the pronounced effects on intra PFC connectivity found in a previous ketamine study could not be observed. Traxoprodil also reduced whole brain network segregation. HC-PFC connectivity appears to be a promising target for further investigation of NMDA receptor antagonists and their antidepressant effects.

4531	Computer 22	Optimising simultaneous EEG-fMRI data acquisition: artefact minimisation
		Christopher Sabin[1], David Carmichael[2], and Amy McDowell[2]
		[1]UCL, London, United Kingdom, [2]UCL Institute of Child Health, London, United Kingdom
		Simultaneous EEG-fMRI benefits from the two modalities' high-temporal and high-spatial resolutions. However, the MRI environment can cause artefacts in EEG signal, as movement of the EEG equipment causes artefactual voltages. This work investigated configurations of the EEG equipment (in-bore 'sled' v 'cantilever') in terms of their artefact reduction; in particular relating to vibrations from the scanner's helium cooling pump. We found vibration artefacts were broadly similar between the two configurations but the sled significantly reduced raw gradient artefact while increasing helium pump artefact. The helium pump needs to be turned off for highest recording quality in either configuration.

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fMRI: Basic Neuroscience (Non-Connectivity-Based)

Exhibition Hall	Wednesday 8:15 - 9:15

4532	Computer 25	Brain Structural Impairment Associated with Aberrant Functional Responses to the Valsalva Maneuver in Heart Failure
		Xiaopeng Song[1], Bhaswati Roy[2], Sadhana Singh[1], Ashish Sahib[1], Cristina Caberera-Mino[2], Gregg C. Fonarow[3], Mary A. Woo[2], and Rajesh Kumar[1,4,5]

		[1]Departments of Anesthesiology, University of California at Los Angeles, Los Angeles, CA, United States, [2]UCLA School of Nursing, University of California at Los Angeles, Los Angeles, CA, United States, [3]Division of Cardiology, University of California at Los Angeles, Los Angeles, CA, United States, [4]Radiological Sciences, University of California at Los Angeles, Los Angeles, CA, United States, [5]Brain Research Institute, University of California at Los Angeles, Los Angeles, CA, United States
		Heart failure (HF) patients show inability to regulate heart rate and blood pressure in response to autonomic challenge. Using BOLD-fMRI and DTI-MD procedures, we found that functional MRI responses during the Valsalva maneuver in cerebellum and insular are delayed or reduced in amplitude, and comparable areas showed structural injury in HF subjects. These findings show that impaired functional responses during the Valsalva maneuver have brain structural basis in HF condition.

4533	Computer 26	On the (non-)equivalency of monopolar and bipolar settings for deep brain stimulation fMRI studies of Parkinson’s disease patients
		Ileana Hancu[1], Radhika Madhavan[2], Alexandre Boutet[3], Manish Ranjan[3], Julia Prusik[4], Davix Xu[3], Suneil Kalia[3], Mojgan Hodaie[3], Walter Kucharczyk[3], Jeffrey Ashe[1], Alfonso Fasano[3], Julie Pilitsis[4], and Andres Lozano[3]
		[1]GE Global Research Center, Niskayuna, NY, United States, [2]GE Global Research Center, Bangalore, India, [3]University Hospital Network, Toronto, ON, Canada, [4]Albany Medical Center, Albany, NY, United States
		The equivalency of brain responses in fMRI studies of Parkinson’s disease (PD) patients studied in monopolar and bipolar deep brain stimulation (DBS) configurations was assessed. Five PD patients underwent 30s/30s ON/OFF DBS fMRI scans using their clinical (monopolar) settings and an equivalent bipolar setting, in which the cathode remained unchanged, and a proximal electrode was rendered positive; the voltage was increased by 30% to compensate for the reduced efficacy of the bipolar setting. Monopolar and bipolar configurations resulted in different patterns of brain activation; blind monopolar-bipolar conversion should be avoided for purposes of understanding mechanisms of DBS action.

4534	Computer 27	The Relationship between Glutamate and BOLD signal changes During Face-Name Paired-Associates Encoding and Retrieval Task in Healthy Adults - A combined 1H-MRS and fMRI study
		H Zhang[1], PW Chiu[1,2], SWH Wong[3], T Liu [4], GHY Wong[4], Q Chan[5], and HKF Mak[1,2,6]
		[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, Hong Kong, Hong Kong, [3]Department of Educational Psychology, Chinese University of Hong Kong, Hong Kong, Hong Kong, [4]Department of Social Work and Administration, The University of Hong Kong, Hong Kong, Hong Kong, [5]Philips Healthcare, Hong Kong, Hong Kong, [6]Alzheimer’s Disease Research Network, The University of Hong Kong, Hong Kong, Hong Kong

		Glutamate is hypothesized to be the neurotransmitter in mediating BOLD fMRI. In our study, face-name paired-associates (FN-PA) encoding and retrieval tasks are used to investigate the relationship between glutamate and the BOLD signal changes in 72 healthy adults of varying age. Our results showed that $[Glx]_{abs}$ in the left hippocampus to be significantly positively correlated with the activations in the memory-related circuitry obtained from the FN-PA encoding and retrieval tasks. This might implicate the role of glutamate as the neurotransmitter mediating the BOLD signal changes in the memory tasks.

4535	Computer 28	Analysis of colour discrimination ability in Parkinson's Disease patients using fMRI
		Shefali Chaudhary[1], Senthil Kumaran[1], Vinay Goyal[2], Achal Srivastava[2], Gaurishanker Kaloiya[3], Mani Kalaivani[4], Rajesh Sagar[5], and Naranamangalam R Jagannathan[1]
		[1]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [2]Department of Neurology, All India Institute of Medical Sciences, New Delhi, India, [3]Department of NDDTC and Psychiatry, All India Institute of Medical Sciences, New Delhi, India, [4]Department of Biostatistics, All India Institute of Medical Sciences, New Delhi, India, [5]Department of Psychiatry, All India Institute of Medical Sciences, New Delhi, India
		Ocular and visual disorders has been reported in Parkinson's Disease (PD). BOLD activation was mapped during visual color hue discrimination stimuli in PD (n=10, mean age=59 years, SD=6.8) and healthy control (HC) (n=6, mean age=53.67 years, SD=2.6) participants at 3 T MR scanner. Comparison between the two groups revealed lower activation in secondary visual areas (BA 18/19) and fusiform gyrus (BA 37), more dependence on memory areas and increased cluster size in PD (in comparison with HC) suggesting impairment in colour hue processing.

4536	Computer 29	Association of cerebral perfusion alterations in sudden sensorineural hearing loss detected by arterial spin labeled MRI
		Xiao-Min Xu[1] and Gao-Jun Teng[2]
		[1]Department of Medical School, Southeast University, Nanjing, China, [2]Radiology, Southeast University, Nanjing, China
		To explore associations between cerebral blood flow (CBF) and depression by using arterial spin labeled MRI (ASL). Voxel-wise based comparisons between sudden sensorineural hearing loss (SSHL) patients and controls were investigated by whole-brain analysis, which might reflect a new insight into SSHL-related dysregulation and treatment target for psychological abnormalities.

4537	Computer 30	Detection of BOLD Response in the Limbic System to Non-invasive Stimulation of Autonomic Nervous System with SMS at 7T

		Tie-Qiang Li[1], Yanlu Wang[1], and Masaki Fukunaga[2]
		[1]Department of Medical Radiation and Nuclear Medicine, Karolinska University Hospital Huddinge, Stockholm, Sweden, [2]Division of Cerebral Integration, National Institute of Physiological Sciences, Okazaki, Japan
		Previous studies of clinical patients indicate that kinetic oscillatory stimulation (KOS) in nasal cavity has a positive impact on the functioning of autonomic nervous system (ANS). For better under standing of the mechanisms underlying this treatment efficacy, we used a 7T MRI system equipped with simultaneous multiple slice (SMS) imaging techniques to study the brain activation during a robust block design of KOS.The findings from the current study demonstrate that KOS is effective to induce regulatory response of the CNS control network.

4538	Computer 31	Influence of propofol and isoflurane anesthesia in brain activations induced by thermal stimulation and capsaicin: an fMRI study in Macaca fascicularis
		Willy Gsell[1,2], Elaine Manigbas[2,3], Uwe Himmelreich[1], and Zhimin Wang[2]
		[1]Biomedical MRI, KU Leuven, Leuven, Belgium, [2]Maccine, Pte Ltd, Singapore, Singapore, [3]National University of Singapore, Singapore, Singapore
		Preclinical fMRI is often performed under general anesthesia which may compromise the brain reactivity but also interfere with the central effect of test compounds. We hereby performed a comparison of Isoflurane and propofol anesthetic regimens in order to determine the compatibility of both compounds with hyperalgesia induced by capsaicin. Threshold to reach robust somatosensory activation seems to be increased under propofol anesthesia but pain related activation remained at 44 degrees using both anesthetics. Capsaicin induced significant T2* changes in both groups but mismatches were observed suggesting different pathways to be involved and therefore prevail further investigation.

4539	Computer 32	Probability distribution of functional areas in human brain
		Weiwei Men[1,2], Sizhong Zhou[1], Yaoyu Zhang[1], Xiaolin Chen[3], Tianyi Qian[4], Changyu Lu[5], and Jia-Hong Gao[1,2,6]
		[1]Center for MRI Research, Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [2]Beijing City Key Lab for Medical Physics and Engineering, Institute of Heavy Ion Physics, School of Physics, Peking University, Beijing, China, [3]Department of neurosugery, Capital Medical University Affiliated Beijing Tiantan Hosipital, Beijing, China, [4]MR Collaboration NEA, Siemens Healthcare, Beijing, China, [5]Neurosurgery Department, Peking University International Hospital, Beijing, China, [6]McGovern Institute for Brain Research, Peking University, Beijing, China

		fMRI can be used to detect the functional areas of human brain in vivo, which is helpful for neurosurgeons to make accurate pre-surgical plans. Due to the individual differences of the brain, the topography of different functional areas will vary across subjects. The purpose of this study was to construct group functional probability maps of different functional areas based on a large database of normal subjects. It has the potential to help neurosurgeons to make accurate pre-surgical plans and to improve the functional outcome of patients after surgery.

4540	Computer 33	Working memory decline in patients with amnestic mild cognitive impairment (aMCI) during 2-back tasks
		Zhaoxia Qin[1], Mengxing Wang[1], Jilei Zhang[1], Haifeng Lu[1], Shuai Xv[1], Jianren Liu[2], and Xiaoxia Du*[1]
		[1]East China Normal University, Shanghai, China, [2]Shanghai Ninth People's Hospital, Shanghai, China
		This study investigated brain functional abnormalities that are specifically related to working memory in amnestic mild cognitive impairment (aMCI) patients using fMRI in combination with an n-back task. Nineteen aMCI patients (aged, 52-78 years, 13 female) and 19 age-and gender-matched healthy adults participated in this experiment. In the task performance, aMCI group had lower accuracy on the 2-back task. The aMCI patients exhibited less areas of activation during performance of the 2-back vs. 0-back tasks, and more deactivation in the default mode network, compared with healthy group. The aMCI patients exhibited decreased activation in dorsolateral prefrontal cortex and supplementary motor cortex during the 2-back vs. 0-back tasks, compared with healthy group.

4541	Computer 34	A comparison of audiovisual and auditory cue based gaming using fMRI
		Surabhi Ramawat[1], Senthil Kumaran[1], Shefali Chaudhary[1], Sunita Gudwani[1], Sadhana Kumari[1], Rohit Saxena[2], and Naranamangalam R Jagannathan[1]
		[1]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [2]Dr. Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi, India
		Gaming involves coordination between attention, spatial processing and motor processes. In the present study, fMRI during an audio-video gaming paradigm was carried out in healthy participants (n=6, 2M, 4F, mean age=31.2 years and SD=5.58), in two sessions, with audio-only stimulus and audio-video stimuli. Data processing and inter-group comparison was done using spm12. The results suggest attention, cognitive control and learning processes during the audio-only task as compared to the audiovisual task.

4542	Computer 35	Enhancement of midbrain auditory responses to behaviorally relevant vocalization by optogenetically-initiated dorsal hippocampal inputs

		Celia M. Dong[1,2], Russell W. Chan[1,2], Alex T. L. Leong[1,2], Eddie C. Wong[1,2], and Ed X. Wu[1,2]
		[1]*Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China,* [2]*Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China*
		The hippocampus is a central hub of the brain with abundant connections to numerous remote structures. However, whether and how hippocampus interacts with the auditory subcortical regions remains unknown. The inferior colliculus (IC), the auditory midbrain, is the first station where the responses selectivity for vocalization is formed. In this auditory fMRI study, we revealed that IC responses to vocalization, but not broadband noise, could be enhanced by dorsal hippocampal inputs initiated optogenetically. Our findings indicate that hippocampus plays a role in midbrain processing of the behaviorally relevant sound, a phenomenon that was unknown previously.

4543	Computer 36	Effects of a high-fat diet in the mouse cerebral response to appetite detected by functional diffusion MRI and HRMAS studies
		Irene Guadilla[1], María José Guillén[1], Sebastián Cerdán García-Esteller[1], and Pilar López-Larrubia[1]
		[1]*Instituto de Investigaciones Biomédicas CSIC-UAM, Madrid, Spain*
		Obesity and overweight are common problems in developed world population, affecting to a greater number of children. In young people, it is becoming more usual to diagnose diabetes or heart problems due to fat accumulation. In this work, we wanted to assess the effects of a fat diet in the cerebral response to an appetite stimulus in mice. We evaluated changes in diffusion magnetic resonance imaging parameters and metabolomic profiles. Our results suggest that high fat diet consumption causes alterations in the brain response to appetite that can be signaled by magnetic resonance approaches.

4544	Computer 37	Magnetic resonance to characterize the cerebral response to fasting status in a glioblastoma mouse model
		Irene Guadilla[1], María José Guillén[1], Sebastián Cerdán García-Esteller[1], and Pilar López-Larrubia[1]
		[1]*Instituto de Investigaciones Biomédicas CSIC-UAM, Madrid, Spain*
		Involuntary weight loss in patients with cancer is a common secondary effect in tumor pathologies being a cause of weakening and progression of the disease. This phenomenon causes cachexia that is estimated to be the direct cause of at least 20% of cancer deaths. In this line, untreated intracranial glioma-bearing mice develop cachexia, and the use of magnetic resonance imaging characterization of the cerebral response to different appetitive conditions can contribute to the better understanding of the cachectic status. For that, we employed functional diffusion MRI and metabolomic studies in a glioblastoma mouse model.

4545	Computer 38	Functional and metabolic magnetic resonance evaluation of the role of the aquaporin-4 in the cerebral response to appetite
		Irene Guadilla[1], María José Guillén[1], Sebastián Cerdán García-Esteller[1], and Pilar López-Larrubia[1]
		[1]Instituto de Investigaciones Biomédicas CSIC-UAM, Madrid, Spain
		Aquaporin-4 (AQP4) is the main water channel protein found in the brain. It is located at the end-feet of astrocytes allowing to maintain the ion and water balance. In our group, we previously employed functional diffusion magnetic resonance imaging to detect the swelling of astrocytes in response to appetite. In this line, we wanted to study the function of the AQP4 in the volume changes of these glial cells. For that, we administrated a glucose bolus and the aquaporin inhibitor TGN to assess the role of this protein in the brain response to a feeding stimulus.

4546	Computer 39	Resting-state sensorimotor networks in adults with atypical swallowing: a fMRI study
		Sidy Fall[1], Stéphanie Dakpé[2], Pauline Nicol[3], Juliette Baudel[3], Evane Pailler[3], Sylvie Testelin[2], Bernard Devauchelle[2], Patrick Goudot[3], and Jean-Marc Constans[4]
		[1]BioFlow Image, University of Picardy, Amiens, France, [2]Maxillo Facial Department, Facing Faces Institute, University Hospital, Amiens, France, [3]Maxillo Facial Department, Pitié Salpétrière University Hospital, UPMC Paris 6, Paris, France, [4]Radiology Department, Facing Faces Institute, University Hospital, Amiens, France
		Most previous functional neuroimaging studies on swallowing were focused on investigating the cortical (and subcortical) representation of the swallowing functions in healthy individuals using task-related data. The present function magnetic resonance imaging (fMRI) study examine whether individuals with atypical and normal swallowing differ in brain activity patterns associated to the resting-state sensorimotor network. Our findings revealed that the individuals with normal swallowing showed stronger and broader patterns of activation than the individuals with atypical swallowing, particularly in the midcingulate cortex. These differences of activation patterns between the two groups may suggest that the midcingulate cortex is crucially involved in the coordination or/and integration of swallowing functions.

4547	Computer 40	Test-Retest Reproducibility of Cerebral Blood Flow at Rest and During A Vigilance Task
		Hengyi Rao[1], Fan Yang[1], Sihua Xu[1], and John A. Detre[1]
		[1]Center for functional Neuroimaging, University of Pennsylvania, Philadelphia, PA, United States

		It is unclear whether ASL test-retest reproducibility would be different between absolute CBF and relative task-induced CBF changes, and across resting and task scans. Here we scanned 15 healthy participants three times in a 5-day well-controlled study while participants were at rest and performing a simple vigilance task. Absolute CBF showed excellent test-retest reliability across three days, which were comparable to performance reliability. However, reliability of task-induced CBF changes were much lower than reliability of absolute CBF, suggesting that absolute CBF rather than relative CBF changes may be a more reliable brain function measurement for longitudinal and clinical studies.

4548	Computer 41	Inter-subject correlation and adaptation effects across cortical depths in the human auditory cortex during natural music listening
		Pu-Yeh Wu[1], Jo-Fu Lotus Lin[1], Shu-Yu Huang[1], Shang-Yueh Tsai[2], Wen-Jui Kuo[3], and Fa-Hsuan Lin[1,4]
		[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [2]Institute of Applied Physics, National Chengchi University, Taipei, Taiwan, [3]Institute of Neuroscience, National Yang Ming University, Taipei, Taiwan, [4]Department of Neuroscience and Biomedical Engineering, Aalto University, Espoo, Finland
		We explore the inter-subject correlated BOLD signal across subjects in the auditory cortex acorss cortical depth when listening to musical pieces. More synchronized brain activity was observed at intermediate cortical depths. Repeated listening caused variable modulations on the inter-subject correlated BOLD signal across songs and cortical depths.

4549	Computer 42	Calculation of the Susceptibility Effect on the Rate of Transverse Relaxation using Real Microvascular Networks
		Xiaojun Cheng[1], Jonathan R. Polimeni[2,3], Louis Gagnon[2], Anna Devor[4,5], Sava Sakadžić[2], Richard B. Buxton[4], and David A. Boas[1,2]
		[1]Department of Biomedical Engineering, Boston University, Boston, MA, United States, [2]Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [3]Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States, [4]Departments of Radiology, UC San Diego, La Jolla, CA, United States, [5]Departments of Neurosciences, UC San Diego, La Jolla, MA, United States
		We obtain the exponent in the power law relation of the transverse relaxation rate and the susceptibility difference between vessels and tissue from first-principles calculations using our recently developed VAN model. We find that this exponent is close to 1, and is more uniformly distributed across regions at higher magnetic field strengths. The results from the uniform vascular partitioning relevant for BOLD fMRI are compared, and the exponent is closer to 1 for the latter. These help inform interpretation fo the physiological variables including CMRO2 and CBV from BOLD and contrast-enhanced fMRI respectively.

4550	Computer 43	fMRI mapping of brain-wide networks to optogenetically-evoked spindle-like activity from somatosensory thalamus
		Xunda Wang [1,2], Alex T. L. Leong[1,2], Karim El Hallaoui[1,2], Celia M. Dong[1,2], and Ed X. Wu[1,2]
		[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China
		The brain is a highly complex, interconnected structure with parallel and hierarchical networks distributed within and between neural systems. During information processing in the brain, spontaneous oscillatory neural events such as slow oscillations, spindles and sharp wave ripples provoke global dynamic patterns. We propose that spindle-like optogenetic stimulation can be employed to study global interaction patterns in long-range networks by stimulating the ventral posteromedial thalamus (VPM) thalamocortical excitatory neurons.

4551	Computer 44	Video C3D features learned by deep network correlate with functional MRI signal variation associated with the video
		Xu Chen[1], Jason Langley[1], Sujoy Paul[2], Tahmida Mahmud[2], Amit K Roy-Chowdhury[2], Aaron Seitz[3], and XiaoPing Hu[1,4]
		[1]Center for Advanced Neuroimaging, UC Riverside, Riverside, CA, United States, [2]Dept. of Electrical & Computer Engineering, UC Riverside, Riverside, CA, United States, [3]Dept. of Psychology, UC Riverside, Riverside, CA, United States, [4]Dept. of Bioengineering, UC Riverside, Riverside, CA, United States
		To gain further insights into the mechanisms of deep network learning from the perspective of brain imaging, we compared spatio-temporal features of video segments extracted via a 3-dimensional convolutional network (3D ConvNets) with video representations in human brain characterized by functional MRI signal variation when viewing video segments. We found correlations between C3D features and fMRI signal variation in brain regions selectively activated by video segments after the optimization of time lag due to the hemodynamic response function (HRF). Distinct activation patterns were also revealed by functional MRI for video segments classified as different classes of activity.

4552	Computer 45	Olfactory functional magnetic resonance imaging in the human brain at 7 Tesla
		Ikuhiro Kida[1,2], Yuka Donoshita[3], and Uksu Choi[1,2]
		[1]Center for Information and Neural Networks, National Institute of Information and Communications Technology, Suita-shi, Japan, [2]Graduate School of Frontier Biosciences, Osaka University, Suita-shi, Japan, [3]Daikin Industries, Ltd., Osaka, Japan

		In contrast to the understanding of the visual and auditory functions, the understanding of the olfactory function in the human brain is less advanced. Because the regions involved in olfaction are prone to signal losses due to strong magnetic field inhomogeneity in the susceptibility boundary between air in the paranasal sinuses and brain tissues, a study of olfaction using functional MRI (fMRI) is challenging, especially at ultra-high magnetic field strength (UHF). In this study, we investigated the role of olfactory fMRI with high spatial resolution at 7T involving the ventral brain area. We found that the brain activations are reproducible within and between subjects. These results suggested that fMRI with high spatial resolution at UHF has the potential for use in olfaction studies, also involving the ventral brain regions.

4553	Computer 46	A pneumatic tactile stimulus to explore the primary somatosensory area with fMRI, at different magnetic fields
		Laura Biagi[1,2], Paolo Cecchi[3], Simona Fiori[1], Graziella Donatelli[4], Andrea Guzzetta[1,5], Giovanni Cioni[1,5], Michela Tosetti[1,2], and Mirco Cosottini[2,3,4]
		[1]IRCCS Fondazione Stella Maris, Pisa, Italy, [2]IMAGO7 Foundation, Pisa, Italy, [3]3Unit of Neuroradiology, AOU Pisa, Pisa, Italy, [4]Department of Translational Research and New Technologies in Medicine and Surgery, University of Pisa, Pisa, Italy, [5]Department of Clinical and Experimental Medicine, University of Pisa, Pisa, Italy
		Difficulties to separate sensory and motor activations in fMRI studies limited the potentialities of the technique to study mechanisms of plasticity and processes of re-organization occurring in primary somatosensory area after brain lesions. Here we present the results of the use of a tactile stimulus developed ad hoc to investigate this area at different magnetic fields. The tactile stimulator is able to activate selectively a specific area in post-central region at 3T and 7T, and thanks to its safety and handiness it seems a useful tool to study (re-)organization processes in patients with brain lesion.

4554	Computer 47	The alexithymic trait is reflected in emotional processing in subjects below the threshold of alexithymic disorder.
		Johanna Närväinen[1], Pekka Kuoppa[2], Leila Karhunen[3,4], Sanna Sinikallio[5], Mervi Könönen[6], and Mika P Tarvainen[2,7]
		[1]VTT Technological Research Centre of Finland, Kuopio, Finland, [2]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland, [3]Institute of Public Health and Clinical Nutrition, University of Eastern Finland, Kuopio, Finland, [4]Institute of Clinical Medicine, Kuopio University Hospital, Kuopio, Finland, [5]School of Educational Sciences and Psychology, University of Eastern Finland, Joensuu, Finland, [6]Kuopio University Hospital, Kuopio, Finland, [7]Department of Clinical Physiology and Nuclear Medicine, Kuopio University Hospital, Kuopio, Finland

		Alexithymia is a disorder linked to altered brain processing of emotions and to other disorders and substance abuse. In sub-disorder range, alexithymia can be considered a personality trait. In this paper, we first characterize the fMRI results of emotion induction in non-alexithymic subjects, and then explore the correlation between brain activation in amygdala, anterior cingulate cortex and prefrontal cortex; and the degree of the alexithymic trait assessed by TAS-20 questionnaire. As conclusion, the alexithymic trait seems to be reflected in emotional processing already in subjects well below the threshold of alexithymia disorder.

4555	Computer 48	**Support vector machine prediction of clinical pain response using resting-state fMRI**
		Scott J. Peltier[1,2], Eric Ichesco[3], Lynne Pauer[4], Daniel J. Clauw[3], and Richard E. Harris [3]
		[1]Functional MRI Laboratory, University of Michigan, Ann Arbor, MI, United States, [2]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [3]Anesthesiology, University of Michigan, Ann Arbor, MI, United States, [4]Pfizer Inc., Groton, CT, United States
		The mechanisms of chronic pain and its response to pharmacological treatment remains an open challenge. Multivariate pattern analysis can offer an alternative to standard analysis techniques. This study applies SVM classification in resting-state fMRI data to predict improvements in clinical pain after drug therapy.

Electronic Poster

Body Imaging: Fetal & Placenta

Exhibition Hall	Wednesday 8:15 - 9:15

4556	Computer 49	Non-invasive estimation of fetal lung maturity using MR spectroscopy
		Vidya Rajagopalan[1,2] and Stefan Bluml[2,3]
		[1]Radiology and Imaging Services, Children's Hospital Los Angeles, Los Angeles, CA, United States, [2]Rudi Schulte Research Institute, Santa Barbara, CA, United States, [3]University of Southern California, Los Angeles, CA, United States
		Magnetic resonance spectroscopy (MRS) can potentially be used to non-invasively measure the lipid levels in the amniotic fluid (AF), in-utero, to determine fetal lung maturity (FLM). This would eliminate the need to perform invasive and risky amniocentesis solely to determine FLM. In this study we measured the lipid to water ratio in the amniotic fluid of women with normal pregnancies. Our results showed that this ratio remained steady until after 36 gestational weeks at which point it increased exponentially. This indicates that MRS is a potential replacement for amniocentesis for estimating FLM.

4557	Computer 50	Feasibility of Estimating Umbilical Vein Oxygen Saturation with Susceptometry-Based Oximetry Ana E Rodríguez-Soto[1], Michael C Langham[1], Nadav E Schwartz[2], and Felix W Wehrli[1] *[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Obstetrics and Gynecology, Division of Maternal-Fetal Medicine, University of Pennsylvania, Philadelphia, PA, United States* Quantitative MRI allows the estimation of fetal oxygen transport in vivo, for which knowledge of the oxygen saturation (HbO_2) of blood in the umbilical vein (UV) is required. The method of choice to estimate HbO_2 in fetal applications is T_2-based oximetry, which requires a sequence-specific calibration equation to convert blood T_2 to HbO_2. Therefore, in the present work we examined the feasibility of using susceptometry-based oximetry (SBO) to measure HbO_2 at the UV as it is calibration-free and implementable across field strengths. Results show, in a limited number of participants, no difference in HbO_2 measured with both MRI-based oximetric techniques.

4558	Computer 51	Estimating global cerebral venous oxygenation in the human fetus using QSM Brijesh Kumar Yadav[1,2], Sagar Buch[3], Uday Krishnamurthy[1,2], Pavan Jella[2], Edgar Hernandez-Andrade[4], Anabela Trifan[2], Lami Yeo[4], Sonia Hassan[4], E. Mark Haacke[1,2], Roberto Romero[4,5], and Jaladhar Neelavalli[2,6] *[1]Department of Biomedical Engineering, Wayne State University, Detroit, MI, United States, [2]Department of Radiology, Wayne State University, Detroit, MI, United States, [3]The MRI Institute for Biomedical Research, Waterloo, ON, Canada, [4]Department of Obstetrics and Gynecology, Wayne State University, Detroit, MI, United States, [5]Perinatology Research Branch, NICHD/NIH/DHHS, Detroit, MI, United States, [6]Philips Innovation Campus, Philips India Limited, Banglore, India* Unobstructed oxygen supply is important for proper health and development of the growing fetus and therefore, fetal cerebral oxygenation measurement has been attempted previously using SWI. However, vessel curvature and oblique fetal orientation posed a major challenge in the oxygenation measurement, especially in younger foetuses. To overcome these problems, we present the first application of quantitative susceptibility mapping for the fetal brain oxymetry. We also studied the effect of resolution on QSM using simulations. Results showed the mean putative fetal cerebral oxygenation was 67%±7% and minimum of 5 voxels around the vessel and 5 slices gives <3% error in oxygenation.

4559	Computer 52	Assessment of the effect of maternal posture on the placental oxygenation transport by means of BOLD MRI Esra Abaci Turk[1], Jie Luo[1,2], Natalie Copeland[1], Michelle Restrepo[1], Ata Turk[3], Borjan Gagoski[1], Lawrence L. Wald[4,5,6], Elfar Adalsteinsson[6,7,8], Drucilla J. Roberts[9], Polina Golland[7,10], P. Ellen Grant[1], and William H. Barth Jr[11]

		[1]*Fetal-Neonatal Neuroimaging & Developmental Science Center, Boston Children's Hospital, Boston, MA, United States,* [2]*School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China,* [3]*Electrical Computer Engineering Department, Boston University, Boston, MA, United States,* [4]*Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States,* [5]*Radiology, Harvard Medical School, Boston, MA, United States,* [6]*Harvard-MIT Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States,* [7]*Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States,* [8]*Institute for Medical Engineering and Science, Massachusetts Institute of Technology, Cambridge, MA, United States,* [9]*Pathology, Massachusetts General Hospital, Boston, MA, United States,* [10]*Computer Science and Artificial Intelligence Laboratory (CSAIL), Massachusetts Institute of Technology, Cambridge, MA, United States,* [11]*Maternal-Fetal Medicine, Obstetrics and Gynecology, Massachusetts General Hospital, Boston, MA, United States*
		Aorta-caval compression due to maternal posture can change uterine artery blood flow, which is the major determinant of maternal intervillous perfusion and may affect MRI measures of placental oxygenation. We investigated the effect of maternal posture on estimates obtained from BOLD MRI of the placenta. We observed higher oxygenation signals in the supine position for a group at younger gestational age. In the group with higher gestational age, the influence of the maternal position on oxygen transport was inconsistent. These findings underscore the need to account for the effect of maternal posture on MRI studies of utero-placental circulation.

4560	Computer 53	The development of fat in fetus: Observation by magnetic resonance imaging
		TING YI CHEN[1], SHU HUEI SHEN[1,2], NAI CHI CHIU[1,2], HAN JUI LEE[1,2], SZ SHIAN YU[1,2], and WAN YOU GUO[1,2]
		[1]*Radiology, Taipei Veterans General Hospital, Taipei, Taiwan,* [2]*National Yang-Ming University School of Medicine, Taipei, Taiwan*
		The fetal structures including fat change vigorously during the development progress. In this study, by using 2-point Dixon method, we demonstrated that the fetal fat development followed a predictable chronological sequence in terms of both location and composition. The fat at face appears the earliest at 22-23 weeks, followed by subcutaneous fat of other body part in the order of buttock, thigh, posterior neck, upper arm and lower back. Most subcutaneous fat could be well visualized at 27-28 weeks. The fat at deep part appeared later. The fat fraction in all body part gradually increased as the development progress.

4561	Computer 54	3D Water-Fat MRI Detection of Developmental Maturity in Fetal Adipose Tissue Compartments
		Stephanie A Giza[1], Tianna L Koreman[2], Barbra de Vrijer[3,4], and Charles A McKenzie[1,4]

		[1]Medical Biophysics, Western University, London, ON, Canada, [2]Schulich School of Medicine and Dentistry, Western University, London, ON, Canada, [3]Obstetrics and Gynaecology, Western University, London, ON, Canada, [4]Division of Maternal, Fetal and Newborn Health, Children's Health Research Institute, London, ON, Canada
		Fetal adipose tissue begins development at different gestational ages in different regions of the body. Proton density fat fraction (PDFF) increases with gestational age as fetal adipocytes fill with lipid. The PDFF was found to be significantly different in different regions of the body in mid-late gestation fetuses.

4562	Computer 55	Prediction of invasive placenta with quantitative placental textures features from clinical MRI scan
		Huaiqiang Sun[1], Haoyang Xing[1,2], Haibo Qu[3], Yi Liao[3], Xiaoxia Zhou[4], Zhiyi Zhou[4], Qiyong Gong[1], and Shu Zhou[4]
		[1]Huaxi MR Research Center, Department of Radiology, West China Hospital, Sichuan University, Chengdu, China, [2]College of Physical Science and Technology, Sichuan University, chengdu, China, [3]Department of Radiology, West China Second University Hospital, Sichuan University, Chengdu, China, [4]Department of Obstetrics and Gynecology, West China Second University Hospital, Sichuan University, Chengdu, China
		A machine learning framework that can predict invasive placenta with MRI texture features and identify significant relevant image features

4563	Computer 56	Oxygen transfer through the placenta on hyperoxia
		Simon Shah[1], Nia Jones[2], Lucy Edwards[1], Richard Bowtell[1], and Penny Gowland[1,3]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, Nottingham, United Kingdom, [2]Division of Child Health, Obstetrics and Gynaecology, School of Medicine, Nottingham, United Kingdom, [3]Nottingham University Hospitals NHS Trust and University of Nottingham, NIHR Nottingham Biomedical Research Centre, Nottingham, United Kingdom
		Rapid transport of oxygen through the placenta is important to ensure efficient exchange. The aim of this work was to measure the rate of oxygenation distribution across the placenta on hyperoxia using susceptibility mapping. It also attempts to relate the rate of uptake of oxygen in the placenta to the total flow to the placenta. It was observed that upon hyperoxia the susceptibility decreased as the BOLD signal increased in the placenta. We propose that that the rate of homogenization of susceptibility is a marker of transport through the placenta.

4564	Computer 57	Movement of blood within the placenta

		Simon Shah[1], Nia Jones[2], Lucy Edwards[1], Richard Bowtell[1], and Penny Gowland[1,3]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, Nottingham, United Kingdom, [2]Division of Child Health, Obstetrics and Gynaecology, School of Medicine, Nottingham, United Kingdom, [3]Nottingham University Hospitals NHS Trust and University of Nottingham, NIHR Nottingham Biomedical Research Centre, Nottingham, United Kingdom
		Healthy placental function requires optimum percolation of blood throughout the intervillous space to provide adequate feto-maternal exchange. This depends on blood flow from the spiral arteries and permeability of the intervillous space - both being altered in conditions leading to fetal growth restriction. This study explores the use of diffusion based MRI to visualise and depict the blood flow within the placenta and explore the underlying micro-structure, including the repeatability of the measures.

4565	Computer 58	Rapid single slice multidimensional fetal flow imaging with MRI
		Datta Singh Goolaub[1,2], Christopher Roy[2], Dafna Sussman[2,3,4], Mike Seed[5,6], and Christopher Macgowan[1,2]
		[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Translational Medicine, Hospital for Sick Children, Toronto, ON, Canada, [3]Biomedical Engineering, Ryerson University, Toronto, ON, Canada, [4]The Keenan Research Centre for Biomedical Science, St. Michael's Hospital, Toronto, ON, Canada, [5]Division of Cardiology, Hospital for Sick Children, Toronto, ON, Canada, [6]Paediatrics, University of Toronto, Toronto, ON, Canada
		In this study, we demonstrate multidimensional fetal blood flow quantification, using a novel radial phase contrast sampling strategy combined with compressed sensing reconstruction. This acquisition and analysis pipeline provides high temporal resolution real-time reconstructions that enable image-based gating for subsequent CINE reconstruction. Experimental validation of gating and flow quantitation are presented from an adult volunteer. Preliminary results in two human fetuses show the feasibility of this novel strategy for multidimensional fetal flow in imaging in a single slice.

4566	Computer 59	Placental Functional Imaging with Endogenous Contrast: Preliminary Comparison of BOLD Effect and ASL FAIR in Rhesus Macaque and Human
		Ante Zhu[1,2], Kai D. Ludwig[3], Wei Zha[2], Sydney Nguyen[4], Thaddeus G. Golos[4,5,6], Ian M. Bird[5], Dinesh M. Shah[5], Oliver Wieben[2,3], Sean B. Fain[1,2,3], Scott B. Reeder[1,2,3,7,8], Diego Hernando[2,3], and Kevin M. Johnson[2,3]

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Non-invasive MRI techniques are needed to quantify placental perfusion and oxygenation during pregnancy. In this work, we assessed the feasibility and correspondence of T2* mapping and arterial spin labeling (ASL) to evaluate placental oxygen delivery. Six pregnant rhesus macaques and seven pregnant women underwent MRI that included T2* mapping and ASL with flow-sensitive alternating inversion recovery (FAIR). Regions of locally high ASL perfusion signal correlated spatially with the regions of locally maximum T2* in animals and humans. The two imaging techniques with endogenous contrast are promising approaches for the detection of oxygen delivery via the placenta.

4567 Computer 60

Proton Spectroscopy of the Human Placenta In-Utero to Establish Normal Ranges Throughout Gestation

David M Morris[1,2], Gillian Macnaught[1,3], Marian C Aldhous[4], Fiona C Denison[4], and Scott IK Semple[1,3]

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For magnetic resonance proton spectroscopy to be of potential future use in investigating placental dysfunction *in-utero*, a normal range of detectable metabolites is required. Seventy-seven healthy pregnant women with an uncomplicated singleton pregnancy were scanned between 20 and 40 week's gestation. Robust quality assurance removed compromised data and spectra were quantified for the commonly observed peaks and metabolites expected in the placenta. A characteristic spectrum was observed, which was independent of gestational age. Quantification of this technique in terms of the expected results and their variability will inform future studies and suggest technical improvements that may be useful.

4568 Computer 61

An MRI assessment of inferior vena cava vessel morphology and venous flow in chronic hypertensive and normotensive pregnant women in the supine position.

Ana Isabel Dos Santos Gomes[1], Emer Hughes[2], Alison Ho[3], Anthony Price[2], Christopher Kelly[1], Jana Hutter[2], Joseph Hajnal[2], Lucy Chapell[4], and Mary Rutherford[1]

		[1]Department of Perinatal Imaging and Health, Kings College London, London, United Kingdom, [2]Perinatal Imaging and Health, Kings College London, London, United Kingdom, [3]Faculty of Life Sciences and Medicine, Kings College London, London, United Kingdom, [4]Department of Womens Health, Kings College London, London, United Kingdom
		The supine position in pregnancy may develop supine hypertensive syndrome (SHS) caused by the gravid uterus compressing the inferior vena cava (IVC) and compromising venous return. The effect of positioning on vessel morphology and venous return in chronic hypertensive pregnant women has not been assessed. We used phase contrast imaging to assess matched groups of chronic hypertensive and normotensive women in the supine position. There were no significant differences in IVC morphology or venous return between the two groups, supporting the conclusion that chronic hypertensive women are not at higher risk than normotensives when supine.

4569	Computer 62	Fetal Cardiac Hemodynamics: Initial Experience using 4D flow MRI in Large Animal Models
		Eric M. Schrauben[1], Brahmdeep Saini[2,3], Jack R.T. Darby[4], Jia Yin Soo[4], Mitchell C. Lock[4], Elaine Stirrat[1], Aodhnait S. Fahy[5], Joshua Bradshaw[1], Greg Stortz[1], John G. Sled[1,6], Janna L. Morrison[4], Mike Seed[7,8], and Christopher K. Macgowan[1,6]
		[1]Translational Medicine, Hospital for Sick Children, Toronto, ON, Canada, [2]Heart Centre, Hospital for Sick Children, Toronto, ON, Canada, [3]Institute of Medical Science, University of Toronto, Toronto, ON, Canada, [4]Sansom Institute for Health Research, University of South Australia, Adelaide, Australia, [5]Division of General and Thoracic Surgery, Hospital for Sick Children, Toronto, ON, Canada, [6]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [7]Division of Cardiology, Hospital for Sick Children, Toronto, ON, Canada, [8]Paediatrics, University of Toronto, Toronto, ON, Canada
		4D flow MRI, coupled with advanced surgical preparation of animal subjects, is performed to capture fetal cardiac hemodynamics in two animal models of late gestation pregnancy – pig and sheep. Characterization and visualization of complex flow is presented alongside quantitative measures of flow in major fetal cardiac vessels and shunts.

4570	Computer 63	Exploring placental function over gestation using multi-modal functional MRI
		Jana Hutter[1], Paddy Slator[2], Laurence Jackson[1], Alison Ho[1,3], Ana Dos Santos Gomes[1], Anthony N Price[1], Daniel Alexander[2], Lucy Chappell[3], Mary Rutherford[1], and Joseph V Hajnal[1]
		[1]Biomedical Engineering, King's College London, London, United Kingdom, [2]Centre for Medical Image Computing, University College London, London, United Kingdom, [3]Women's Health Academic Centre, King's College London, London, United Kingdom

		The delivery of oxygen and nutrients to the growing fetus in the human placenta is crucial for any successful pregnancy. Major pregnancy complications such as growth restriction and pre-eclampsia have been linked to placental insufficiency. This study attempts to use a comprehensive multi-modal functional MRI approach to visualize and quantify the complexity of the underlying structural and functional processes and monitor their evolution over gestation. The required placenta data can be acquired in the clinically feasible time of ~12 min and requires no contrast agent. The presented acquisition is completed by a dedicated multi-modal pipeline and a set of quantitative features.

4571	Computer 64	Optimised b-values and Gradient Directions for Placental Diffusion MRI
		Paddy J Slator[1], Jana Hutter[2,3], Laurence H Jackson[2,3], Andrada Ianus[1], Ana Dos Santos Gomes[2], Alison Ho[2], Lisa Story[2], Laura McCabe[2], Eleftheria Panagiotaki[1], Mary Rutherford[2], Joseph V Hajnal[2,3], and Daniel C Alexander[1]
		[1]Centre for Medical Image Computing and Department of Computer Science, University College London, London, United Kingdom, [2]Centre for the Developing Brain, King's College London, London, United Kingdom, [3]Biomedical Engineering Department, Division of Imaging Sciences, King's College London, London, United Kingdom
		Diffusion MRI (dMRI) has the potential to assess placental microstructure and microcirculation in-vivo, and hence provide insight into conditions such as fetal growth restriction and pre-eclampsia. The utility of dMRI data depends heavily upon the choice of b-values and gradient directions, although these choices have to be weighed against scanning time restrictions. To address these issues, we developed an organ-specific, data-driven, clinically-viable protocol for placental dMRI. This optimised protocol compares favourably with a naive protocol of comparable scan time.

4572	Computer 65	Perfusion MRI of the Placenta by Arterial Spin Labeling (ASL) and Ferumoxytol Dynamic Contrast Enhanced (DCE) MRI in the Rhesus Macaque
		Kai D Ludwig[1], Sean B Fain[1,2,3], Sydney Nguyen[4], Thaddeus G Golos[4,5,6], Scott B Reeder[1,2,3,7,8], Ian M Bird[6], Oliver E Wieben[1,2], Dinesh M Shah[6], and Kevin M Johnson[1,2]
		[1]Medical Physics, University of Wisconsin - Madison, Madson, WI, United States, [2]Radiology, University of Wisconsin - Madison, Madson, WI, United States, [3]Biomedical Engineering, University of Wisconsin - Madison, Madson, WI, United States, [4]Wisconsin National Primate Research Center, University of Wisconsin - Madison, Madson, WI, United States, [5]Comparative Biosciences, University of Wisconsin - Madison, Madson, WI, United States, [6]Obstetrics & Gynecology, University of Wisconsin - Madison, Madson, WI, United States, [7]Medicine, University of Wisconsin - Madison, Madson, WI, United States, [8]Emergency Medicine, University of Wisconsin - Madison, Madson, WI, United States

		We evaluate two ASL based techniques for non-contrast measurement of perfusion compared with ferumoxytol-based DCE MRI in ten pregnant rhesus macaques. Localized regions of ASL perfusion were observed that coincided with regions of early contrast arrival times and high relative blood flow as seen in DCE, likely identifying locations of material spiral artery inputs into the placenta intervillous space.

4573	Computer 66	Quantitative ferumoxytol DCE MRI of the primate placenta perfusion domains
		Kai D Ludwig[1], Sean B Fain[1,2,3], Erin B Adamson[1], Sydney Nguyen[4], Thaddeus G Golos[4,5,6], Scott B Reeder[1,2,3,7,8], Ian M Bird[6], Oliver E Wieben[1,2], Dinesh M Shah[6], and Kevin M Johnson[1,2]
		[1]Medical Physics, University of Wisconsin - Madison, Madson, WI, United States, [2]Radiology, University of Wisconsin - Madison, Madson, WI, United States, [3]Biomedical Engineering, University of Wisconsin - Madison, Madson, WI, United States, [4]Wisconsin National Primate Research Center, University of Wisconsin - Madison, Madson, WI, United States, [5]Comparative Biosciences, University of Wisconsin - Madison, Madson, WI, United States, [6]Obstetrics & Gynecology, University of Wisconsin - Madison, Madson, WI, United States, [7]Medicine, University of Wisconsin - Madison, Madson, WI, United States, [8]Emergency Medicine, University of Wisconsin - Madison, Madson, WI, United States
		The placental vascular network is organized to effectively mediate exchange of nutrients, oxygen, and waste between mother and fetus. We report on the estimated number of placental functional domains in a healthy population of rhesus macaques using ferumoxytol DCE MRI. Noninvasive imaging of the maternal vasculature organization and localized perfusion within the placenta may be a sensitive biomarker to predict pregnancy complications.

4574	Computer 67	ADC and perfusion fraction f obtained by IVIM model are markers of maternal and fetal human placenta development in normal pregnancy
		Amanda Antonelli[1], Silvia Capuani[2], Michele Guerreri[2,3], Silvia Bernardo[1], Carlo Catalano[1], and Lucia Manganaro[1]
		[1]Department of Radiological, Oncological and Pathological Sciences, Policlinico Umberto I Università Sapienza di Roma, Rome, Italy, [2]Physics Dpt. Sapienza Roma, CNR ISC Roma Sapienza, Rome, Italy, [3]SAIMLAL Department, Morphogenesis & Tissue Engineering, Sapienza University of Rome, Roma, Italy
		The purpose was to investigate the potential of IVIM model to quantify diffusion and perfusion in human placenta of normal pregnancy. The relation between Apparent diffusion coefficient ADC, perfusion fraction f and pseudo-diffusion coefficient D* obtained in fetal and maternal placenta with microstructural changes occurring during placenta development was investigated. 30 pregnant women (gestational age, GA range = 19-37w) underwent DW examination with b=0,10,30,50,75,100,150,400,700,1000s/mm2. The Pearson correlations between ADC, D*, f and clinical data (GA, Body-Mass Index and basal Glycaemia) were evaluated. ADCvsGA showed significant positive and negative correlation during the II and III trimester of gestation, respectively.

4575	Computer 68	High dielectric material application in fetal MR imaging at 3T Chao Luo[1,2], Nan Li[1,2], Guoxi Xie[3], Xiaoliang Zhang[4,5], Xin Liu[1,2], and Ye Li[1,2] *[1]Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Shenzhen Key Laboratory for MRI, Shenzhen, China, [3]School of Basic Science, Guangzhou Medical University, Guangzhou, China, [4]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [5]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco, CA, United States* In this paper, we evaluated the imaging performance in fetal imaging for supine and lateral positions of pregnant patients with/without high permittivity dielectric pad at 3T through numerical modeling and simulation. The results suggest that the lateral position is advantageous over the supine positions in terms of B1+ efficiency and SAR or MR safety.

4576	Computer 69	Metabolic imaging of rodent placenta using hyperpolarized 13C pyruvate MRI Renuka Sriram[1], Jeremy Gordon[1], Robert A Bok[1], Eugene Milshteyn[1], Daniel B Vigneron[1], Peder E.Z Larson[1], John Kurhanewicz[1], and Priyanka Jha[1] *[1]University of California, San Francisco, San Francisco, CA, United States* We have demonstrated the initial feasibility of hyperpolarized carbon-13 MRI assessment of placental metabolism in a pregnant rat model using [1-^{13}C]pyruvate. This opens avenues for multiple applications investigating metabolic changes of placental dysfunction detrimental to maternal and fetal health.

4577	Computer 70	Spatial Vascular Heterogeneity in the Normal Placenta Assessed with Multi-compartment Placental MRI Rosalind Aughwane[1], Andrew Melbourne[1], David Owen[1], Magdalena Sokolska[2], Alan Bainbridge[2], David Atkinson[1], Jan Deprest[1], Giles Kendall[2], Tom Vercauteren[1], Sebastien Ourselin[1], and Anna David[2] *[1]University College London, London, United Kingdom, [2]University College Hospital, London, United Kingdom*

		The placenta is perfused by the fetus and mother, allowing oxygen and nutrients to be transferred to the developing fetus. Histologically there is large variation in vascularity within normal placentae but this has not been studied in vivo. The DECIDE model was fitted to separate signals from fetal and maternal perfusion. We imaged placental perfusion using the multi-compartment MR DECIDE model over the placental volume to investigate signal heterogeneity in four uncomplicated singleton pregnancies. The spatial composition of the placenta is investigated by inspecting the parametric heterogeneity across the organ.

4578	Computer 71	Fast, automated slice prescription of standard anatomical planes for fetal brain MRI
		Malte Hoffmann[1,2], Borjan Gagoski[2,3], Esra A Turk[3,4], Paul Wighton[1,2], M Dylan Tisdall[5], Martin Reuter[1,2,6], Elfar Adalsteinsson[4], P Ellen Grant[2,3], Lawrence L Wald[1,2], and André J W van der Kouwe[1,2]
		[1]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Fetal-Neonatal Neuroimaging and Developmental Science Center, Boston Children's Hospital, Boston, MA, United States, [4]Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [5]Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States, [6]German Center for Neurodegenerative Diseases, Bonn, Germany
		Motion limits MRI of the fetal brain to rapid 2D acquisitions with low resolution. Even with such sequences, it is challenging to obtain images aligned with standard anatomical planes of the brain, and views rendered retrospectively across slices typically suffer from artifacts due to between-slice motion. Here, we present an automated on-scanner slice prescription: immediately before sequence execution, the FOV/slice tilt is updated to match the orientation and position of the brain, derived from the previous acquisition. The fast update is achieved by registration to a template.

4579	Computer 72	In Utero Mouse Embryo Imaging Using Inductive Over-Coupling Clip Coil
		Orlando Aristizabal[1], Dung Hoang[2], Choong Heon Lee[2], Zakia B.Y. Gironda[2], Jiangyang Zhang[2], Daniel H Turnbull[3], and Youssef ZaimWadghiri Wadghiri[2]
		[1]Skirball Institute, NYU School of Medicine, New York, NY, United States, [2]Radiology, NYU School of Medicine, New York, NY, United States, [3]Skirball Institute,Radiology, NYU School of Medicine, New York, NY, United States
		In-utero fetal imaging is prone to respiratory and cardiac artifacts from the mother. These motion artifacts can be reduced via gated- or self-gated navigator acquisitions. For random fetal movements, each subject must be immobilized within the RF coil or require rapid acquisition and serial co-registration involving complex off-line image processing and high performance hardware that may not be available. We propose the use of 3D printed cylindrically shaped clip to effectively immobilize embryos incorporating a resonator mutually coupled with a surface resonator while ensuring an optimized filling factor. Our setup results in increased sensitivity demonstrated via high quality volumetric datasets.

Electronic Poster

Body Imaging: Kidney

Exhibition Hall	Wednesday 8:15 - 9:15

4580	Computer 73	Renal BOLD & Diffusion MRI in CKD: First Application to a Multi-center Trial Wei Li[1], Tamara Isakova[2], Stuart M Sprague[1], COMBINE Investigators[1], and Pottumarthi V Prasad[1] *[1]Northshore University Healthsystem, Evanston, IL, United States, [2]Northwestern University School of Medicien, Chicago, IL, United States* There is growing interest in applying functional MRI methods to patient studies, especially BOLD and Diffusion MRI in patients with chronic kidney disease. We have had the opportunity to analyze data from a multi-center trial involving patients with advanced CKD (stage 3B & 4) with multiple etiologies. A healthy control group was used to compare the patient cohort. Data shows small increase in cortical R2*, decrease in medullary R2* and response to furosemide in CKD. ADC was reduced in CKD and was correlated with medullary R2*.

4581	Computer 74	Multiparametric MRI for assessment of renal transplant fibrosis: preliminary results. Octavia Bane[1,2], Stefanie Hectors[1,2], Sonja Gordic[2,3], Paul Kennedy[1,2], Mathilde Wagner[2,4], Rafael Khaim[5], Veronica Delaney[5], Madhav Menon[5], Fadi El Salem[6], Sara Lewis[1,2], and Bachir Taouli[1,2] *[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [2]Radiology, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [3]University Hospital Zurich, Zurich, Switzerland, [4]Groupe Hospitalier Pitie-Salpetriere, Paris, France, [5]Recanati-Miller Transplantation Institute, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [6]Pathology, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States* The goal of our study is to develop a multiparametric MRI (mpMRI) protocol for the assessment of renal transplant fibrosis. Our initial results show decrease of cortical and medullary ADC, cortical D and PF, and increase of cortical T1 in fibrotic allografts compared to functional allografts. We also observed loss of corticomedullary differentiation in ADC and T1 with fibrosis. We conclude that diffusion and T1 measurements are sensitive to renal allograft fibrosis, to be confirmed in a larger study.

4582	Computer 75	Use of Multiparametric MRI in assessment of Chronic Kidney Disease: reproducibility, correlation with histology and progression

		Charlotte E Buchanan[1], Huda Mahmoud[2], Eleanor F Cox[1], Benjamin L Prestwich[1], Nicholas M Selby[2], Maarten W Taal[2], and Susan T Francis[1]
		[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Centre for Kidney Research and Innovation, University of Nottingham, Nottingham, United Kingdom
		We use multi-parametric renal MRI including T_1, ASL perfusion and DWI to assess structural and haemodynamic changes in CKD patients compared to healthy volunteers (HV). A significant increase in renal cortex and medulla T_1 (and reduced corticomedullary differentiation), and reduction in renal cortex perfusion, was found between CKD patients and HVs. MRI measures in CKD patients were highly reproducible. A significant negative correlation was found between renal cortex T_1 and eGFR, and a positive correlation of corticomedullary differentiation and perfusion with eGFR. Renal cortex T_1 and corticomedullary differentiation correlated most strongly with quantitative biopsy measures of renal interstitial fibrosis (IF).

4583	Computer 76	MRI assessment of renal function in Acute Kidney Injury and associated longitudinal changes with recovery
		Charlotte E Buchanan[1], Huda Mahmoud[2], Eleanor F Cox[1], Benjamin L Prestwich[1], Maarten W Taal[2], Nicholas M Selby[2], and Susan T Francis[1]
		[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Centre for Kidney Research and Innovation, University of Nottingham, Nottingham, United Kingdom
		Acute Kidney Injury (AKI), a sudden reduction in kidney function, arises from a number of causes with the degree of renal recovery varying widely between individuals. We use multi-parametric MRI to monitor renal changes at the time of AKI and during the subsequent recovery from AKI. At peak AKI, an increase in renal volume, and both renal cortex and medulla T_1 was seen. Medullary T_1 significantly correlated with the severity of biochemical injury as measured by serum creatinine, whilst no significant correlation was found for cortex T_1. At 3 months post AKI, T1 remained elevated compared to healthy volunteers.

4584	Computer 77	Depiction of Transplant Renal Vascular Anatomy and Complications: Unenhanced MR Angiography by Using Spatial Labeling with Multiple Inversion Pulses
		Hao Tang[1], Zhen Li[1], Xianlun Zou[1], and Daoyu Hu[1]
		[1]Radiology, Tongji Hospi□tal, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

		In this study, the preliminary data from our study demonstrate that SLEEK sequence was capable of displaying transplant renal vascular anatomy and complications. Our results show that consistantly high-quality images can be obtained by using SLEEK, which enabled visualization of even small branches within the transplant renal parenchyma and subtle accessory renal arteries. However, because the signal of the arteries depends on the cardiac output of the patient, a suboptimal blood-suppression TI may lead to poor signal-to-noise ratio and vessel depiction. We did not obtain an additional scout image, which may be helpful in evaluating the flow velocity in the aorta to optimize the blood-suppression TI; thus, a larger study for full comparative evaluation of diagnostic performance is necessary. In conclusion, unenhanced MR angiography with SLEEK preliminarily proved to be a reliable diagnostic method for depiction of anatomy and complications of renal vascular transplant. It may be used for evaluation of patients with renal transplant, and in particular for those with renal insufficiency.

4585	Computer 78	ADC and T1-weighted MRI Identifies Necrosis in Wilms Tumours Without the Need for Contrast Agents
		Harriet Rogers[1], Martijn Verhagen [2], Christopher Clark[1], and Patrick Hales[1]
		[1]Great Ormond Street Institute of Child Health, University College London, London, United Kingdom, [2]Great Ormond Street Hospital, London, United Kingdom
		Wilms Tumour (WT) is a paediatric renal tumour. Identifying necrosis in WT is clinically important; it can assess patients' chemotherapy response and ultimately predict progression-free survival. It is also important for guiding biopsies. Lack of enhancement following intravenous administration of gadolinium is commonly used to identify necrosis, however, WT is a kidney tumour, and the use of gadolinium is contra-indicated in patients with renal failure. In this study we demonstrate how apparent diffusion coefficient values from DWI and pre-gad T_1 imaging can predict the level of enhancement in WT, and quantify the percentage of necrotic tissue without exogenous contrast agents.

4586	Computer 79	IVIM DWI evaluation in assessment of of Diabetic Nephropathy: a initial clinical application
		long Liang[1], Yingjie mei[2], Yunfan Wu[1], Guomin Li[1], Mengchen Liu[1], and Guihua Jiang[1]
		[1]Medical image center, Guang dong No.2 General Hospital, Guangzhou, China, [2]Philips Healthcare, Guangzhou, China
		Previous studies using IVIM DWI in evaluating the dynamic change of renal functions both in normal and CIAKI rats' kidney, However, to the best of our knowledge, this techniques have not been explored to evaluate Diabetic Nephropathy(DN). In oue study, we found that IVIM DWI showed potential value of clinical application in DN.

4587	Computer 80	MR elastography and US elastography for assessment of renal transplant dysfunction: preliminary results.

		Paul Kennedy[1,2], Octavia Bane[1,2], Sonja Gordic[2,3], Stefanie Hectors[1,2], Mark Berger[1,2], Rafael Khaim[4], Veronica Delaney[4], Madhav Menon[4], Fadi El Salem[5], Sara Lewis[1,2], and Bachir Taouli[1,2]
		[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [2]Radiology, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [3]University Hospital Zurich, Zurich, Switzerland, [4]Recanati-Miller Transplantation Institute, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [5]Pathology, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States
		The aim of this study is to determine whether MR and US elastography methods can differentiate functional and chronically dysfunctional renal allografts by measuring renal corticomedullary stiffness with MR elastography (MRE) and cortex stiffness with ultrasound point shear wave elastography (pSWE). Our preliminary results indicate that renal stiffness measured with MRE is significantly increased in dysfunctional kidneys, while no significant difference was found with pSWE. Renal stiffness measured with MRE also significantly correlated with Banff scores for interstitial fibrosis and tubular atrophy. These preliminary results suggest that MRE is sensitive to fibrotic changes in chronically dysfunctional allografts.

4588	Computer 81	Usefulness of Testicular Volume, Apparent Diffusion Coefficient, and Normalized Apparent Diffusion Coefficient in the Magnetic Resonance Imaging in Evaluation of Infertile Men with Azoospermia
		Sung Bin Park[1], Byoung Hee Han[2], and Hyun Jeong Park[1]
		[1]Radiology, Chung-Ang University Hospital, Seoul, Republic of Korea, [2]Cheil General Hospital and Women's Healthcare Center, Seoul, Republic of Korea
		It is important to distinguish the obstructive type from the non-obstructive type of azoospermia. To distinguish obstructive from non-obstructive azoospermia, it is useful and important to measure testicular volume using these techniques. To our knowledge, no reports have used DWI to evaluate the testes in case of azoospermia. Therefore, the present study aimed to evaluate the ability of testicular volume, ADC, and normalized ADC (nADC), as measured using MRI, can be used to predict the histopathological grade of azoospermia and to differentiate obstructive from non-obstructive azoospermia.

4589	Computer 82	Optimizing Diffusion-Weighted MRI of the Kidneys: Comparison between Simultaneous Multi-Slice and Integrated Slice-by-Slice Shimming Echo Planar Sequences
		Gumuyang ZHANG[1], Tianyi Qian[2], Bing Shi[1], Hailong Zhou[1], Alto Stemmer[3], Xiaoyan Peng[4], Yan Liu[4], Limeng Chen[4], Hao Sun[1], Huadan Xue[1], and Zhengyu Jin[1]

		[1]Radiology, Peking Union Medical College Hospital, Beijing, China, [2]MR Collaboration, Siemens Healthcare Ltd., Beijing, China., Beijing, China, [3]Siemens Healthcare, Application Development, Germany, Erlangen, Germany, [4]Nephrology, Peking Union Medical College Hospital, Beijing, China
		This study aimed to evaluate the image quality and scan time of the simultaneous multi-slice (SMS) technique compared to integrated slice-by-slice shimming (iShim[MB1]) single-shot echo planar imaging (ss-epi) for diffusion-weighted imaging (DWI) of the kidneys. Six healthy subjects and 22 patients with renal disease underwent both SMS and iShim DWI scans on a 3T MR scanner. Despite the average scan time of SMS DWI being decreased by 53.5% compared to iShim DWI, the image quality of SMS DWI was slightly better, with a higher signal-to-noise ratio and similar contrast-to-noise ratio. ADC values of the kidneys were comparable in both DWI sequences. [MB1]Our product name is "SliceAdjust".

4590	Computer 83	Across vendor comparison of multi-echo GRE R2* measurements in the kidney and a tissue-mimicking phantom
		Pim Pullens[1] and Hubert Raeymaekers[1]
		[1]Radiology, UZ Brussel, Brussel, Belgium
		BOLD MRI may serve as an indicator of blood oxygenation in the kidney and could potentially be used as a MRI biomarker in several kidney diseases. To be effective as a quantitative imaging biomarker, BOLD MRI must be an objective measure, independent of the MRI scanner model and MRI sequence implementation details. We have compared BOLD imaging across vendors in a tissue-mimicking phantom and in the healthy kidney by assessing R2* values in 12 concentric layers.

4591	Computer 84	T1ρ mapping for assessment of fibrosis in renal allografts.
		Stefanie Hectors[1], Octavia Bane[1], Paul Kennedy[1], Fadi El Salem[2], Madhav Menon[3], Maxwell Segall[1], Rafael Khaim[3], Veronica Delaney[3], Sara Lewis[1,4], and Bachir Taouli[1,4]
		[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Pathology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [3]Recanati-Miller Transplantation Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [4]Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States
		The goal of our study was to assess the utility of $T_{1\rho}$ measurements for the differentiation between functional and fibrotic renal allografts. We observed a significant increase in $T_{1\rho}$ in the cortex of fibrotic renal allografts compared to functional allografts. Our results show that $T_{1\rho}$ may be a suitable biomarker for the assessment of fibrosis in renal allografts, which needs to be verified in a larger cohort of patients.

4592	Computer 85	Value of endovaginal MRI derived tumor volumes for predicting outcomes in patients selected for trachelectomy vs hysterectomy in cervical cancer Katja N De Paepe[1], Thomas E J Ind[2], Ayoma D Attygalle[2], Veronica A Morgan[2], Karen Thomas[2], and Nandita M deSouza[1] *[1]Institute of Cancer Research, Sutton, United Kingdom, [2]The Royal Marsden NHS Foundation Trust, London, United Kingdom* A pre-surgical endovaginal MRI was performed in 142 women with early stage cervical cancer scheduled for hysterectomy (n=43) or trachelectomy (n=99). Total tumor volume was calculated by summing MRI and LLETZ/biopsy (done prior to imaging) volumes. In the hysterectomy group, tumour volume, grade and lymphovascular space invasion (LVSI) differed significantly between those without and with an adverse outcome (need for adjuvant treatment or recurrence); only volume and LVSI were significant in the trachelectomy group where multivariate analysis demonstrated their independence. In patients eligible for trachelectomy, with tumors >1.4 cm^3 and with LVSI, administration of (neo)adjuvant treatment may potentially improve outcome.

4593	Computer 86	Feasibility of Renal ASL in a Paediatric Cohort with Impaired Renal Function Fabio Nery[1], Enrico De Vita[2,3], Chris A Clark[1], Isky Gordon[1], and David L Thomas[3] *[1]Developmental Imaging and Biophysics Section, UCL Great Ormond Street Institute of Child Health, London, United Kingdom, [2]National Hospital for Neurology and Neurosurgery, Lysholm Department of Neuroradiology, London, United Kingdom, [3]UCL Institute of Neurology, Department of Brain Repair and Rehabilitation, London, United Kingdom* Arterial Spin Labelling (ASL) allows for non-invasive measurements of tissue perfusion. As such, it presents an attractive alternative to contrast-enhanced based methods for quantification of renal perfusion, particularly in populations with impaired renal function. In this work, we assess the feasibility of ASL in a paediatric cohort with severe kidney disease by combining a robust acquisition scheme with an optimised retrospective motion correction approach.

4594	Computer 87	Multiparametric MRI of Folic Acid Induced Renal Pathology in Mice: A Longitudinal Study Kai Jiang[1], Tristan A. Ponzo[1], Hui Tang[1], Prasanna K. Mishra[2], Slobodan I. Macura[2], and Lilach O. Lerman[1] *[1]Division of Nephrology and Hypertension, Mayo Clinic, Rochester, MN, United States, [2]Department of Biochemistry and Molecular Biology, Mayo Clinic, Rochester, MN, United States*

		Multiparametric MRI was used to assess folic acid-induced renal pathology in mice. Kidney volume, R_2^*, magnetization transfer ratio (MTR), perfusion, T_1, and glomerular filtration rate (GFR) were measured at 2 and 4 weeks post-treatment. While kidney structure (volume and MTR) and hypoxia (R_2^*) showed progressive deterioration, renal perfusion and normalized GFR dropped dramatically at 2 weeks but recovered slightly at 4 weeks. T_1 elevated at 2 weeks and slightly dropped at 4 weeks, suggesting development of transient edema. In conclusion, multiparametric MRI provides a valuable tool for investigation and monitoring of folic acid induced renal pathology.

4595	Computer 88	Tri- and Biexponential Diffusion Analyses of the Kidney: Effect of Respiratory Controlled Acquisition on Measurement Accuracy and Repeatability of Diffusion Parameters
		Yuki Koshino[1], Naoki Ohno[2], Tosiaki Miyati[2], Naoki Hori[1], Yukihiro Matsuura[1], and Toshifumi Gabata[3]
		[1]Department of Radiological Technology, Kanazawa University Hospital, Kanazawa, Japan, [2]Faculty of Health Sciences, Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan, [3]Department of Radiology, Kanazawa University Hospital, Kanazawa, Japan
		To investigate the effect of respiratory-controlled acquisition on intravoxel incoherent motion analysis in the kidney, we compared the fitting accuracy and repeatability of diffusion parameters with tri- and biexponential models among three different methods, ie., respiratory triggering, abdominal belt, and free breathing. Respiratory triggering shows better fitting accuracy and repeatability of tri- and biexponential diffusion parameters compared with free breathing. Moreover, abdominal belt can improve the measurement repeatability even with free breathing.

4596	Computer 89	Multiparametric MRI Data in Diabetic Nephropathy: Correlation with eGFR and eGFR_slope
		Lu-Ping Li[1], Wei Li[1], Bradley Hack[1], Orly Kohn[2], Stuart Sprague[1], and Pottumarthi Prasad[1]
		[1]NorthShore University HealthSystem, Evanston, IL, United States, [2]University of Chicago, Chicago, IL, United States
		BOLD, Diffusion and ASL MRI are useful in the evaluation of renal oxygenation, fibrosis and blood flow. In this study, these three functional MRI data were acquired in patients with diabetic nephropathy (DN) patients and stage-3 chronic kidney disease (CKD). For the first time, we report that the cortical blood flow and response to furosemide in renal medulla are significantly correlated with yearly rate of change in eGFR. These relationships were independent of any correlations observed with eGFR. The correlations with eGFR seem to depend on whether a control group was included.

4597	Computer 90	Preliminary study of evaluating Intrarenal Oxygenation in Iodinated Contrast-Induced Acute Kidney-Injured pig models by BOLD MRI

		Junjie Ren[1], Shengzhang Ji[1], Zhizheng Zhuo[2], and Chenjie An[1]
		[1]TianJin 4th Center Hospital, TianJin, China, [2]Philips Healthcare, Beijing, China
		Iodinated contrast agent (CA) is important for many radiologic and interventional procedures. However, contrast-induced acute kidney injury (CIAKI) is potentially life-threatening, especially for patients with impaired renal function, and it has become one of the leading causes of hospital-acquired acute kidney injury (AKI)[1] . The pathogenesis of CIAKI is not yet fully understood, but the relevance of renal medullary hypoxia in the pathophysiology of AKI is well accepted. In recent years, many studies focused on the change of intrarenal oxygenation and showed renal hypoxia especially in medulla. Blood oxygen level dependent magnetic resonance imaging (BOLD MRI) is a noninvasive method that can assess hypoxia by utilizing the endogenous contrast generated by paramagnetic deoxyhemoglobin[2] .

4598	Computer 91	Effect of orally administered aspirin on renal function in hypertensive rats
		Greg O. Cron[1,2,3], Rafael Glikstein[1,3], Jean-François Thibodeau[4], Anthony Carter[4], Naomi C. Boisvert[5], Chet E. Holterman[2], Lihua Zhu[2], and Chris Kennedy[5,6]
		[1]Radiology, University of Ottawa, Ottawa, ON, Canada, [2]Ottawa Hospital Research Institute (OHRI), Ottawa, ON, Canada, [3]Medical Imaging, The Ottawa Hospital, Ottawa, ON, Canada, [4]University of Ottawa, Ottawa, ON, Canada, [5]Cellular and Molecular Medicine, University of Ottawa, Ottawa, ON, Canada, [6]Medicine, Kidney Research Centre, The Ottawa Hospital, Ottawa, ON, Canada
		Although aspirin and other NSAIDs are commonly perceived as harmless, they may be dangerous for hypertensive patients. We recently showed that in hypertensive mice, genetic suppression of the renal vessel EP4 receptor (which mimics downstream effects of NSAIDs) leads to a massive reduction in renal perfusion. However, direct genetic manipulation of a drug end target is not the same thing as actually administering the drug. Thus, we repeated that study, this time giving aspirin instead of using genetic manipulation. Hypertensive rats that drank aspirin water suffered severe kidney damage and 2/5 died. For hypertensive patients, NSAIDs warrant extreme caution.

4599	Computer 92	Analysis of kidney function and therapy monitoring with DCE-MRI in a murine model of septic shock
		Claudia Weidensteiner[1], Wilfried Reichardt[1], Joachim Struck[2], Anne Kirchherr[3], Katja Wagner[4], Florian Wagner[4], and Dominik von Elverfeldt[1]
		[1]Dept. of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany, [2]AdrenoMed AG, Hennigsdorf, Germany, [3]nanoPET Pharma GmbH, Berlin, Germany, [4]Institute of Anesthesiological Pathophysiology and Process Engineering, University Hospital Ulm, Ulm, Germany

		DCE-MRI with a 3D spoiled gradient echo sequence and injection of Gd-DTPA was used to analyze the kidney function in mice during septic shock (cecal ligation and puncture CLP model). Gd concentration time courses were analyzed without pharmacokinetic modelling. In renal cortex and medulla of septic mice a slower exponential decay compared to baseline or even non-exponential curve shapes were observed. In most septic mice there was no Gd accumulation in the urine in the bladder. Treatment with an antibody targeting adrenomedullin (a vasodilatory peptide) resulted in a faster half-life of tracer elimination in the kidneys compared to vehicle-treatment.

4600	Computer 93	Assessment of Optimal Technique for Measurement of Medullary Perfusion
		Chris R Bradley[1,2], Charlotte E Buchanan[1], Eleanor F Cox[1,2], and Susan T Francis[1,2]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Nottingham Biomedical Research Centre, University of Nottingham, Nottingham, United Kingdom
		The ability to assess medullary perfusion is important in kidney disease, for example in acute kidney injury (AKI) in which reduced medullary blood flow is implicated. In this study, we compare the use of a spin echo (SE) EPI and balanced FFE (bFFE) readout at multiple post label delay (PLD) times to determine the optimal readout scheme and to assess the number of ASL pairs required to compute medullary perfusion. Using a bFFE FAIR ASL scheme, it is possible to quantify tissue perfusion within the renal medulla.

4601	Computer 94	T2WI Texture Analysis in Renal Cell Carcinoma: Histologic Subtype Classification
		Zhenhao Liu[1,2], Haiyi Wang[2], Xu Bai[2], Huiling Yi[3], and Huiyi Ye[2]
		[1]Affiliated Hospital of Changzhi Institute of Traditional Chinese Medicine, Changzhi, China, [2]Chinese PLA General Hospital, Beijing, China, [3]Qinhuangdao Municipal No.1 Hospital, Qinhuangdao, China
		This retrospective study investigates the possibility of distinguishing between clear cell renal cell carcinoma (ccRCC) and non-clear cell renal cell carcinoma (nccRCC) using MRI-derived parameters by exploring a predictive method. We enrolled the patients with three common subtypes of renal tumor - clear cell renal cell carcinoma (ccRCC), papillary renal cell carcinoma (pRCC) and chromophobic renal cell carcinoma (cRCC). We combined pRCC and cRCC into one subtype - nccRCC. Our results demonstrated that MRI texture analysis can differentiate ccRCC from nccRCC with high specificity, sensitivity and accuracy and can probably facilitate the precise treatment of renal tumors in the future clinical practice.

4602	Computer 95	A comparison of 7 and 3 Tesla time-of-flight renal MR angiography for detection of intrarenal vessels

		Emma Doran[1], Stephen Bawden[1], Christopher Mirfin[1], Paul Glover[1], Richard Bowtell[1], Penny A. Gowland[1], and Susan Francis[1]
		[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom
		Chronic Kidney Disease (CKD) is thought to be due to small artery disease at the cortico-medullary border, however these vessels are too small to be imaged at conventional field strengths. Here, we assess the feasibility of 2D gradient echo Time-of-flight (TOF) renal angiography at 7 T to detect the arterial vasculature of the kidney and delineate the intrarenal vasculature network. We compare TOF MRA data collected at 3 T and 7 T in the same subjects, and illustrate the superiority of 7 T for high spatial resolution MRA.

4603	Computer 96	Effects of anesthesia on renal function and metabolism in rats
		Haiyun Qi[1], Christian Østergaard Mariager[1], Jakob Lindhardt[1], Per Mose Nielsen[1], Hans Stødkilde-Jørgensen[1], and Christoffer Laustsen[1]
		[1]MR Research Centre, Department of Cinical Medicine, Aarhus University, Århus N, Denmark
		Performing MRI of animals typically requires anesthesia. However, anesthesia is known to modulate a wide variety of important metabolic and functional processes, and as such represents potential limitations in study design. Here we investigated renal functional and metabolic consequences of three typical rodent anesthetics of sevoflurane, inactin and a mixture of fentanyl, fluanisone and midazolam (FFM), with hyperpolarized [1-^{13}C] pyruvate MRI and DCE imaging. FFM increased renal lactate/pyruvate ratio and blood lactate concentration. Inactin and sevoflurane had reasonable renal metabolism and function. The results indicate inactin and sevoflurane are preferable when renal metabolism and function are the consideration of research.

Electronic Poster

Body DWI & Liver Tumour

Exhibition Hall	Wednesday 8:15 - 9:15

4604	Computer 97	Combined hepatocellular-cholangiocarcinoma: diagnostic and prognostic values of LI-RADS v2017 categorization on gadoxetic acid-enhanced MR imaging
		Sun Kyung Jeon[1], Ijin Joo[1], Dong Ho Lee[1], Sang Min Lee[2], Hyo Jin Kang[1], and Jeong Min Lee[1]

		[1]Seoul National University Hospital, Seoul, Republic of Korea, [2]Hallym University Sacred Heart Hospital, Anyang, Republic of Korea
		Our retrospective study investigated the utility of Liver Imaging Reporting and Data System (LI-RADS) v2017 for combined hepatocellular cholangiocarcinoma (cHCC-CCs) in the differential diagnosis from HCCs and prediction of prognosis. Using LI-RADS on gadoxetic acid-enhanced MRI, among cHCC-CCs (n=70), 61.4% (43/70) were accurately categorized as LR-M (probable malignancy, not specific for HCC) while 37.1% (26/70) as LR-5/4 (definitely/probably HCC); among HCCs (n=70), 88.6% (62/70) and 10.0% (7/70) were categorized as LR-5/4 and LR-M, respectively. After surgical resection, patients with LR-M cHCC-CCs showed a higher early recurrence rate (≤6 months) than those with LR-5/4 cHCC-CCs (27.8% (10/36) vs. 4.8% (1/21), *P*=0.041).

4605	Computer 98	Preoperative Prediction of Microvascular Invasion in Hepatocellular Carcinoma Using Radiomic Analysis of Diffusion-weighted MRI
		Xiangtian Zhao[1], Qiang Gao[1], and Jingliang Cheng[1]
		[1]MRI, the first affiliated hospital of zhengzhou university, zhengzhou,henan province, China
		Microvascular invasion (MVI) in hepatocellular carcinoma (HCC) is an independent predictor of poor outcomes subsequent to surgical resection or liver transplantation (LT); however, MVI currently cannot be reliably determined preoperatively. In this study, we investigated the association between radiomic features on preoperative ADC maps and the MVI (with or without) in resected 96 HCCs. Furthermore, we employed machine-learning methods and independently evaluated their prediction performance. Total 1029 radiomic features were extracted from cancerous VOIs on ADC maps of each patient. Finally, 7 features could differentiate HCCs with MVI versus HCCs without. The random forest classifier using the optimal feature subset achieved the best performance, with an area under the receiver operating characteristic curve 0.79, sensitivity 71.0%, specificity 85.0%, precision 73%, and recall 70%.

4606	Computer 99	MDCT outperforms gadoxetate-enhanced MRI in differentiating stroma-rich tumors from hepatocellular carcinomas developing in patients with chronic liver diseases
		Kengo Yoshimitsu[1]
		[1]Radiology, Fukuoka University, Fukuoka, Japan

		Consecutive 179 patients with chronic liver diseases who underwent gadoxetate enhanced-MRI and MDCT firstly developed hypervascular liver masses were retrospectively recruited, and 14 stroma-rich tumors (SRT), such as intrahepatic cholangiocellular carcinoma, and 165 hepatocellular carcinoma (HCC) were found. Using rim enhancement, and target sign on DWI, which were confirmed to favor SRT over HCC by multivariate analysis on gadoxetate-enhanced MRI, 71% sensitivity and 97% specificity were obtained, however, MDCT provided almost 100% accuracy when delayed or prolonged enhancement was considered signs suggesting SRT. For diagnosing SRT, MDCT outperforms gadoxetate-enhanced MRI.

4607	Computer 100	An automated lesion detection method on hepatic hemangioma and hepatic cyst using fully convoluted network
		Yajing Zhang[1], Mo Shen[1], Yin Guo[2], Huiyu Qiao[2], Qian Jiang[1], Sussi Wang[1], and Yi Yang[3]
		[1]Philips Healthcare (Suzhou) Co. Ltd., Suzhou, China, [2]Biomedical engineering, Tsinghua University, Beijing, China, [3]Radiology, second affiliated hospital of Soochow University, Suzhou, China
		Hepatic hemangioma and hepatic cyst are two kinds of common benign liver diseases. MR has been widely used for their diagnosis due to its significance of detection on small lesions. This study proposes a deep learning based method to detect the lesion of hemangioma and cyst on MR dynamic contrast-enhanced images. The results show good alignment of automated detection boundary with the actual lesion boundary for both lesion types.

4608	Computer 101	High Acceleration Three Dimensional T1-weighted Dual Echo Dixon Imaging using Compressed Sensing-SENSE: Comparison of Image Quality and Solid Lesion Detectability with the Standard T1-Weighted Sequence
		Ju Gang Nam[1], Jeong Min Lee[2], Sang Min Lee[3], Hyo-Jin Kang[2], Eun Sun Lee[4], Bo Yun Hur[5], Jeong Hee Yoon[2], EunJu Kim[6], and Mariya Doneva[7]
		[1]Seoul National University Hostpital, Seoul, Republic of Korea, [2]Seoul National University Hospital, Seoul, Republic of Korea, [3]Hallym University Sacred Heart Hospital, Gyeonggi-do, Republic of Korea, [4]Chung-Ang University Hospital, Seoul, Republic of Korea, [5]National Cancer Center, Gyeonggi-do, Republic of Korea, [6]Philips Healthcare Korea, Seoul, Republic of Korea, [7]Philips Research Hamburg, Hamburg, Germany

		A total of 163 consecutive patients underwent gadoxetic acid-enhanced liver MRI at 3T with two HBP protocols using the standard mDIxon-3D-GRE technique with sensitivity-encoding method (SENSE; acceleration factor (AF): 2.8, standard mDixon-GRE) and a high acceleration mDIxon-3D GRE technique using the combined compressed sensing (CS)-SENSE technique (CS-SENSE mDixon-GRE). The consensus reading revealed no significant difference in overall image quality. CS-SENSE mDixon-GRE showed higher image noise, but less motion artifact and overall artifact levels. In terms of lesion detection, reader-averaged JAFROC figures-of-merit showed non-inferior performance of CS-SENSE mDixon-GRE over standard mDixon-GRE was confirmed (JAFROC figure-of-merits difference: 0.064 [-0.012, 0.081])

4609	Computer 102	Diagnostic Accuracy of Liver Imaging Reporting and Data System 2017 (LIRADS) Criteria for Hepatocellular Carcinoma
		Andrea Siobhan Kierans [1], Jasnit S. Makkar[2], Joshua Cornman-Homonoff[1], Preethi Guniganti[1], and Elizabeth M Hecht[2]
		[1]Radiology, Well Cornell Medical Center, New york, NY, United States, [2]Columbia university medical center, New york, NY, United States
		The aim of our investigation is to assess the diagnostic accuracy of the LI-RADS 2017 criteria at two institutions using multiple readers with varying levels of experience with explant or imaging follow-up as the reference standard. Radiology databases from two academic institutions were searched (2013-2014) for patients with a clinical diagnosis of chronic liver disease and at least one reported hepatic observation on dynamic contrast enhanced CT or MRI. This yielded a final cohort of 103 patients with 141 hepatic observations. Two radiologists reviewed the imaging independently and assigned a LI-RADs category to each observation. Inter-reader reliability for LI-RAD assessment was moderate (ICC = 0.63). Sensitivity of LI-RADs categorization for diagnosing HCC was 62% and 59% and specificity was 96% and 84% for reader 1 and 2 respectively. LI-RADs categorization using gadoxetate disodium MR demonstrated higher specificity for HCC diagnosis for reader 2, than MR with extracellular agent.

4610	Computer 103	Changes in HCC tumor stiffness post 90Yttrium radioembolization assessed with MR elastography: Early results.
		Paul Kennedy[1,2], Sara Lewis[1,2], Octavia Bane[1,2], Stefanie Hectors[1,2], Maxwell Segall[1], Edward Kim[2], and Bachir Taouli[1,2]
		[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States, [2]Department of Radiology, Icahn School of Medicine at Mount Sinai Hospital, New York, NY, United States

		The goal of the current study was to assess the changes in hepatocellular carcinoma (HCC) stiffness using 2D MR elastography (MRE) at baseline and 6 weeks after ^{90}Yttrium radioembolization (RE). Preliminary results are presented in 10 patients and show that HCC stiffness and liver stiffness adjacent to the treated lesion are both significantly increased 6w after therapy. Percentage change in tumor stiffness is significantly correlated with degree of tumor necrosis at 6w.

4611	Computer 104	Diffusion Kurtosis Imaging for Assessing the Therapeutic Response of Transcatheter Arterial Chemoembolization in Hepatocellular Carcinoma
		Zhenguo Yuan[1], Mengying Xia[1], and Weibo Chen[2]
		[1]Shandong Medical Imaging Research Institute, School of Medicine, Shandong University, Jinan, China, [2]Philips Healthcare, Shanghai, China
		Hepatocellular carcinoma (HCC) is one of the major causes of morbidity and mortality in patients with chronic liver disease. Transcatheter arterial chemoembolization (TACE) play an important role in treatment for HCC. Evaluation of the response to TACE treatment affects not only the therapeutic efficacy but also the treatment plan. Data from 43 patients with hepatic cancer between January 2017 and September 2017 were recruited for this study. Magnetic resonance imaging (MRI) and DKI (b=0, 800, 1500, 2000 mm^2/s) were performed before and 3 weeks after initiating TACE. Contrast-enhanced MRI was performed 3 months and 6 months after initiating TACE. We observed a significant decrease in MK in HCC tissues that were completely necrotic after TACE. The MK value can reflect the complexity of tissue structure. A lower MK value indicates evidence of necrosis, implying more stable lesions and hence better treatment outcomes. Therefore, the differences in MK values observed in our study reflected the differences in tissue microstructural complexity between the progressing and non-progressing groups. The change of MK values before and after TACE can thus be used to estimate the degree of tumor necrosis and to further evaluate the effect of interventional therapy.

4612	Computer 105	Contrast-enhanced MR Imaging 3D texture analyses as a potential tool for preoperative prediction of microvascular invasion in hepatocellular carcinoma: Comparison with postoperative pathology
		Yongjian Zhu[1], Xiaohong Ma[1], Xinming Zhao[1], Bing Feng[1], and Lizhi Xie[2]
		[1]Department Of Imaging Diagnosis, National Cancer Center / Cancer Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China, [2]GE healthcare, China, Beijing, China

		Microvascular invasion (MVI) is a significant risk factor contributing to high recurrence ratio and poor prognosis of hepatocellular carcinoma (HCC). Therefore, it is of great clinical significance to accurately predict MVI of HCC preoperatively. Texture analyses (TA) is a novel image post-processing technique, which analyze the distribution and associations of pixel intensities in images with a series of quantitative texture parameters. However, there was limited report on applying TA on MVI of HCC . The purpose of this study was to explore the value of contrast enhanced MRI texture analyses in the preoperative prediction of MVI of HCC preoperative.

4613	Computer 106	Using deep learning to investigate the value of diffusion weighted images for malignancy characterization of hepatocellular carcinoma
		Wu Zhou[1], Qiyao Wang[2], Changhong Liang[3], Hairong Zheng[2], and Lijuan Zhang[2]
		[1]School of Medical Information Engineering, Guangzhou University of Chinese Medicine, Guangzhou, China, [2]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [3]Department of Radiology, Guangdong General Hospital, Guangdong Academy of Medical Sciences, Shenzhen, China
		The apparent diffusion coefficient (ADC) derived from Diffusion-weighted imaging (DWI) has been widely used for lesion characterization. However, ADC is calculated from image intensities with different b values, which is a low-level image feature that might be insufficient to represent heterogeneous of neoplasm. Furthermore, ADC measurements are subject to the influence of motion and image artifacts. The deep feature based on the emerging deep learning technique has been considered to be superior to traditional low-level features. The purpose of this study is to effectively characterize the malignancy of HCC based on deep feature derived from DWI data using deep learning.

4614	Computer 107	Discriminative deep feature fusion of Contrast-enhanced MR for malignancy characterization of hepatocellular carcinoma
		Wu Zhou[1], Tianyou Dou[1], Miaoyun Zhangwen[1], Hui Ye[1], Dong Cao[1], Honglai Zhang[1], Changhong Liang[2], Hairong Zheng[3], and Lijuan Zhang[3]
		[1]School of Medical Information Engineering, Guangzhou University of Chinese Medicine, Guangzhou, China, [2]Department of Radiology, Guangdong General Hospital, Guangdong Academy of Medical Sciences, Guangzhou, China, [3]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China

		The malignancy of hepatocellular carcinoma (HCC) is of great significance to prognosis. Recently, deep feature in the arterial phase of Contrast-enhanced MR has been shown to be superior to texture features for malignancy characterization of HCCs. However, only arterial phase was used for deep feature extraction, ignoring the impact of other phases in Contrast-enhanced MR for malignancy characterization. In this work, we design a discriminative multimodal deep feature fusion framework to both extract correlation and separation of deep features between Contrast-enhanced MR images for malignancy characterization of HCC, which outperforms the simply concatenation and the recently proposed deep correlation model.

4615	Computer 108	Late gadolinium MRI hyperintensity of colorectal liver metastases with extracellular contrast agents (gadobutrol) versus intravascular contrast agents (gadofosveset)
		Helen Cheung[1], Natalie Coburn[2], Paul J Karanicolas[2], Calvin Law[2], John M Hudson[1], and Laurent Milot[1]
		[1]Department of Medical Imaging, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada, [2]Department of Surgery, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada
		Late gadolinium hyperintensity (LGH) of colorectal liver metastases (CRCLM) using MRI with extracellular contrast agents presents a diagnostic dilemma that is commonly encountered clinically because it can be difficult to distinguish from benign hemangiomas. CRCLM may demonstrate less LGH using MRI with intravascular contrast agents due to reduced retention of contrast within these lesions. Approximately half of CRCLM demonstrate LGH on MRI with extracellular contrast agents versus only 6% on MRI with intravascular contrast agents. LGH is significantly better at excluding malignancy in patients with intravascular agents compared with extracellular contrast agents and may be a clinically useful problem-solving tool.

4616	Computer 109	High-b Fast Advanced Spin Echo Diffusion-Weighted Imaging in the Abdomen
		Takeshi Yoshikawa[1], Katsusuke Kyotani[2], Yoshiharu Ohno[1], Yoshimori Kassai[3], Masao Yui[3], Eiji Takeda[2], Shinichiro Seki[1], and Yuji Kishida[4]
		[1]Advanced Biomedical Imaging Research Center, Kobe University Graduate School of Medicine, Kobe, Japan, [2]Center of Radiology and Radiation Oncology, Kobe University Hospital, Kobe, Japan, [3]Toshiba Medical Systems Co., Otawara, Kazakhstan, [4]Radiology, Kobe University Graduate School of Medicine, Kobe, Japan
		High-b FASE-DWI can improve image quality and decrease image distortion without hampering abdominal lesion detection and ADC measurement.

4617	Computer 110	Multiband SENSE accelerated diffusion weighted imaging of the abdomen with CAIPIRINHA: Preliminary study on clinical applicability
		Yi Wang[1,2], Tyson Nunn[3], Noah Briller[2], Carolyn Wang[2,3], and Sooah Kim[2,3]
		[1]Philips Healthcare, Gainesville, FL, United States, [2]Radiology, University of Washington, Seattle, WA, United States, [3]Radiology, Seattle Cancer Care Alliance, Seattle, WA, United States
		DWI is rapidly becoming a modality of choice to detect, characterize and monitor malignant lesions. Although diffusion imaging has benefited greatly from multiband imaging in the brain, investigation on abdomen DWI using MB has been limited. The purpose of this study was to examine the feasibility of MB-SENSE for abdominal DWI. The study demonstrated that MB-SENSE can be used to accelerate abdominal DWI with drastically reduced acquisition time (~50%) without having a significant impact on image quality. Though, refinement of the MB-SENSE free-breathing single-shot EPI sequence is necessary to ascertain the clinical value of MB-SENSE in DWI for the abdomen.

4618	Computer 111	Comparison of Referenceless Methods for EPI Ghost Correction in Breast Diffusion Weighted Imaging
		Jessica A McKay[1], Steen Moeller[2], Lei Zhang[3], Edward J Auerbach[2], Michael T Nelson[2], and Patrick J Bolan[2]
		[1]Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States, [2]Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [3]Clinical and Translational Science Institute, University of Minnesota, Minneapolis, MN, United States
		Three-line navigator correction of Nyquist ghosts in spin-echo echo-planar imaging (SE-EPI) diffusion weighted imaging (DWI) often fails in body imaging. Several alternative strategies have been proposed including *referenceless methods*, which do not require any type of reference information but instead minimize a cost function based on the data itself. The purpose of this work is to assess ghost correction of undersampled (R=3) breast DWI using several referenceless methods, including minimization of SVD in k-space, image entropy, a ghost/object ratio of the image, and a combination. All four referenceless strategies outperform the standard navigator correction, providing higher quality images and unbiased ADC maps.

4619	Computer 112	Repeatability of Apparent Diffusion Coefficient measurements using Simultaneous Multi-slice Diffusion-Weighted imaging with elastic in-plane motion correction: a Comparison with Conventional DWI in Healthy Liver Parenchyma
		Jia Xu[1], Xuan Wang[1], Tianyi Qian[2], Shitian Wang[1], Huadan Xue[1], and Zhengyu Jin[1]
		[1]Department of Radiology, Peking Union Medical College Hospital, Beijing, China, [2]Siemens Healthcare, MR Collaboration NE Asia, Beijing, China

		The simultaneous multi-slice (SMS) technique allows reducing the scan time of DWI without significant compromises in image quality. An adequate test-retest reliability of apparent diffusion coefficient (ADC) is essential for clinical use. The aim of this study was to prospectively compare the ADC value and test-retest repeatability of SMS-DWI with elastic in-plane motion correction in comparison to conventional DWI in healthy liver parenchyma. SMS-DWI and motion corrected SMS-DWI images (Moco-SMS) demonstrated significantly higher ADC values than conventional DWI in almost all liver regions. Moco-SMS showed significantly higher test-retest repeatability than conventional DWI in regions close to liver edges.

4620	Computer 113	CNN based Super-Resolution of Intravoxel Incoherent Motion Imaging for Liver
		Jiqing Huang[1], Jin Qin[1], Lihui Wang[1], Rongpin Wang[2], Zi-Xiang Kuai[3], Chen Ye[1], Tianye Wang[1], and Yuemin Zhu[4]
		[1]Key Laboratory of Intelligent Medical Image Analysis and Precise Diagnosis of Guizhou Province, School of Com-pute Science and Technology, Guizhou University, Guiyang, China, [2]Department of Radiology, Guizhou Provincial People's Hospital, Guiyang, China, [3]Harbin Medical University Cancer Hospital, Harbin, China, [4]Univ.Lyon, INSA-Lyon, Université Claude Bernard Lyon 1, UJM-Saint Etienne, CNRS, Inserm, CREATIS UMR 5220, U1206, F-69621, LYON, France
		We investigated the super-resolution reconstruction method for IVIM imaging based on convolution neural networks (CNN). Three-layers-CNN was constructed and trained firstly with a series of paired low- and high-resolution images, and then the super-resolution IVIM images were reconstructed with such network, the reconstruction quality was evaluated finally in terms of PSNR, SSIM, diffusivity, perfusion fraction and pseudo-diffusivity respectively. The results show that the CNN-based super resolution reconstruction for IVIM has a great performance and may enable IVIM to be analyzed with unprecedent resolution.

4621	Computer 114	Comparison of Slice-specific Shim and Volume Shim for 1.5T Whole-body Diffusion Weighted Imaging
		Sarah McElroy[1], Jessica M Winfield[1], Radhouene Neji[2], Alto Stemmer[3], Kiefer Berthold[3], Joanna Bell[1], John Spence[1], Geoff Charles-Edwards[1,4], Olwen Westerland[1], and Vicky Goh[1,4]
		[1]Guy's and St Thomas' Hospital, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare, Frimley, United Kingdom, [3]MR Application Predevelopment, Siemens Healthcare, Erlangen, Germany, [4]Division of Imaging Sciences, King's College London, London, United Kingdom
		This study compared whole body diffusion weighted MR imaging (WB-DWI) acquired on a 1.5T scanner with and without integrated slice-specific shimming with retrospective distortion correction (iShim) for evaluation of monoclonal plasma cell disorders. WB-DWI with iShim showed significant reduction of the spinal displacement artefact and increased signal in the sternum.

4622	Computer 115	Toward quantification of renal tubular volume fraction using diffusion-weighted split-echo RARE in conjunction with a three-compartment IVIM model Joao Periquito[1], Katharina Paul[1], Till Huelnhagen[1], Yiyi Ji[1], Min-Chi Ku[1], Sarah Brix[2], Kathleen Cantow[2], Erdmann Seeliger[2], Bert Flemming[2], Thomas Gladytz[3], Dirk Grosenick[3], Andreas Pohlmann[1], and Thoralf Niendorf[1,4] *[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrueck Center for Molecular Medicine, Berlin, Germany, [2]Institute for Vegetative Physiology, Charité – University Medicine Berlin, Berlin, Germany, [3]Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany, [4]Experimental and Clinical Research Center (ECRC), a joint cooperation between the Charité Medical Faculty and the Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany* T_2* mapping does not fully represent renal tissue oxygenation. Diffusion-weighted imaging (DWI) can provide information about confounding factors such as tubular volume fraction, which can be used to correct T_2*. By using a three compartment IVIM model, tubular volume fraction can be mapped with DWI. The most widely used DWI technique is spin-echo EPI which is sensitive to magnetic field inhomogeneities and hence prone to geometric distortions. In this work we propose a diffusion-weighted Rapid Acquisition Relaxation Enhancement (RARE) variant for DWI of the rat kidney free of geometric distortions to quantify tubular volume fraction at 9.4 Tesla.

4623	Computer 116	Robustness of diffusion-prepared 3D TSE for isotropic-resolution large-FOV coronal DWI of neurogenic tumors in cervical and pelvic regions Barbara Cervantes[1], Alexandra Gersing[1], Benedikt Schwaiger[1], Andreas Hock[2], Johannes M. Peeters[3], Carolin Knebel[4], Klaus Wörtler[1], and Dimitrios Karampinos[1] *[1]Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Philips Healthcare, Hamburg, Germany, [3]Philips MR Clinical Science, Best, Netherlands, [4]Orthopaedic Surgery, Technical University of Munich, Munich, Germany* DWI of musculoskeletal tumors has been proposed as a non-invasive tool of potential valuable diagnostic utility. Large-FOV isotropic-resolution DWI can provide improved visualization of MSK tumors but deems particularly challenging for conventionally used DW-EPI in terms of geometric distortions and chemical-shift artifacts. 3D DW-TSE techniques can alleviate these challenges and have been shown to be useful in DWI of different body regions. The present work examines the robustness to distortions and artifacts of 3D DW-TSE in isotropic-resolution large-FOV coronal DWI of neurogenic tumors in two anatomical regions where DW-EPI is highly prone to distortion artifacts.

4624	Computer 117	Variable-TE STIR computed Diffusion Weighted Imaging Technique for the abdomen Hiroshi Kusahara[1], Yuki Takai[1], and Yoshimori Kassai[1]

		[1]MRI Systems Development Department, Toshiba Medical Systems Corporation, Tochigi, Japan
		In this study to the authors adapted the variable-TE cDWI (vTE-cDWI) technique to the abdominal region, using ADC map, T2 map and T1 map with IR-based images. The algorithm under evaluation allows computing diffusion images for arbitrary combinations of TE, b-value and TI based on four acquisitions (4-points method). This technique was shown to generate STIR-cDWI with higher SNR compared to the acquired STIR-DWI, as well as obtain ADC maps and T1 maps with optimal TI for any arbitrary tissue. The clinical benefits of the method and the preliminary results on volunteers are discussed.

4625	Computer 118	Computed DWI for breast cancer detection: improved fat suppression and lesion-to-background contrast with a novel low ADC pixel cut-off technique
		Toshiki Kazama[1], Taro Takahara[2], Tetsu Niwa[3], Jun Endo[1], Hiroshi Yamamuro[1], Tatsuya Sekiguchi[1], Jun Hashimoto[1], Thomas Kwee[4], and Yutaka Imai[1]
		[1]Diagnostic Radiology, Tokai University School of Medicine, Isehara, Japan, [2]Tokai University, Hiratsuka, Japan, [3]Tokai University School of Medicine, Isehara, Japan, [4]University Medical Center Utrecht, Utrecht, Netherlands
		When we calculate very high b-value images using computed diffusion-weighted imaging (cDWI), a tremendous number of bright pixels (noise) appears on the images and they disturb the visualization of lesions. Bright noise on high b-value images may be suppressed by cutting off pixels with very low ADC values. Because the ADC of fat is very low, unsuppressed fat signal can be deleted using the same technique. With appropriate use of the low ADC pixel cut-off technique on cDWI, diagnostic performance of cDWI of the breast may be improved.

4626	Computer 119	Prediction of treatment response based on baseline volumetric functional MR imaging criteria in patients with unresectable HCC who are candidate for Trans-Arterial Chemoembolization.
		Mounes Aliyari Ghasabeh[1], Ankur Pandey[2], Sanaz Ameli[2], Pallavi Pandey[2], pegah Khoshpouri[3], Yan luo[3], Farnaz Najmi varzaneh[4], Manijeh Zargham pour[3], and Ihab R. Kamel[3]
		[1]John Hopkins Hospital, Baltimore, MD, United States, [2]Johns Hopkins Hospital, Baltimore, MD, United States, [3]Johns Hopkins Hospital, baltimore, MD, United States, [4]johns Hopkins Hospital, Baltimore, MD, United States

		Synopsis: Predicting overall survival in HCC patients before initiating treatment is essential to personalize a treatment plan for each patient. Barcelona clinic liver cancer (BCLC) is one of the current criteria for predicting pre-therapeutic overall survival (OS). Several studies suggested a valuable role of functional MRI biomarkers including diffusion-weighted imaging (DWI) with apparent diffusion coefficients (ADC), tumor venous enhancement (VE) and tumor volume (TV) in tumor response assessment. These metrics rely on changes post therapy; none of these parameters assessed baseline values of these variables in predicting OS before starting treatment.

4627	Computer 120	Magnetic resonance imaging features of parenchymal mass with tumor in vein in patients with cirrhosis
		Saya Igarashi[1], Adrija Mamidipalli[1], Carolina Constantino[2], Atsushi Higaki[1], Mohanad Alhumayed[1], Jonathan Hooker[1], Chul Park[1], and Claude B. Sirlin[1]
		[1]Liver Imaging Group, Radiology, San Diego, CA, United States, [2]Dimagem Diagnostico por Imagem, Rio de Janeiro, Brazil
		The purpose of this study is to determine in cirrhotic patients the proportion of MRI-diagnosed TIV cases with parenchymal masses, the proportion of cases due to HCC or non-HCC malignancy, and whether assessment of the parenchymal mass allows differentiation of the malignancy type. All TIV cases had parenchymal masses. Using a composite reference standard and excluding tumors with no reference standard, the underlying malignancy was HCC in 91% (41/45), ICC in 4% (2/45), and H-ChC in 4% (2/45). LI-RADS categorization of the parenchymal mass may help identify patients in whom TIV is not due to HCC. In particular, patients with TIV and LR-M parenchymal masses may need biopsy to exclude non-HCC malignancy.

Electronic Poster

fMRI: Physiology

Exhibition Hall	Wednesday 9:15 - 10:15

4628	Computer 1	Age-modulated changes in cerebrovascular reactivity after a single bout of exercise in young adults
		Jessica J. Steventon[1], Catherine Foster[2], Daniel Helme[3], and Kevin Murphy[1]
		[1]School of Physics and Astronomy, Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff University, Cardiff, United Kingdom, [2]School of Psychology, Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff University, Cardiff, United Kingdom, [3]Cardiff and Vale University Health Board, Cardiff, United Kingdom

		Exercise is a potent trigger for both neurogenesis and vascular plasticity yet the underlying temporal dynamics are not known. We aimed to test whether a single 20-minute bout of aerobic exercise was sufficient to induce changes in cerebrovascular reactivity (CVR) to carbon dioxide in young healthy adults using a dual-echo pulsed ASL sequence with a hypercapnia challenge. We show that age modulates the change in CVR following exercise, and strongly predicts baseline CVR, independent of resting physiology and fitness. Our findings motivate the further exploration of the role of age in exercise-induced vascular plasticity.

4629	Computer 2	Investigation of the relationship between grey matter volume and cerebrovascular reactivity in aging
		Claudine Joëlle Gauthier[1], Dalia Sabra[2], Brittany Intzandt[3], Arno Villringer[4], Richard D. Hoge[5], and Christopher J. Steele[5]
		[1]Physics, Concordia University, Montreal, QC, Canada, [2]Université de Montréal, Montreal, QC, Canada, [3]Concordia University, Montreal, QC, Canada, [4]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [5]McGill University, Montreal, QC, Canada
		Cerebrovascular reactivity (CVR) is decreased in aging and disease, and is thought to reflect vascular health in the brain. Here, we explore the relationship between grey matter volume (GMV) and CVR in healthy younger and older adults. Results show that this relationship is more complex than previously thought, with a positive relationship between CVR and GMV when GMV is low, but a negative relationship at high GMVs both in younger and older adults. Future analyses will explore the role of cerebral blood flow in this relationship.

4630	Computer 3	Physiology of CO2 and neurovascular coupling: the impact of cerebrovascular reserve on Blood-Oxygenation-Level-Dependent functional MRI measurements
		Marco Piccirelli[1], Christiaan van Niftrik[2], Oliver Bozinov[2], Nicolai Maldaner[2], Catherine Strittmatter[2], Athina Pangalu[1], Antonios Valavanis[1], Luca Regli[2], and Jorn Fierstra[2]
		[1]Neuroradiology, University Hospital Zurich, Zurich, Switzerland, [2]Neurosurgery, University Hospital Zurich, Zurich, Switzerland
		We investigate the effect of a general resting state of 40mmHg CO2 as compared to a physiological resting state on BOLD fMRI cerebrovascular reactivity and task based finger-tapping measurements in healthy subjects. We found that BOLD CVR and fMRI activation are significantly lower when measured at a set ‘‘isocapnic’’ baseline then at the physiological resting CO2. Our second finding is that fMRI signal changes significantly correlates to CVR and both measurements are similarly affected.

4631	Computer 4	Contribution of Systemic Vascular Effects on White Matter BOLD fMRI Signal Pinar S Özbay[1], Catie Chang[1], Dante Picchioni[1], Hendrik Mandelkow[1], Thomas Moehlman[1], Miranda Chappel-Farley[1], Peter van Gelderen[1], Jacco A de Zwart[1], and Jeff H Duyn[1] *[1]Advanced MRI Section, LFMI, NINDS, National Institutes of Health, Bethesda, MD, United States* To probe a potential physiological mechanism behind reported BOLD fMRI signals in white matter (WM), we compared pulse-oximetry signals measured from finger-tip photo-plethysmography (PPG) with fMRI signals recorded simultaneously during an overnight sleep study. Intermittent amplitude (AMP) drops were observed during which WM signal increased and grey matter signal decreased. These findings point to a systemic vascular contribution to WM fMRI signals, driven by AMP drops, and possibly linked to fluctuations in arousal state.

4632	Computer 5	Spin Echo measurement of oxygen BOLD reactivity - A simple method for mapping functional capillary blood volume? Michael Germuska[1] and Richard Wise[1] *[1]Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom* A simple non-invasive method is presented for the mapping of functional cerebral capillary blood volume. Functional capillary blood volume is a potentially powerful biomarker that is highly correlated with the average rate of glucose metabolism in the tissue. In-vivo maps of capillary blood volume are shown to be highly correlated with resting CBF in healthy volunteers and can be easily acquired within a few minutes with standard MR imaging sequences.

4633	Computer 6	Differences in BOLD temporal behavior in the cortical and subcortical structures of the visual and somatosensory systems Daniil P. Aksenov[1], Michael J. Miller[1], Limin Li[1], and Alice M. Wyrwicz[1] *[1]NorthShore University HealthSystem, Evanston, IL, United States* The temporal behavior of the BOLD response can vary considerably between nodes within sensory circuits as well as across different modalities. Understanding the nature of these variations could provide more information about the factors that shape the hemodynamic response. In this work fMRI data were acquired from both thalamic and cortical regions of the visual and somatosensory systems during prolonged sensory stimulation. Our findings show that while the thalamic BOLD responses for both circuits were quite similar, the cortical responses showed different adaptive behavior, which may reflect underlying regional differences in the contributions of local excitatory/inhibitory processes.

4634	Computer 7	Brain or cardiovascular oscillation: ultra-slow oscillations under 0.01 Hz detected by resting-state fMRI Patricia Pais Roldán[1,2], Brian Edlow[3], Johannes Stelzer[1], Yuanyuan Jiang[1], and Xin Yu[1] *[1]Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Graduate Training Centre of Neuroscience, Tübingen, Germany, [3]Massachusetts General Hospital, Boston, MA, United States* A high amplitude slow wave component of frequency 0.005 to 0.012 Hz was observed in multiple resting state fMRI scans of the rat brain under different anesthetics. These ultra-slow waves were localized predominantly in the hypothalamus. We hypothesize that these ultra-slow oscillations might have a neurological origin and may contribute to the analysis of resting state connectivity, which is currently limited to frequencies above 0.01 Hz . Future studies should investigate the origin of these oscillations with an independent measure (e.g. calcium imaging) and the implications of their incorporation into the analysis of rs-fMRI.

4635	Computer 8	The interaction between neural and autonomic correlates of stress: a pilot study measuring simultaneous heart rate variability and BOLD fMRI Ariane T Orosz[1] and Andrea Federspiel[1] *[1]Translational Research Center, University Hospital of Psychiatry and Psychotherapy, Bern, Switzerland* Stress has been associated with autonomic arousal as well as functional alterations in frontal and limbic regions which are important in the regulation of autonomic activity. Latter can be indexed by heart rate variability (HRV). In the present pilot study simultaneous BOLD fMRI and HRV were measured during the performance of a stress test. In three healthy subjects stress, relaxation and paced breathing were associated with frontal and limbic activation. More subjects need to be measured in order to strengthen the results and to integrate them as neural markers in an integrative and multilevel model of stress.

4636	Computer 9	Hemodynamic modeling of laminar resolution fMRI Kamil Uludag[1] and Martin Havlicek[1] *[1]Maastricht University, Maastricht, Netherlands*

		Neuronal laminar information reflected in high-resolution fMRI is reduced due to ascending veins, carrying hemodynamic changes from various cortical depths to surface draining veins. Here, we propose an invertible generative hemodynamic model, which takes the effect of ascending veins to the laminar-specific fMRI signal explicitly into account. We illustrate the versatility of this novel model to characterize common experimental observations in laminar fMRI: we show that the spatial increase of laminar fMRI towards CSF is due to baseline blood volume. In contrast, a peak in the middle layer is due to higher neuronal activity rather than higher baseline blood volume.

4637	Computer 10	Optimization of breath hold cerebrovascular reactivity mapping (BH CVR) at ultra-high field through temporal correction of the hemodynamic response function
		Shruti Agarwal[1], Jun Hua[2,3], Haris I. Sair[1], Sachin K. Gujar[1], Hanzhang Lu[2,3], and Jay J. Pillai[1,4]
		[1]Division of Neuroradiology, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Division of MR Research, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]F. M. Kirby Research Center For Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [4]Department of Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States
		Cerebrovascular reactivity (CVR) provides clinical insight into vascular health and is useful for identifying cortical regions affected by neurovascular uncoupling (NVU). BOLD imaging using breath-hold (BH) tasks can be effectively used for CVR mapping. At 7T, spatial specificity can be improved relative to standard 3T imaging, but optimization of CVR maps is often problematic. We propose temporal correction of the theoretical hemodynamic response function (HRF) to account for subject-wise temporal adjustment of the average respiration-induced hemodynamic response to a BH task to optimize 7T BH CVR maps in cases of poor patient task compliance.

4638	Computer 11	Optimization of motor fMRI activation in the setting of brain tumors via temporal resampling applied to the canonical HRF
		Shruti Agarwal[1], Jun Hua[2,3], Haris I. Sair[1], Sachin K. Gujar[1], Scott Faro[1], Hanzhang Lu[2,3], and Jay J. Pillai[1,4]
		[1]Division of Neuroradiology, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Division of MR Research, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]F. M. Kirby Research Center For Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [4]Department of Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States

		BOLD fMRI, which is an indirect measure of neuronal activity, involves several seconds offset in both initiation and cessation of the microvascular response with respect to actual timing of neural activity. In this study, we propose resampling of the canonical hemodynamic response function (HRF) to account for subject-wise temporal variability in BOLD responses in task paradigms. We demonstrate that temporal resampling of the canonical HRF may allow recapturing of lost signals in motor task activation maps (task fMRI). Further, it can also mitigate the effects of neurovascular uncoupling (NVU) in the sensorimotor network in patients with perirolandic gliomas.

4639	Computer 12	Demonstration of brain tumor-induced neurovascular uncoupling within the language network at ultra-high field
		Shruti Agarwal[1], Jun Hua[2,3], Haris I. Sair[1], Hanzhang Lu[2,3], and Jay J. Pillai[1,4]
		[1]Division of Neuroradiology, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Division of MR Research, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]F. M. Kirby Research Center For Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [4]Department of Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States
		False-negative activations caused by neurovascular uncoupling (NVU) can lead to erroneous interpretation of clinical BOLD fMRI examinations. At 7T, spatial specificity can be improved relative to clinical 3T imaging. In this study, we demonstrate that NVU within the language network may affect the resting-state (rsfMRI) frequency domain metric ALFF (amplitude of low-frequency fluctuation) and breathhold cerebrovascular reactivity (BH CVR) maps as evident in the criterion standard task fMRI at ultra-high field despite known substantial BOLD signal-to-noise ratio advantages provided by higher field strength, which may not fully mitigate the effects of such NVU.

4640	Computer 13	Resting state default-mode network functional connectivity correlates with Glutamate +Glutamine/Creatine ratio of the medial prefrontal cortex in methamphetamine males : An fMRI-MRS study
		Qiuxia Wu[1], Chang Qi[1], Yanhui Liao[1], Jingsong Tang[1], We Hao[1], and Tieqiao Liu[1]
		[1]Mental Health Institute of the Second Xiangya Hospital, Central South University, Changsha, China
		This study investigates the functional connectivity (FC) of medial prefrontal cortex (mPFC) within default mode network (DMN) and the ratio of Glutamate+Glutamine/Creatine (Glx/Cr) in male methamphetamine-dependent subjects (MADs). We combined functional magnetic resonance imaging and magnetic resonance spectroscopy to investigate the altered FC and its relation with ratio of Glx/Cr in 54 male MADs and 52 healthy male controls. We found increased FC of mPFC with left posterior cingulate cortex and the ratio of Glx/Cr and their negative relation in male MADs. Our results may help with investigation of MADs pathophysiology.

4641	Computer 14	Brain states govern resting state functional connectivity dynamics Felipe Aedo Jury[1], Lara Hamzehpour[1], and Albrecht Stroh[1] *[1]Institute of Microscopic Anatomy and Neurobiology, Mainz University, Mainz, Germany* A key aspect governing spatio-temporal activity patterns in fMRI is the brain state, particularly in animals being imaged mostly during sedation or anesthesia. Two main brain states have been recently identified in rodents[1], a persistent state similar to awake conditions, and a slow wave state characterized by spontaneous slow oscillation-associated slow wave activity. We analyzed the brain functional connectivity using spontaneous BOLD recordings in rats during these different states. We found that both states lead to differential functional connectivity patterns that can be clearly dissociated. These results are crucial for interpreting rodent studies in the framework of translational resting state research.

4642	Computer 15	Simultaneous acquisition of CBV, CBF and BOLD signals induced by visual stimulations of 1, 4 and 8 Hz under normoxia and hypoxia conditions Yaoyu Zhang[1,2], Yayan Yin[1,3], Bing Wu[1,4], Yang Fan[4], and Jia-Hong Gao[1,3] *[1]Center for MRI Research, Peking University, Beijing, China, [2]Peking-Tsinghua Center for Life Sciences, Peking University, Beijing, China, [3]Beijing City Key Lab for Medical Physics and Engineering, Peking University, Beijing, China, [4]MR Research China, GE Healthcare, Beijing, China* A simultaneous acquisition of VASO, ASL and BOLD signals was employed to measure relative functional changes induced by a block-designed, black-and-white checkerboard visual task containing three stimulus frequencies and two oxygen-level conditions. We report that 1) δCBV, δCBF and δBOLD increase along with visual stimulus frequencies for both oxygen-level conditions; 2) δBOLD, but not δCBV or δCBF, acquired under hypoxia condition is significantly lower than that acquired under normoxia condition for all the three stimulus frequencies. According to Fick's principle, our results predict increases of oxygen consumption rate among various stimulus frequencies during hypoxia.

4643	Computer 16	Probing the Signal Physiology of Resting-State fMRI at High Frequencies using Hypocapnia Abraham Dominguez Hernandez[1], Arpad Zolyomi[2], Arvind Caprihan[3], Kishore Vakamudi[4], Stephen R Dager[5], and Stefan Posse[4] *[1]Neurology, University of New Mexico, Albuquerque, NM, United States, [2]Anesthesiology, University of New Mexico, Albuquerque, NM, United States, [3]The Mind Research Network, Albuquerque, NM, United States, [4]Neurology, Physics and Astronomy, University of New Mexico, Albuquerque, NM, United States, [5]Radiology, University of Washington, Seattle, WA, United States*

		We investigate the dependence of high frequency signal changes on decreases in global blood flow using hyperventilation induced hypocapnia, which substantially alter the amplitude and time course of the hemodynamic response function (HRF) with only minor changes in neural activation levels. We also investigate the sensitivity of multi-band-EPI and a prototype ultra-high-speed multi-band-EVI (MB-EVI) sequence for detecting high frequency correlations. In the first subject, an increase in high frequency correlations during hypocapnia was detected in MB-EPI and MB-EVI. These studies suggest that high frequency signals changes may be mediated by vascular physiology, but movement related artifacts cannot be excluded.

4644	Computer 17	3D Pseudocontinuous Arterial Spin-Labeling Perfusion Imaging Detected Crossed Cerebellar Daschisis at Acute, Subacute and Chronic Intracerebral Hemorrhage
		Liang Yin[1], Ying Zhu[1], and Jiangxi Xiao[1]
		[1]Radiology, Peking University First Hospital, Beijing, China
		Crossed cerebellar diaschisis (CCD) is the phenomenon of a decreased cerebellar perfusion and glucose metabolism in the cerebellar hemisphere contralateral to a supratentorial cerebral lesion. Although mostly seen in cerebral infarct, CCD has been reported in other clinical conditions such as intracerebral hemorrhage. Recently findings suggested that CCD is not just a neuroradiological phenomenon, arterial spin-labeling (ASL) is a novel noninvasive MRI method that uses arterial water as an endogenous tracer for perfusion imaging. The purpose of this study were to evaluate the value of 3D pCASL to detect CCD in different stage of ICH and to identify the relevant imaging or clinical factors of CCD development.

4645	Computer 18	Caffeine enhances BOLD response to electrical whisker pad stimulation in rats
		Shao-Chieh Chiu[1], Chiun-Wei Huang[1], and Shin-Lei Peng[2]
		[1]Center for Advanced Molecular Imaging and Translation, Chang Gung Memorial Hospital, Taoyuan, Taiwan, [2]Department of Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan
		The effects of caffeine on BOLD responses are still controversial. The potential explanation to this discrepancy may be associated with different dietary caffeine consumption among subjects. Here, we test the effect of caffeine on BOLD responses by using the caffeine-naïve animals. By reducing the baseline cerebral blood flow and therefore increasing the baseline deoxygenation concentration, caffeine significantly enhanced the magnitude of BOLD responses to the electrical whisker pad stimulation. These findings may suggest that caffeine-naïve animals could be a potential model to shed more light on effects of caffeine on BOLD fMRI measurements.

4646	Computer 19	Enhancement of the Negative BOLD Response with DANTE-EPI Linqing Li[1], Yuhui Chai[1], Andy Derbyshire[1], Karla Miller[2], Peter Jezzard[2], and Peter Bandettini[1] *[1]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States, [2]Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom* We derived and verified an equation for the theoretical description of longitudinal magnetization for pass- and transition-band bSSFP at steady state. In addition, we show evidence that a DANTE (b-SSFP) preparation module may be employed with an EPI readout to increase negative BOLD response by 12.8% in average ($p<0.03$) compared to conventional EPI (GE-EPI).

4647	Computer 20	The vascular fingerprint of non-balanced BOLD SSFP coherence pathways: gradient echoes show spin echo behavior Klaus Scheffler[1,2], Mario Gilberto Báez-Yánez[1], and Gabriele Lohmann[1,2] *[1]MPI for biological Cybernetics, Tuebingen, Germany, [2]Biomedical Magnetic Resonance, University of Tuebingen, Tuebingen, Germany* The S2-SSFP echo (the echo before the RF pulse in non-balanced SSFP sequences, or F^-_0, PSIF, CE-FAST, T2-FFE) is a refocused echo and has thus been proposed for BOLD imaging to suppress larger vessels, similar to the classical spin echo. Here we demonstrate in Monte Carlo simulations that the primary S1-SSFP gradient echo shows nearly identical properties as the S2-SSFP echo. Both echoes of this non-balanced SSFP sequence can be used for BOLD imaging exhibiting a pure spin echo behavior, i.e suppression of larger vessels.

4648	Computer 21	Infrequent auditory stimuli elicit BOLD signals of shorter duration Jo-Fu Lotus Lin[1], Yi-Ting Lin[1], Juan Silva-Pereyra[2], and Fa-Hsuan Lin[1,3] *[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [2]Facultad de Estudios Superiores Iztacala (FES-I), Universidad Nacional Autónoma de México, Mexico City, Mexico, [3]Department of Neuroscience and Biomedical Engineering, Aalto University, Espoo, Finland* To characterize the hemodynamic responses of mismatch negativity, we measured BOLD signals elicited by frequent and infrequent sequences of sounds using fast fMRI acquisitions with 0.1 s precision. The average temporal width of the hemodynamic responses was 4.2 s in the superior temporal areas. The width of hemodynamic responses was significantly wider in the standard (4.9 s +/- 1.1 s) than the deviant trials (3.6 s +/- 1.7 s).

4649	Computer 22	Vascular Origins of “Anti-correlations” in Resting-State fMRI Mahdi Khajehim[1] and J. Jean Chen[1,2] *[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Rotman Research Institute, Baycrest, Toronto, ON, Canada* Several explanations for the existence of anti-correlations in rsfMRI have been suggested so far, ranging from true neural activity to a side effect of preprocessing. In this abstract, we investigate the possible vascular origins of anti-correlation by presenting a biophysical model that is inspired by past simulation studies. Our model suggests resting-state BOLD anti-correlations across voxels may arise simply from the physiological and magnetic properties of arterial and venous blood, and may not be solely due to anti-correlated neural activity.

4650	Computer 23	Vascular Origins of the Negative BOLD fMRI Response Mahdi Khajehim[1] and J. Jean Chen[1,2] *[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Rotman Research Institute, Baycrest, Toronto, ON, Canada* While the origin of negative BOLD response in fMRI has been debated, we present an explanatory biophysical model that accounts for imaging and physiological parameters, including vascular-orientation, CBV change, TR, TE, inflow and even different oxygenation levels in arterial and venous compartments. This model shows that it is possible for negative BOLD to arise from both arterial and venous sources even in the presence of neural-activity increase. This abstract suggests part of the negative BOLD response originates simply from the vascular origin of the signal.

4651	Computer 24	Activating glucose transporter 2 positive neurons stimulates cerebral blood flow Hongxia Lei[1,2], Gwenaël Labouèbe [3], and Bernard Thorens[3] *[1]École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]University of Geneva, Geneva, Switzerland, [3]Center for Integrative Genomics, University of Lasuanne, Lasuanne, Switzerland* Glucose transporter 2 (Glut2)-positive cells are sparsely distributed in brain and play an important role in the stimulation of glucagon secretion in response to hypoglycemia. The effect on CBF of optogenetic activation of hypoglycemia responsive Glut2-positive neurons of the paraventricular thalamic area was measured in mice expressing channelrhodopsin2 under the control of the Glut2 promoter. Optogenetic activation of Glut2-positive neurons in the paraventricular thalamic nucleus induced a local CBF change similar in magnitude to the effect of hypoglycemia. Thus, our data indicate that brain Glut2-positive neurons are key regulators of hypoglycemia-induced activation of CBF.

Electronic Poster

Basic Neuroscience (Connectivity)

Exhibition Hall	Wednesday 9:15 - 10:15

4652	Computer 25	Optogenetically-initiated low frequency dorsal hippocampal activity enhances resting-state fMRI connectivity and visual memory retrieval performance
		Russell W. Chan[1,2,3], Eddie C. Wong[1,2], Alex T. L. Leong[1,2], Xunda Wang[1,2], Celia M. Dong[1,2], Karim E. Hallaoui[1,2], Lee W. Lim[4], and Ed X. Wu[1,2]
		[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China, [3]Neurology and Neurological Sciences, Stanford University, Stanford, CA, United States, [4]School of Biomedical Sciences, The University of Hong Kong, Hong Kong, China
		Our recent study demonstrated that low frequency optogenetically-initiated hippocampal activities enhances brain-wide resting-state fMRI connectivity. However, the behavioral consequence of such connectivity enhancement remains unknown. Since hippocampus is known to play a prominent role in memory, we assessed the effects of such connectivity enhancement on short-term and long-term memory. Our experimental results demonstrated that, while low frequency dorsal hippocampus stimulation enhanced interhemispheric fMRI connectivity (in hippocampus, V1, A1 and S1), it also improved the long-term visual memory by enhancing memory retrieval (in contrast to memory encoding) performance.

4653	Computer 26	Left and right temporal lobe epilepsies with mesial temporal sclerosis reveal distinct alterations in the intrinsic effective connectivity within the Papez circuit
		Yao-Chia Shih[1,2], Fa-Hsuan Lin[1], Horng-Huei Liou[3,4], and Wen-Yih Isaac Tseng[2,4,5,6]
		[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [2]Institute of Medical Device and Imaging, College of Medicine, National Taiwan University, Taipei, Taiwan, [3]Department of Neurology, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan, [4]Graduate Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, Taipei, Taiwan, [5]Department of Medical Imaging, National Taiwan University Hospital and College of Medicine, Taipei, Taiwan, [6]Molecular Imaging Center, National Taiwan University, Taipei, Taiwan

		The present resting-state fMRI study performed structural equation modeling to evaluate intrinsic effective connectivity (iEC) within the Papez circuit in patients with unilateral temporal lobe epilepsy with mesial temporal sclerosis (TLE-MTS). Left TLE-MTS is characterized by decreased iEC on the left frontotemporal path, which might be associated with deficits in executive functions and working memory. Right TLE-MTS is characterized by decreased iEC on the paths in the right posterior limbic regions, which might be associated with deficits in autobiographical memory processing. Our findings might facilitate identifying potential epileptic network pathways and developing novel targeted therapies for unilateral TLE-MTS.

4654	Computer 27	Tract-specific footprint of functional interhemispheric connectivity in the brain
		Jeroen Mollink[1,2], Saad Jbabdi[2], Michiel Kleinnijenhuis[2], Fidel Alfaro-Almagro[2], Anne-Marie van Cappellen van Walsum[1], Stephen M Smith[2], and Karla L Miller[2]
		[1]Donders Institute for Brain, Cognition and Behaviour, Department of Anatomy, Radboud University Medical Centre, Nijmegen, Netherlands, [2]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom
		Linking the anatomy of neuronal connections to brain function is fundamental to our understanding of how brain architecture underpins human cognition. In this work, we hypothesized that the microstructural features of a white matter pathway relate to functional connectivity between the brain regions it connects. In a large cohort of subjects from UK Biobank, we demonstrate that the functional connectivity of homotopic brain regions from the two hemispheres can be predicted from the microstructure of the tract that connects them.

4655	Computer 28	Serotonin transporter occupancy predicts default-mode network connectivity: a SPECT and rsfMRI study
		Anouk Schrantee[1,2,3], Paul J Lucassen[3], Jan Booij[1], and Liesbeth Reneman[1]
		[1]Department of Radiology and Nuclear Medicine, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands, [2]Spinoza Centre for Neuroimaging, Royal Netherlands Academy of Arts and Sciences (KNAW), Amsterdam, Netherlands, [3]Swammerdam Institute for Life Sciences, Center for Neurosciences, University of Amsterdam, Amsterdam, Netherlands
		The serotonergic neurotransmitter system is thought to play a substantial role in modulating the default mode network (DMN). For example, antidepressants (SSRIs) have consistently shown to decrease DMN connectivity. However, it is unclear whether SSRIs also dose-dependently affect DMN connectivity. Therefore, we investigated the association between SERT occupancy by SSRIs (SPECT) and DMN functional connectivity (rs-fMRI). We confirm a dose-dependent effect of SSRIs on connectivity with the DMN; higher SERT occupancy by the SSRI in the thalamus was significantly associated with decreased DMN connectivity. This suggests that DMN connectivity might be interesting biomarker, e.g. for treatment monitoring.

4656	Computer 29	Frequency preference and tuning width dependent intrinsic functional connectivity within and across cortical depths in the human auditory cortex Pu-Yeh Wu[1], Ying-Hua Chu[1], Jo-Fu Lotus Lin[1], Shang-Yueh Tsai[2], Wen-Jui Kuo[3], and Fa-Hsuan Lin[1,4] *[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [2]Institute of Applied Physics, National Chengchi University, Taipei, Taiwan, [3]Institute of Neuroscience, National Yang Ming University, Taipei, Taiwan, [4]Department of Neuroscience and Biomedical Engineering, Aalto University, Espoo, Finland* This study revealed the frequency preference as well as tuning width dependent intrinsic functional connectivity (iFC) within and across cortical depths in the human auditory cortex. We demonstrated that both the within-depth and cross-depth feature dependent iFC have a higher selectivity in the core than noncore region as we moved from superficial to deep cortical depths. We also found that the selectivity of cross-depth feature dependent iFC decreases when two cortical depths were farther away from each other. Taken together, our findings provide the direct evidence of a cortical depth specific feature dependent iFC in the human auditory cortex.

4657	Computer 30	Longitudinal Study Functional Reorganization within Resting-state Brain Networks in Subcortical Infarction Stroke Patients Caihong Wang[1], Peifang Miao[1], Yafei Guo[1], Dandan Zheng[2], and Jingliang Cheng[1] *[1]Department of MRI, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China, [2]GE Healthcare MR Research China, Beijing, China* In order to identify dynamic evolution model of functional reorganization in stroke patients during recovery process based on the large-scale brain network, eleven meaningful RSNs derived from resting-state data across four consecutive time points within six months in subcortical infarction stroke patients and healthy controls groups were identified using independent component analysis. The results revealed that stroke patients exhibited significantly dynamic functional connectivity changes in the right superior parietal lobule of the dorsal attention network and the cuneus of medial visual networks. Note that functional connectivity to some meaningful brain networks demonstrated consistent alterations over time. The findings may reflect the adaptive reorganization of the functional network in stroke patients.

4658	Computer 31	Comparison of Spatial Profiles of Activation and Resting State fMRI Signals Across Cortical Depth Arabinda Mishra[1], Feng Wang[1], John C Gore[1], and Li Min Chen[1] *[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States*

		FMRI at high spatial resolution is capable of resolving signals from different cortical layers providing the ability to examine local inter-layer information processing. In this study, we quantified the spatial profiles of BOLD fMRI activations and the point spread functions (PSF) of resting state correlations within layers. We found significantly broader extent of stimulus-evoked activity and resting state correlation profiles in the top layer than those in middle and lower layers. These differences may reflect differences in vasculature or neural activity between the layers.

4659	Computer 32	Assessing the functional connectivity of hippocampal subfields in healthy controls and TLE: a resting state fMRI study at 7T
		Lisanne PW Canjels[1,2], Walter Backes[1,2], Tamar M van Veenendaal[1], Rob PW Rouhl[2,3,4], Marielle CG Vlooswijk[2,3,4], Albert P Aldenkamp[3,4,5], and Jacobus FA Jansen[1,2]
		[1]Department of Radiology and Nuclear Medicine, Maastricht University Medical Center, Maastricht, Netherlands, [2]School for Mental Health and Neuroscience, Maastricht University, Maastricht, Netherlands, [3]Department of Neurology, Maastricht University Medical Center, Maastricht, Netherlands, [4]Epilepsy Center Kempenhaeghe, Heeze, Netherlands, [5]Faculty of Electrical Engineering, University of Technology Eindhoven, Eindhoven, Netherlands
		It has been suggested that hippocampal subfields show functional specialization. Resting-state functional MRI studies have improved our understanding of brain function. Using rs-fMRI, we examined the possibility of segmenting the hippocampal subfields at 7T and assessed the functional correlations between the hippocampal subfields with other cortical regions. This method was tested in both healthy controls and temporal lobe epilepsy patients. Only small differences in functional connectivity between healthy controls and epilepsy patients were found. This study demonstrated the potential of assessing the resting-state functional connectivity of the hippocampal subfields with other regions of interest in the cortex.

4660	Computer 33	Resting State fcMRI Reveals Distinc Connectivity Patterns for Core-Belt-Parabelt Subfields of Human Auditory Cortex
		Michael Amann[1,2], Julia Reinhardt[2], Jan Benner[2,3], Elke Hofmann[4], Peter Schneider[3,5], Christoph Stippich[2], and Maria Blatow[2]
		[1]Medical Image Analysis Center (MIAC), Basel, Switzerland, [2]Department of Radiology, University Hospital of Basel, Basel, Switzerland, [3]Department of Neuroradiology, University of Heidelberg Medical School, Heidelberg, Germany, [4]School of Music, Music-Academy Basel, Basel, Switzerland, [5]Department of Neuroradiology, Section of Biomagnetism, University of Heidelberg Medical School, Heidelberg, Germany

		Converging evidence supports the hypothesis that human auditory cortex (AC) follows the core-belt-parabelt organization found in non-human primates. In the study presented here, we assessed the functional connectivity of the core (medial Heschl's gyrus, mHG), belt (posterior-lateral HG, plHG) and parabelt subfields (anterior-lateral HG, alHG and planum temporale, PT) by applying resting state functional connectivity MRI (fcMRI) on a cohort of 84 musicians. Assessing inter-hemispheric connectivity, we found significant differences between right and left plHG as well as in right and left PT. The contrast between the different subfields revealed highly differentiated neuronal networks, especially between mHG and plHG.

4661	Computer 34	Resting state DfMRI revealed alterations of brain activity and network in obsessive–compulsive disorder mouse model
		Yoshifumi Abe[1], Yuki Sakai[2], Hiroaki Hamada[3], Norio Takata[1], Yuichi Hiraoka[4], Tomomi Aida[4], Kohichi Tanaka[4], Kenji Doya[3], and Kenji Tanaka[1]
		[1]Departemnt of Neuropsychiatry, Keio University School of Medicine, Tokyo, Japan, [2]ATR Brain Information Communication Research Laboratory Group, Kyoto, Japan, [3]Neural Computation Unit and Biological Physics Theory unit, Okinawa Insititute of Science and Technology, Okinawa, Japan, [4]Department of Molecular Neuroscience, Medical Research Institute, Tokyo Medical and Dental University, Tokyo, Japan
		Diffusion fMRI (DfMRI) is a powerful functional imaging method to investigate neural activity and network without BOLD confounding hemodynamic effects. In this study, we applied DfMRI to evaluate brain activity and network of neuropsychiatric disease model, obsessive–compulsive disorder (OCD). Our DfMRI study revealed that the cortex was excited and the hippocampus was inhibited. Functional connectivity analysis of DfMRI detected alterations of cortico-striatal-thalamic networks, in line with the previous study with OCD patients. Additionally, we found that interesting network alterations of the hippocampal networks in this OCD model mice.

4662	Computer 35	Alterations in resting-state functional connectivity in patients with Crohn's disease in remission
		Jiancheng Hou[1], Rosaleena Mohanty[1], VEENA A NAIR[2], Poonam Beniwal-Patel[3], Vivek Prabhakaran[1,4,5], and Sumona Saha[3]
		[1]Radiology, UW-Madison, Madison, WI, United States, [2]RADIOLOGY, UW-MADISON, MADISON, WI, United States, [3]Medicine, UW-Madison, Madison, WI, United States, [4]Neurology, UW-Madison, Madison, WI, United States, [5]Neuroscience Training Program, UW-Madison, Madison, WI, United States

		Crohn's disease (CD) is a chronic inflammatory disorder that commonly affects the small intestine and is a phenotype of inflammatory bowel disease (IBD). Several studies have reported changes in cortical thickness and neurologic deficits in patients with IBD. Here we report alterations in resting state functional MRI connectivity in patients in CD in remission compared to healthy controls, specifically in the executive control and default mode networks. Alterations in resting state functional connectivity in patients with CD may explain some of the mechanisms underlying the development and progression of CD and associated deficits in cognitive and affective functioning.

4663	Computer 36	Effect of abstinent duration on brain function in heroin addicts: a resting-state fMRI study
		Xin Li[1], Qiang Li[1], Jiajie Chen[1], Wei Li[1], Yongbin Li[1], Jierong Liu[1], Xuan Wei[1], Xiaohuai Li[1], and Wei Wang[1]
		[1]Tangdu Hospital, Air Force Military Medical University, Xi'an, China
		Heroin addiction is increasingly severe in China. Protracted abstinence is commonly used in China. However the effect of protracted abstinence treatment on brain function of heroin dependent patients remains unclear. Previous studies have demonstrated that resting state functional connectivity and amplitude of low frequency fluctuation (ALFF)is useful for studying function of brain.Using the above methods, we found that that prolonged abstinent duration is conducive to function restoring of brain network in heroin-dependent patients, which may be useful to reduce the risk of relapse of heroin addicts.

4664	Computer 37	Modulation of Perfusion and Functional Connectivity by Intermittent Theta Burst Stimulation
		Marc Lindley[1], Mark Sundman[2], Chidi Ugonna[1], Nan-kuei Chen[1], and Ying-hui Chou[2]
		[1]Biomedical Engineering, University of Arizona, Tucson, AZ, United States, [2]Psychology, University of Arizona, Tucson, AZ, United States
		Transcranial magnetic stimulation produces a noninvasive stimulation that excites or inhibits regions of the brain. Theta burst stimulation(TBS), has been considered the most efficient protocol. The impact of TBS on brain perfusion and intrinsic functional connectivity networks of human brains has not been systematically evaluated. Perfusion values were measured with pCASL and resting state fMRI was performed to compare connectivity networks using seed based analysis and matrix based analysis. Perfusion was measured as increased after iTBS. Analysis of seed based data generated from the left dorsolateral prefrontal cortex showed connectivity network changes before and after TBS.

4665	Computer 38	Alteration of resting state functional connectivity following cocaine self-administration

		Sung-Ho Lee[1,2], Heather K Decot[1,2,3,4], Fei Fei Wang[5], Regina M. Carelli[5,6], Yen-Yu Ian Shih[1,2,3,6,7,8], and Garret D Stuber[3,4,6,8]
		[1]Neurology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [2]Biomedical Research Imaging Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [3]Curriculum in Neuroscience, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [4]Psychiatry, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [5]Psychology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [6]Neuroscience Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [7]Biomedical Engineering, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [8]Cell Biology and Physiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States
		We investigate the alteration of resting-state functional connectivity across the brain following self-administration of cocaine in the rat. The result of group-independent component analysis (ICA) and dual regression reveals that cocaine self-administration orchestrates dynamic shifts in co-activity and functional connectivity across resting-state neuronal networks and nodes, several of which that do not directly receive dopamine input.

4666	Computer 39	Disease Definition for Schizophrenia by Functional Connectivity using Radiomics Strategy
		Long-Biao Cui[1,2], Lin Liu[3], Yi-Bin Xi[1], Wei Qin[3], and Hong Yin[1]
		[1]Department of Radiology, Xijing Hospital, Fourth Military Medical University, Xi'an, China, [2]School of Medical Psychology, Fourth Military Medical University, Xi'an, China, [3]School of Life Sciences and Technology, Xidian University, Xi'an, China
		Specific biomarker reflecting its neurobiological substrates is required for diagnosis and treatment selection of schizophrenia (SZ). We aimed to develop and validate a method of disease definition for SZ by resting-state functional connectivity using radiomics strategy in two data sets. The accuracy was 87.09% for diagnosing SZ patients by applying functional connectivity features, with a validation in the independent replication data set (accuracy = 82.61%). Our findings demonstrate a valid radiomics approach by functional connectivity to diagnose SZ, which is helpful to facilitate objective SZ individualized diagnosis using quantitative and specific functional connectivity biomarker in different sites.

4667	Computer 40	Functional connectivity MRI in head-fixed awake mice differentiates acute and chronic neuroinflammation
		Esteban Adrian Oyarzabal[1], Carolyn Liu[2], Tzu-Wen Wang[1], and Yen-Yu Ian Shih[1]
		[1]Biomedical Research Imaging Center and Department of Neurology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [2]Biomedical Engineering, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

		Differentiating between acute and chronic neuroinflammation could improve clinical diagnoses of Alzheimer's disease, multiple sclerosis, and Parkinson's disease as well as disorders with no established clinical diagnostic methods such as Chronic Traumatic Encephalopathy and Chronic Fatigue Syndrom. This study implements mouse models of acute and chronic neuroinflammation to examine how neuroinflammation alter fcMRI in awake mice.

4668	Computer 41	Functional Connectivity changes during Real-time fMRI based Neuro-rehabilitation of post-stroke Aphasic Patients.
		Sujesh Sreedharan[1], Arun K. M.[1], Sylaja P. N.[2], Ranaganatha Sitaram[3], and Kesavadas C.[1]
		[1]Imaging Sciences and Interventional Radiology, SCTIMST, Trivandrum, India, [2]Neurology, SCTIMST, Trivandrum, India, [3]Department of Psychiatry and Division of Neuroscience, Pontificia Universidad Católica de Chile, Santiago, Chile
		Recovery from stroke to lead an improved life is one of the most sought after rehabilitation programs around the globe. Various factors are involved in the process of restoration of an impaired function. The study examined the functional network disruption due to stroke and the network changes happening during the real-time fMRI based neurofeedback training for aphasic stroke survivors to retrain the language areas. The results show that though the contralateral hemisphere for test group has strong connections when compared with controls, and with training the ipsilateral connections are strengthened and are recovering through alternate connections.

4669	Computer 42	Increased functional connectivity in the SOD1(G93A) animal model of Amyotrophic Lateral Sclerosis: a rs-fMRI study at 4.7T
		Pietro Bontempi[1], Rachele Podda[2], Alice Busato[1], Roberta Bonafede[2], Ilaria Scambi[2], Raffaella Mariotti[2], and Pasquina Marzola[1]
		[1]Department of Computer Science, University of Verona, Verona, Italy, [2]Department of Neurosciences, Biomedicine and Movement science, University of Verona, Verona, Italy
		To date fMRI studies on Amyotrophic Lateral Sclerosis (ALS) patients are still inconsistent. Here, we performed a rs-fMRI study on a pre-clinical model of ALS with the aim to identify biomarkers at functional level, defining an experimental platform useful for the evaluation of disease progression and therapies development. rs-fMRI was performed in SOD1(G93A) and WT mice using a 4.7T tomograph and an EPI sequence. Our results showed increased functional connectivity in SOD1(G93A) mice at the end-stage of disease. In this work, we defined a functional testbed for ALS animal model and demonstrated the feasibility of rs-fMRI in mice at 4.7T.

4670	Computer 43	BRAIN FUNCTIONAL CHANGES CORRELATE WITH COGNITIVE DYSFUNCTION IN FRIEDREICH'S ATAXIA: AN RS-fMRI STUDY
		Sirio Cocozza[1], Teresa Costabile[2], Enrico Tedeschi[1], Filomena Abate[2], Camilla Russo[1], Agnese Liguori[2], Walter Del Vecchio[3], Francesca Paciello[2], Mario Quarantelli[3], Alessandro Filla[2], Francesco Saccà[2], and Arturo Brunetti[1]
		[1]Department of Advanced Biomedical Sciences, University of Naples "Federico II", Naples, Italy, [2]University of Naples "Federico II", Naples, Italy, [3]Institute of Biostructure and Bioimaging, National Research Council, Naples, Italy
		We performed a seed-based Resting-State fMRI analysis in Friedreich's Ataxia (FRDA) patients to assess possible brain functional connectivity (FC) changes in these patients, which are know to be charactherized by an impairment of neuropsychological functions. We found an increased FC in FRDA patients compared to controls in different brain regions, including the medial frontal gryrus, the angular gyri and cingulate gyrus, with a decreased cerebellar FC. Our findings of diffuse alterations of FC in FRDA patients compared to controls may shed new light on the pattern of supratentorial and infratentorial involvement and on dynamics of brain plasticity in this condition.

4671	Computer 44	PRAGMATIC ABILITIES IN MULTIPLE SCLEROSIS PATIENTS: AN RS-fMRI STUDY
		Sirio Cocozza[1], Antonio Carotenuto[2], Mario Quarantelli[3], Giorgio Arcara[4], Vincenzo Brescia Morra[2], Enrico Tedeschi[1], Giuseppe Orefice[2], Valentina Bambini[5], Rosa Iodice[2], and Arturo Brunetti[1]
		[1]Department of Advanced Biomedical Sciences, University of Naples "Federico II", Naples, Italy, [2]University of Naples "Federico II", Naples, Italy, [3]Institute of Biostructure and Bioimaging, National Research Council, Naples, Italy, [4]Scuola Universitaria Superiore IUSS, Pavia, Italy, [5]5. IRCCS Fondazione Ospedale San Camillo, Venice, Italy
		Multiple Sclerosis (MS) patients could experience communicative deficits in "pragmatics", which is the ability to integrate context-dependent aspects of meaning beyond structural components of language. We evaluated relationships between pragmatics and functional connectivity (FC) of the bilateral inferior parietal lobule (the so-called Geschwind's areas -GA-), in MS patients via a seed-based Resting-State fMRI analysis. We found a direct correlation between pragmatic scores and FC of both right ($p=0.003$) and left ($p=0.009$) GAs with the paracingulate cortex. Our results suggest that language is not only a left hemisphere function, and highlight a possible central role of paracingulate cortex in pragmatics.

4672	Computer 45	Functional brain abnormalities in major depressive disorder: evidence from a Chinese multi-site resting-state functional MRI study
		Mingrui Xia[1,2,3], Tianmei Si[4], Xiaoyi Sun[1,2,3], Qing Ma[1,2,3], Bangshan Liu[5], Li Wang[4], Jie Meng[6,7], Miao Chang[8], Xiaoqi Huang[9], Ziqi Chen[9], Yanqing Tang[8], Ke Xu[10], Qiyong Gong[9], Fei Wang[8], Jiang Qiu[6,7], Peng Xie[11,12,13], Lingjiang Li[5], and Yong He[1,2,3]

		[1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [2]Beijing Key Laboratory of Brain Imaging and Connectomics, Beijing Normal University, Beijing, China, [3]IDG/McGovern Institute for Brain Research, Beijing Normal University, Beijing, China, [4]National Clinical Research Center for Mental Disorders & Key Laboratory of Mental Health, Ministry of Health, Peking University the Sixth Hospital, Beijing, China, [5]Mental Health Institute, Second Xiangya Hospital of Central South University, Changsha, China, [6]Department of Psychology, Southwest University, Chongqing, China, [7]Key Laboratory of Cognition and Personality, Ministry of Education, Southwest University, Chongqing, China, [8]Department of Psychiatry, The First Affiliated Hospital of China Medical University, Shenyang, China, [9]Huaxi MR Research Center (HMRRC), Department of Radiolog, West China Hospital, Sichuan University, Sichuan, China, [10]Department of Radiology, The First Affiliated Hospital of China Medical University, Shenyang, China, [11]Institute of Neuroscience, Chongqing Medical University, Chongqing, China, [12]Chongqing Key Laboratory of Neurobiology, Chongqing, China, [13]The First Affiliated Hospital of Chongqing Medical University, Department of Neurology, China
		MDD is characterized by disturbances in mood and cognitive functions; however, the pathophysiological mechanism of MDD is incompletely understood. Using the largest resting-state fMRI MDD dataset in China with 1,434 participants, we revealed significant lower functional coordination in the orbitofrontal and primary sensorimotor and visual cortices and higher coordination in the lateral/medial frontoparietal cortices in MDD. These abnormalities were not affected by medication status but were partially influenced by episode number and onset age in patients. These findings provide solid evidence for functional brain disturbances and crucial insights into neuroimaging-based methods for early diagnosis and therapeutic optimization in MDD.

4673	Computer 46	COMT Val158Met polymorphism modulated the relationship between functional connectivity in prefrontal cortex and working memory performance
		Sichu Wu[1], Zhao Qing[1], Jiaming Lu[1], Yi Sun[1], Ming Li[1], Weiping Li[1], Yingci Yan[1], Xue Liang[1], Junxia Wang[1], Bin Zhu[1], Xin Zhang[1], and Bing Zhang[1]
		[1]Department of Radiology, Drum Tower Hospital, Medical School of Nanjing University, Nanjing, China
		Compared with participants with COMT rs4680-GG, the healthy Han Chinese participants with rs4680-A-allele showed higher degree centrality and functional connectivity in medial prefrontal cortex in resting-state BOLD. The rs4680-A-allele carriers also performed better in 3-back performance than rs4680-GG carriers, and the accuracy of 3-back has significant correlation with functional connectivity value, which indicated that the COMT rs4680 mutation modulated the functional connectivity and working memory performance.

4674	Computer 47	Reorganization of Homotopic Functional Connectivity in two Profiles of High Potential Children: a resting-state fMRI and DTI Study
		Ilaria Suprano[1], Chantal Delon-Martin[2], Gabriel Kocevar[1], Claudio Stamile[1], Sophie Achard[3], Pierre Fourneret[4], Olivier Revol[5], Fanny Nusbaum[6,7], and Dominique Sappey-Marinier[1,8]

		[1]CREATIS, Université Claude Bernard Lyon1, Lyon, France, [2]Grenoble Institut des Neurosciences (GIN), Université Grenoble Alpe, Grenoble, France, [3]GIPSA-lab, Université Grenoble Alpe, Grenoble, France, [4]Service de Psychopathologie du Développement, Hopital Femme Mère Enfant, Hospices Civils de Lyon, Bron, France, [5]Service de psychopathologie du développement de l'enfant et de l'adolescent, Hôpital Neurologique, Hospices Civils de Lyon, Bron, France, [6]Laboratoire Parcours Santé Systémique (P2S), Université de Lyon, Lyon, France, [7]Centre PSYRENE, Lyon, France, [8]CERMEP - Imagerie du Vivant, Lyon, France
		Several changes were previously found in functional and structural networks of High Potential (HP) children but interhemispheric communication was not investigated. In this study, we studied the homotopic connectivity between pairs of left and right hemispheres regions in three groups of children with standard IQ, homogeneous and heterogeneous high IQ. Functional and structural connectivity were investigated using resting-state fMRI and DTI tractography, respectively, and graph theory for brain network analysis. Our findings showed a reorganization of functional homotopic connectivity involving precuneus, amygdala and frontal pole regions in HP children.

4675	Computer 48	Acute changes in blood glucose levels affect the resting state functional connectivity in mice
		Tomokazu Tsurugizawa[1], Boucif Djemai[1], Tangi Roussel[1], and Luisa Ciobanu[1]
		[1]NeuroSpin/CEA, Gif-sur-Yvette, France
		Dopaminergic network can be modified by the blood glucose levels. The medetomidine, which is commonly used anesthesia in functional MRI, increases the blood glucose levels. In the present study, we compared the functional connectivity in fasted or non-fasted mice under isoflurane or medetomidine anesthesia. The blood glucose levels in non-fasted mice under medetomidine anesthesia significantly increased but isoflurane did not. The correlation coefficients in the dopamine network were significantly higher in fasted mice compared with non-fasted mice under medetomidine, but not under isoflurane. These results indicate that medetomidine-induced blood glucose increase altered the functional connectivity in the dopaminergic network.

Electronic Poster

Body Imaging: GU (Non-Prostate) & Female Pelvis (Including Placenta)

Exhibition Hall	Wednesday 9:15 - 10:15

4676	Computer 49	Small (< 4 cm) Renal Masses：Differentiation of clear cell Renal Cell Carcinoma from non-clear cell Renal Cell Carcinoma Using Whole Tumor ADC Histogram Analysis at r-Fov DWI
		Haojie Li[1]

		[1]Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wu Han, China
		The combination of r-FOV DWI and the whole-lesion histogram analysis method may help in the interpretation of DWI of small renal masses and determine the optimal ADC parameter for quantitative assessment. The 75th percentile ADC value was more reliable than other histogram parameter values in distinguishing clear cell from non-clear cell RCCs with high sensitivity and specificity, potentially improving the accuracy of pretreatment diagnosis and selection of clinical therapy.

4677	Computer 50	Utility of 3D histogram analysis of pharmacokinetics parameters using DCE-MRI for differentiating renal clear cell carcinomas from renal harmatomas
		Yanping Miao[1], Yang Gao[1], Peng Cao[1], and Lizhi Xie[2]
		[1]Department of Radiology, he Affiliated Hospital of Inner Mongolia Medical University, Hohhot, China, [2]GE Healthcare, China, Beijing, China
		The aim of this study was to assess if the histogram analysis of DCE-MRIphamocokinetics parameters (Ktrans)can differentiate renal tumors: renal clear cell carcinomas (RCCs) and renal harmatoma with minimal fat. Based on an 3D entire-tumour measurement, the following histogram parameters of Ktrans were derived from histogram analysis, skewness, Energy, Entropy, Uniformity, quartile5, quartile50, Frequency size and kurtosis respectively. We concluded that frequency size was the most significant parameter for predicting renal clear cell carcinoma by analyzing these data，the other parameters had no diagnostic performance.

4678	Computer 51	The Diagnostic Accuracy of MR Imaging for Acute Pyelonephritis
		Amarpreet Bhowra[1], Iva Petkovska[2], Diego Martin[1], and Bobby Kalb[1]
		[1]Medical Imaging, University of Arizona, Tucson, AZ, United States, [2]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States
		MRI may offer a valuable alternative imaging method to diagnosing acute pyelonephritis without exposing patients to ionizing radiation or iodinated CT contrast. Our retrospective study evaluates the accuracy of 4 characteristic MRI findings in diagnosing acute pyelonephritis: (1) T2 hyperintense perinephric edema, (2) loss of corticomedullary differentiation on T2 images, (3) striated nephrogram on contrast-enhanced images, and (4) parenchymal restricted diffusion. Analysis of 108 MRI exams demonstrated that each of the 4 MRI findings was a significant predictor of pyelonephritis. Furthermore, assessing all 4 findings together provided a greater improvement in diagnostic accuracy when compared to any individual finding alone.

4679	Computer 52	Clinical utility of susceptibility-weighted MR sequence (SWAN) for the evaluation of uterine sarcomas Mayumi Takeuchi[1], Kenji Matsuzaki[2], and Masafumi Harada[1] *[1]Department of Radiology, Tokushima University, Tokushima, Japan, [2]Department of Radiological Technology, Tokushima Bunri University, Sanuki-city, Japan* Intra-tumoral hemorrhagic necrosis is one of the characteristic pathological finding of uterine sarcomas. High intensity hemorrhagic foci on T1WI may be suggestive finding, however, the prevalence is not high possibly because only methemoglobin could be detected. Signal voids on SWAN may reflect all phases of hemorrhage, especially both deoxyhemoglobin and hemosiderin and could be useful for the diagnosis. Surgically proven ten sarcomas and 22 benign leiomyomas were retrospectively evaluated. High intensity foci on T1WI were detected in four sarcomas (40%) and in none of leiomyomas, whereas signal voids on SWAN were detected in all sarcomas and in one leiomyoma (5%).

4680	Computer 53	Clinical feasibility of reduced field-of-view diffusion-weighted imaging for assessing the local extent of cervical cancer Mayumi Takeuchi[1], Kenji Matsuzaki[2], and Masafumi Harada[1] *[1]Department of Radiology, Tokushima University, Tokushima, Japan, [2]Department of Radiological Technology, Tokushima Bunri University, Sanuki-city, Japan* The diagnostic performance of reduced FOV DWI (rFOV-DWI) for assessing the local extent of surgically proven 24 cervical cancers was evaluated. The delineation of tumor margin on rFOV-DWI was assessed, and invasion to the vagina and parametrium evaluated on rFOV-DWI was compared with the histologically confirmed tumor extent. rFOV-DWI delineated the tumor margins better than T2WI and 3D DCE-MRI with statistically significance. Parametrial invasion and vaginal invasion as documented by rFOV-DWI agreed with the histopathological findings in 100% and 95% of cases, respectively.

4681	Computer 54	Developing and validating a multivariable prediction model to improve the diagnostic accuracy in determination of cervical vs. endometrial origin of uterine adenocarcinomas: A prospective MR study combining diffusion-weighted imaging and spectroscopy Gigin Lin[1], Yu-Chun Lin[1], Shang-Yueh Tsai[2], Yu-Ting Huang[1], and Chyong-Huey Lai[3] *[1]Medical Imaging and Intervention, Chang Gung Memorial Hospital, Linkou, Taiwan, [2]Graduate Institute of Applied Physics, National Chengchi University, Taipei, Taiwan, [3]Gynecology Oncology, Chang Gung Memorial Hospital, Linkou, Taiwan*

		We developed and validated an MDS score based on integrated morphological, volumetric DW MR imaging and spectroscopy which has incremental values and may be a useful clinical biomarker in distinguishing adenocarcinomas of cervical or endometrial origin.

4682	Computer 55	MR neurography of the female pelvis: mapping somatic and autonomic nerves and plexi
		Katja N De Paepe[1], David M Higgins[2], Iain Ball[3], Veronica A Morgan[4], and Nandita DeSouza[1]
		[1]Institute of Cancer Research, Sutton, United Kingdom, [2]Philips, Guildford, United Kingdom, [3]Philips, Sydney, Australia, [4]The Royal Marsden NHS Foundation Trust, Sutton, United Kingdom
		The visualization of somatic and autonomic female pelvic nerves using a modified NerveVIEW protocol was assessed in volunteers (n=5) and cervical cancer patients (n=7) by 2 independent observers. Image quality (as assessed by visualization of the tibial and fibular components of the sciatic nerve) was high in 75% of cases. 83% of pudendal, superior and inferior hypogastric nerves were well seen by observer1 and 72% by observer2. The superior hypogastric plexus (SHP) was more difficult to identify routinely. Neurography of the female pelvis allowed for confident identification of autonomic and somatic nerve plexi and has potential for pre-surgical planning.

4683	Computer 56	Intravoxel incoherent motion diffusion imaging for grading endometrial cancer
		Qi Zhang[1], Xiaoduo Yu[1], Han Ouyang[1], and Lizhi Xie[2]
		[1]Department of diagnostic radiology, National Cancer Center/Cancer Hospital, Chinese Academy of Medical Science and Peking Union Medical College, Beijing, Beijing, China, [2]GE Healthcare, China, Beijing, China
		Accurate grading of endometrial cancer (EC) is invaluable owing to its relationship with the aggressiveness, prognosis, recurrence as well as its impact on treatment stratification. The differentiation of tumor correlates with the tumor density, the nuclear-to-cytoplasm ratio and microcirculation, which can be quantitatively assessed by using ADC and IVIM parameters (such as D, D* and f). The ADC, D and f values showed good or fair inverse correlation with histological grade. Therefore, IVIM DWI is a valuable supplement to predict histological grade of EC preoperatively which could contribute to treatment planning and prognosis evaluation.

4684	Computer 57	Feasibility of Intravoxel Incoherent Motion (IVIM) Magnetic Resonance Imaging in Distinguishing Adenocarcinoma Originated from Uterine Corpus or Cervix
		Qi Zhang[1], Xiaoduo Yu[1], Han Ouyang[1], and Lizhi Xie[2]

		[1]Department of Imaging Diagnosis, National Cancer Center/Cancer Hospital, Chinese Academy of Medical Science and Peking Union Medical College,Beijing,China, Beijing, China, [2]GE Healthcare, China, Beijing, China
		It is critical to distinguish adenocarcinoma arising from uterine corpus or cervix due to their different treatment methods and prognosis. However, it is hard to make a definite diagnosis based on MRI morphological characteristics, clinical examination., even the biopsy in some cases. The tumor biological information can be quantitatively evaluated by ADC and IVIM parameters(such as D, D* and f). Our study showed that ADC, D and f were significantly lower in the endometrial adenocarcinoma than the cervical adenocancinoma. IVIM parameters are promising biomarkers in predicting tumor origin of the uterine adenocarcinoma which contribute to treatment planning and prognosis evaluation.

4685	Computer 58	Application of Intravoxel incoherent motion diffusion-weighted imaging in the assessment of local aggressiveness of endometrial cancer
		Qi Zhang[1], Xiaoduo Yu[1], Han Ouyang[1], and Dandan Zheng[2]
		[1]Department of Imaging Diagnosis, National Cancer/Cancer Hospital, Chinese Academy of Medical Sciences, Beijing, China, Beijing, China, [2]GE Healthcare, China, Beijing, China
		Local aggressiveness of endometrial cancer (EC) including the quantification of myometrial invasion, the exclusion of cervical stromal infiltration, lymphovascular space invasion (LVSI), etc, are closely related to EC risk classification, development, prognosis and surgical procedures. The ADC and IVIM-derived parameters can quantitatively assess tumor microstructure which is correlated to tumor development and aggressiveness. Our results showed that ADC and some of IVIM parameters demonstrated good diagnostic performance in the identification of deep myometrial invasion, cervical stromal infiltration and LVSI. IVIM DWI could provide valuable information about local aggressiveness of EC preoperatively which contribute to clinical decision-making and prognosis prediction.

4686	Computer 59	Texture analysis of multiparametric MRI: interobserver variability of texture features and associations with nodal status.
		Jose Angelo Udal Perucho[1], Elaine Yuen Phin Lee[1], Richard Du[1], Varut Vardhanabhuti[1], and Queenie Chan[2]
		[1]Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]Philips Healthcare, Hong Kong, Hong Kong

		Texture analysis of pre-treatment multiparametric MRI (mpMRI) consisting of diffusion-weighted MRI (DWI) and T2-weighted (T2W) texture features could be a promising and reproducible quantitative approach in assessing tumor heterogeneity in cervical cancer. We retrospectively studied forty treatment-naïve patients who had mpMRI examinations. We observed that around 30% of texture features had low interobserver variability, and that most of these features were from the Gray-Level Co-occurrence Matrix (GLCM) and Gray-Level Run Length Matrix (GLRLM). Furthermore, T2W features had moderate associations with pelvic lymph node (PLN) status.

4687	Computer 60	Diffusion kurtosis imaging for the diagnosis and prediction of response to treatment in high grade serous ovarian cancer
		Surrin Deen[1], Andrew N Priest[2], Mary A McLean[3], Andrew B Gill[2], Helena Earl[2], Christine Parkinson[2], Sarah Smith[2], Robin Crawford[2], John Latimer[2], Peter Baldwin[2], Helen Addley[2], Susan Freeman[2], Charlotte Hodgkin[2], Ilse Patterson[2], Mercedes Jimenez-Linan [2], James Brenton[2,3], and Ferdia Gallagher[1,2]
		[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]Addenbrooke's Hospital, Cambridge, United Kingdom, [3]Cancer Research UK, Cambridge, United Kingdom
		Diagnosis of high grade serous ovarian cancer (HGSOC) requires a biopsy which is both invasive and does not reflect the heterogeneity of the disease. Diffusion kurtosis imaging (DKI) was performed on 23 treatment naïve ovarian cancer patients. Both mean Dapp (apparent diffusion) and mean Kapp (apparent kurtosis) were found to be significantly different in HGSOC compared to other types of epithelial cancer. Kapp was also significantly greater in the patients who went on to respond to chemotherapy treatment compared to non-responders. DKI may therefore aid in identifying HGSOC and in the selection of the best treatment for individual patients.

4688	Computer 61	Combining 2d RF excitation with multishot acquisition for reduced distortion imaging of the female pelvis.
		Arnaud Guidon[1], Valentina Taviani[2], Holly Blahnik[3], Ann Shimakawa[2], Maggie M Fung[4], Nan-Kuei Chen[5], and Ersin Bayram[6]
		[1]Global MR Applications and Workflow, GE Healthcare, Boston, MA, United States, [2]Global MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [3]Clinical Development, GE Healthcare, Waukesha, WI, United States, [4]Global MR Applications and Workflow, GE Healthcare, New York, NY, United States, [5]Radiology Medical Research Lab, University of Arizona, Tucson, AZ, United States, [6]Global MR Applications and Workflow, GE Healthcare, Houston, TX, United States

		The combination of two-dimensional RF excitation with echo planar imaging has shown to be a useful technique for diffusion-weighted imaging of small anatomical features with high-resolution, such as in the pelvis or pancreas. However, compared to standard single shot dw-epi, the trade-off between resolution and matrix size becomes disadvantageous as the field of view increases. We propose to combine 2d RF excitation with multishot echo planar acquisition to enable high-resolution imaging with reduced distortion over larger FOV and present preliminary results obtained in the female pelvis.

4689	Computer 62	To explore the diagnostic value of Multi-parameter MRI in ovarian endometriosis
		Ye Li[1], Ailian Liu[1], Qingwei Song[1], and Lizhi Xie[2]
		[1]First Affiliated Hospital of Dalian Medical University, Dalian, China, [2]GE Healthcare, MR Research China, Beijing, China
		Endometriosis is a disease characterized by the invasion of active endometrial glands and stroma into any location other than the endometrium. Clinical symptoms of ovarian endometriosis include abdominal pain, irregular menstruation, abnormal vaginal bleeding, and a tendency to malignant transformation. In this study, T1WI, T2WI, diffusion weighted imaging (DWI) and enhanced T2 star weighted angiography (ESWAN) MR measurements were performed to evaluate the feasibility of them in diagnosing ovarian endometriosis cysts, and optimize the combination of the quantitative parameters of the above MRI sequences.

4690	Computer 63	Utility of histogram analysis of apparent diffusion coefficient maps in differential diagnosis of uterine sarcoma and degenerated uterine leiomyoma
		Mengna Huang[1] and Xuemei Gao[1]
		[1]The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China
		Histogram analysis of ADC values could provide more useful information than the mean ADC values and it has been proved to be valuable to evaluate tumor heterogeneity. We analyzed histogram features of ADC maps of uterine sarcoma and degenerated uterine leiomyoma. From our study, histogram analysis of ADC values has a high diagnostic efficiency in differential diagnosis of uterine sarcoma and degenerated uterine leiomyoma.

4691	Computer 64	Investigation of correlation between IVIM and DCE-MRI on uterine cervical carcinoma
		Xiaoduo Yu[1], Meng Lin[1], Yue Kong[2], and Lizhi xie[3]

		[1]National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China, [2]GE Healthcare Life Science, Beijing, China, [3]GE Healthcare, MR Research China, Beijing, China
		Perfusion was of great importance to access tumor properties. In this study, the potential correlations of perfusion parameters derived from IVIM (D*, f, and f D*) and DCE-MRI (K^{trans}, K_{ep} and V_e) for uterine cervical carcinoma (UCC) were investigated and were compared between pathological types. D* and f D* were positively correlated with K^{trans}, K_{ep} and V_e, respectively. Adenocarcinoma had higher f, K^{trans} and K_{ep} values than those of squamous cell carcinoma. Therefore, IVIM, as a non-invasive method, has potential to replace DCE-MRI to accurately access tumor perfusion properties, especially when perfusion differs among different pathological types of UCC.

4692	Computer 65	Evaluating Female Pelvic Pain with DISCO MRI: Pilot study in Pelvic Congestion and Uterine Fibroids
		Rebecca Rakow-Penner[1], Adrija Mamidipalli[1], and Albert Hsiao[1]
		[1]Radiology, University of California San Diego, La Jolla, CA, United States
		Pelvic congestion and uterine fibroids are two common causes of female pelvic pain that can be treated with image guided vascular embolization and often evaluated with MRI prior to treatment. Vascular as well as anatomic imaging are important in evaluation and treatment planning for these two disease processes. Differential sampling with Cartesian ordering (DISCO)-MRI is a technique that allows for both high temporal and spatial resolution. This abstract demonstrates the utility of DISCO-MRI in evaluation and treatment planning for pelvic congestion and uterine fibroids.

4693	Computer 66	Characterization of uterine artery geometry in normal pregnancy with time-of-flight angiography
		Eileen Hwuang[1], M. Dylan Tisdall[1], Nadav Schwartz[1], John A. Detre[1], and Walter R. Witschey[1]
		[1]University of Pennsylvania, Philadelphia, PA, United States
		While measuring uterine artery (UtA) impedance is commonly used to assess for risk of preeclampsia and intrauterine growth restriction, little is understood about the remodeling process during gestation. An improved understanding of geometrical changes can lead to predictive biomarkers of adverse pregnancies. Here we present a method of measuring path length and curvature of the tortuous UtAs by segmentation and centerline extraction of time-of-flight MR angiography. We show in 8 pregnant subjects in the 2nd and 3rd trimester that this technique is feasible for investigating longitudinal trends of UtA remodeling and cases of maladaptation.

4694	Computer 67	Background-suppressed pulsed arterial spin labeling of placental perfusion at 1.5T

		Eileen Hwuang[1], Zhengjun Li[2], Marta Vidorreta[2,3], Sudipto Dolui[2,3], M. Dylan Tisdall[3], Nadav Schwartz[4], Walter R. Witschey[3], and John A. Detre[2,3]
		[1]Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [4]Department of Obstetrics and Gynecology, University of Pennsylvania, Philadelphia, PA, United States
		We present the feasibility of measuring and quantifying placental blood flow in healthy pregnant subjects at 1.5T. We used a Flow Alternating Inverson Recovery (FAIR) scheme with background suppression. Using statistical parametric mapping, discrete regions of labeling were observed, likely corresponding to individual spiral artery distributions.

4695	Computer 68	Placental perfusion imaging using velocity-selective arterial spin labeling
		Zungho Zun[1,2,3,4] and Catherine Limperopoulos[1,2,3,4]
		[1]Division of Diagnostic Imaging and Radiology, Children's National Medical Center, Washington, DC, United States, [2]Division of Fetal and Transitional Medicine, Children’s National Medical Center, Washington, DC, United States, [3]Department of Pediatrics, George Washington University, Washington, DC, United States, [4]Department of Radiology, George Washington University, Washington, DC, United States
		Recently placental perfusion imaging using velocity-selective arterial spin labeling (VSASL) was applied in pregnancies complicated by fetal heart disease. Here we demonstrate the feasibility of performing VSASL in the human placenta and provide supporting evidence that is needed for validation of placental VSASL. In our results, placental VSASL generated significantly higher ASL signal than pseudocontinuous ASL, showed high reproducibility, and demonstrated inflow-dependence. This study lays the groundwork for future investigation of placental perfusion imaging in pregnancies complicated by placental insufficiency.

4696	Computer 69	Free-breathing 3D quantitative susceptibility and T2* mapping of the human placenta: Initial experience in healthy pregnancies
		Zungho Zun[1,2,3,4] and Catherine Limperopoulos[1,2,3,4]
		[1]Division of Diagnostic Imaging and Radiology, Children's National Medical Center, Washington, DC, United States, [2]Division of Fetal and Transitional Medicine, Children’s National Medical Center, Washington, DC, United States, [3]Department of Pediatrics, George Washington University, Washington, DC, United States, [4]Department of Radiology, George Washington University, Washington, DC, United States

		Quantitative susceptibility mapping (QSM) is an emerging imaging technique for measuring magnetic susceptibility of tissue, and may have the potential for depicting hypoxia, hemorrhage, and calcification of the placenta. In this study we demonstrate simultaneous acquisition for QSM and T2* mapping of the human placenta using a 3D multi-echo gradient echo sequence with maternal free breathing. Compared to T2-weighted images, both QSM and T2* maps demonstrate more lobulated contrast in the placenta with lower susceptibility and higher T2* values within the lobules. This is the first study to investigate QSM of the human placenta in vivo.

4697	Computer 70	Textural analysis of the morbidly adherent placenta (MAP) from MR acquisitions
		Quyen N Do[1], Matthew A Lewis[1], Yin Xi[1,2], Ananth J Madhuranthakam[1,3], Timothy Ng[1], Robert E Lenkinski[1,3], and Diane M Twickler[1,4]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Department of Clinical Science, UT Southwestern Medical Center, Dallas, TX, United States, [3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [4]Obstetrics & Gynecology, UT Southwestern Medical Center, Dallas, TX, United States
		The morbidly adherent placenta (MAP) is a significant obstetric condition and hysterectomy is often the outcome for severe cases. We applied region of interest (ROI)-based texture analysis on retrospective placental MR images in women with history of placenta previa and previous cesarean deliveries. Our goal was to evaluate the textural characteristics of placental tissue in proximity to previous surgical scars and compare findings to surgical outcomes. Several significant Haralick texture features were seen in placental ROI's near previous cesarean scars in those women who underwent hysterectomy.

4698	Computer 71	Evaluation of Uterine and Placenta Motion throughout Early Gestation
		Thomas Martin[1,2], Xinzhou Li[1], Irish Del Rosario[3], Teresa Chanlaw[4], Tess Armstrong[1], Sherin Devaskar[4], Carla Janzen[5], Rinat Masamed[1], Holden Wu[1], and Kyunghyun Sung[1]
		[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Biomedical Physics, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Epidemiology, University of California, Los Angeles, Los Angeles, CA, United States, [4]Department of Pediatrics, University of California, Los Angeles, Los Angeles, CA, United States, [5]Department of Obstetrics and Gynecology, University of California, Los Angeles, Los Angeles, CA, United States

		When imaging the uterus and placenta, in pregnant patients, there are potential uterine contractions that compress the superior region of the uterus and can cause significant motion in the uterus and placenta. It is not well studied how much uterine contraction and other motion need to be accounted for during MRI scans in early gestation. In this study we observed and characterized uterine contractions and other bulk motion in pregnant women (gestational age 14-22weeks) using an image based template-matching program. This study can further help develop proper scanning protocols for MRI studies with pregnant patients to avoid potential motion artifacts.

4699	Computer 72	Placental Insufficiency Investigated with Multi-compartment Placental MRI
		Andrew Melbourne[1], Rosalind Aughwane[1], David Owen[1], Magdalena Sokolska[2], Alan Bainbridge[2], David Atkinson[1], Jan Deprest[1], Giles Kendall[2], Tom Vercauteren[1], Anna David[2], and Sebastien Ourselin[1]
		[1]University College London, London, United Kingdom, [2]University College Hospital, London, United Kingdom
		Efficient exchange of oxygen and nutrients across the placenta is vital for a normally grown fetus. When remodelling of maternal arteries does not occur in early pregnancy the result is placental insufficiency, and fetal growth restriction. Previous studies have shown differences in T2 relaxometry and IVIM between normal and FGR placentae. Here we use a combined T2R and IVIM signal model that separates signals from fetal and maternal blood pools over the whole placental volume. We show difference in T2R, ADC, and maternal perfusion fraction, findings in keeping with previous literature and the pathophysiology of placental insufficiency.

Electronic Poster

Pancreas/GI

Exhibition Hall	Wednesday 9:15 - 10:15

4700	Computer 73	Magnetic Resonance Elastography and model diffusion-weighted imaging of Autoimmune Pancreatitis: A Preliminary Study
		Yu Shi[1], Lizhuo Cang[1], Xiaoqi Wang[2], Yanqing Liu[1], Min Wang[1], Ruoyun Ji[1], and Qiyong Guo[1]
		[1]Shengjing Hospital of China Medical University, ShenYang, China, [2]Philips Healthcare China, Beijing, China
		Autoimmune pancreatitis (AIP) is a benign process characterized by lymphoplasmacytic infiltration and massive fibrosis.

4701	Computer 74	Comparison of six diffusion-weighted imaging models for the detection of treatment effects in pancreatic cancer patients Oliver J Gurney-Champion[1,2,3], Remy Klaassen[4,5], Marc R W Engelbrecht[2], Jaap Stoker[2], Johanna W Wilmink[4], Marc G Besselink[6], Arjan Bel[3], Geertjan van Tienhoven[3], Hanneke W M van Laarhoven[4], and Aart J Nederveen[2] *[1]Joint department of physics, Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, London, United Kingdom, [2]Department of Radiology & Nuclear Medicine, Academic Medical Center, Amsterdam, Netherlands, [3]Department of Radiation Oncology, Academic Medical Center, Amsterdam, Netherlands, [4]Department of Medical Oncology, Academic Medical Center, Amsterdam, Netherlands, [5]LEXOR (Laboratory for Experimental Oncology and Radiobiology), Academic Medical Center, Amsterdam, Netherlands, [6]Department of Surgery, Academic Medical Center, Amsterdam, Netherlands* We tested the performance of six diffusion models for detecting effects from treatment in pancreatic ductal adenocarcinoma. All models, including the mono-exponential fit, were able to detect parameter changes after treatment in individual patients for five out of nine patients. For multi-parametric models treatment affected different parameters for different patients, allowing potentially discriminating between types of effects. The pseudo diffusion coefficient values from the intravoxel incoherent motion model were in line with instant dephasing due to bulk motion rather than capillary perfusion, limiting its clinical interpretation. Using two mono-exponential fits, one at low and one at high b-values, was preferred.

4702	Computer 75	Imaging beta-cell function in the mouse pancreas with an implanted imaging window by MRI Veronica Clavijo Jordan[1], Xiaodong Wen[1], Filip Bochner[2], Su-Tang Lo[1], Andre F. Martins[1,3], Sara Chirayil[1], Michal Neeman[2], and A. Dean Sherry[1,3] *[1]University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]The Weizmann Institute of Science, Rehovot, Israel, [3]University of Texas at Dallas, Richardson, TX, United States* We have successfully implanted an imaging window onto the mouse abdomen to locate and hold the tail of the pancreas in place. By use of this MR-compatible window we were able to show with MRI and a Gd-based zinc sensor the non-uniform regional secretion of zinc and insulin as a response to glucose in the tail of the mouse pancreas. This surgical technique and imaging technology could be used to successfully monitor beta-cell function longitudinally through the development of the various diseases of the endocrine pancreas with MRI.

4703	Computer 76	Diffirentiation Between Pancreatic Ductal Adenocarcinoma and Neuroendocrine Tumors :Using Whole-tumor Histogram Analysis of Non-Gaussian Distribution DWI Models Jiali Li[1], Daoyu Hu[1], and Zhen Li[1]

		[1]Tongji Hospital, Huazhong University of Science and Technology, Wuhan, China
		The purpose of this paper is to explore a most helpful DWI mathematical models in differenting pancreatic ductal adenocarcinoma and neuroendocrine tumors. All parameters of three models(monoexponential, biexponential, and stretched exponential) were obtained from a histogram analysis based on the entire tumor. By comparing diagnostic performance, the significant parameters that have the highest diagnostic performance were selected to the most helpful parameters. The results of this study showed that IVIM-DWI model may be the most suitable for differenting pancreatic tumors.

4704	Computer 77	Treatment effect of autoimmune pancreatitis: evaluation with T1 mapping
		Liang Zhu[1], Hua-dan Xue[1], Zhao-yong Sun[1], Marcel Dominik Nickel[2], Tianyi Qian[3], and Zheng-yu Jin[4]
		[1]Radiology, Peking Union Medical College Hospital, Beijing, China, [2]Siemens Healthcare, Erlangen, Germany, [3]Siemens Healthcare, Beijing, China, [4]Peking Union Medical College Hospital, B, China
		This prospective study aims to evaluate the T1 relaxation time of autoimmune pancreatitis (AIP) in the native state and after corticosteroid treatment (CST). Thirty-four patients with AIP and twenty control subjects received pancreatic MR including T1 mapping. All AIP patients had T1 mapping data before and after CST. It turned out that the inflamed pancreatic parenchyma had significantly elongated T1 relaxation time, and after 4-12 weeks of CST, the T1 relaxation time shortened significantly towards normalization, in keeping with the serum biomarkers of disease activity. Therefore MR T1 mapping is a noninvasive, quantitative method to monitor AIP treatment effect.

4705	Computer 78	Intravoxel Incoherent Motion Diffusion-weighted MR Imaging of Solid Pancreatic Masses: reproducibility and usefulness for characterization
		Riccardo De Robertis[1], Nicolò Cardobi[1], Robert Grimm[2], Berthold Kiefer[2], Alto Stemmer[2], Marco Zanirato[3], and Mirko D'Onofrio[4]
		[1]Radiology, Ospedale Pederzoli, Peschiera del Garda, Italy, [2]Siemens Healthcare, Erlangen, Germany, [3]Siemens Healthcare, Milano, Italy, [4]Radiology, G.B. Rossi Hospital - University of Verona, Verona, Italy
		Overall intraobserver agreement for ADC- and IVIM-derived parameters was excellent. Perfusion-related IVIM-derived parameters are the most reliable for differentiation between pancreatic ductal adenocarcinoma and neuroendocrine neoplasms. No significant differences were found between ADC- and IVIM-derived parameters of mass-forming pancreatitis and carcinoma.

4706	Computer 79	Optimal combinations of b-values in computed DWI for pancreatic cancer detection

		Koji Tokunaga[1], Shigeki Arizono[1], Hiroyoshi Isoda[1], Hironori Shimizu[1], Koji Fujimoto[2], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan
		There has been no previous report on the optimal combinations of b-values to obtain computed DWI (cDWI) with b-values above 1000 s/mm^2 to evaluate pancreatic cancer. This retrospective study involved 30 pancreatic cancer patients with tumor associated pancreatitis. We aimed to evaluate the optimal combination of b-values to obtain cDWI with b-value of 1500 s/mm^2 from the combinations of b-values between 0 and 500 s/mm^2 (cDWI$_{0\text{-}500}$), 0 and 1000 s/mm^2 (cDWI$_{0\text{-}1000}$), 500 and 1000 s/mm^2 (cDWI$_{500\text{-}1000}$), and all b-values (cDWI$_{ALL}$). Only cDWI$_{0\text{-}1000}$ demonstrated statistically higher tumor detectability compared to measured DWI, while image quality was preserved in cDWI$_{0\text{-}1000}$ and cDWI$_{ALL}$.

4707	Computer 80	Age dependency of T1 and T2 values in healthy pancreas measured at 7 Tesla
		Mariska Damen[1], Maarten S. van Leeuwen[2], Peter R. Luijten[2], Andrew Webb[1], Dennis WJ Klomp[2], and Catalina S. Arteaga de Castro[2]
		[1]Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Imaging, University Medical Center Utrecht, Utrecht, Netherlands
		Age dependency of T1 and T2 times of the healthy pancreas at 7 Tesla with a multi-transmit system was investigated for MRI protocol optimization of the pancreas. Three age groups were measured (21 -25 yo, 26 -39 yo and 40 -72 yo). Measurements resulted in average T2 times of 52 ms, 97 ms and 127 ms for the 3 different age groups respectively, revealing an age dependency of the T2 relaxation times. Average T1 times were 856 ms, 899 ms and 858 ms for each age group respectively. No age dependency was observed for the T1 relaxation times.

4708	Computer 81	High-Resolution Intravoxel Incoherent Motion (IVIM) diffusion-weighted MR imaging for the characterization of periampullary lesions
		Haixia Yu[1], Chuangliang Chen[1], Dapeng Shi[1], Robert Grimm[2], and Tianyi Qian[3]
		[1]Department of Radiology, People’s Hospital of Zhengzhou University, Henan Provincial People’s Hospital, Zhengzhou, China, [2]MR Application Predevelopment, Siemens Healthcare, Erlangen, Germany, [3]Siemens Healthcare, MR Collaborations NE Asia, Beijing, China

		This study aimed to investigate the clinical diagnostic utility of ZOOMit-DWI-based IVIM imaging technology[1,2] for periampullary lesions. Forty-one patients, comprising cancer of the pancreatic head (n = 6), chronic pancreatitis (n = 9), ampullary adenocarcinoma (n = 9), and distal bile duct carcinoma (n = 17) and 28 healthy volunteers were enrolled. Our results showed that the perfusion fraction (f) of the IVIM-derived parameter has the potential to distinguish between cancer of the pancreatic head, other lesions, and normal tissue in the periampullary regions by using the zoomed DW imaging, which has the capacity to overcome some of the limitations of conventional MRI of the pancreas.

4709	Computer 82	Evaluation of Extracellular Volume (ECV) Fraction of the Normal Pancreas and Correlation with Biophysical Parameters
		Temel Tirkes[1], Kumaresan Sandrasegaran[1], Eugene P Ceppa[1], and Chen Lin[2]
		[1]Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States, [2]Indiana University School of Medicine, Indianapolis, IN, United States
		ECV fraction can be a very useful imaging tool for non-invasive evaluation of solid organ pathologies and is probably underutilized in abdominal imaging. There are potentially several clinical applications of ECV in the abdomen such as evaluation of chronic pancreatitis or chronic liver disease. In this study, we computed the ECV fraction of the pancreas in 60 healthy cohorts and determined that ECV fraction of the normal pancreas is 0.26 (± 0.08). ECV fraction is not influenced by pancreatic steatosis or patient's gender, however gradually increases with age.

4710	Computer 83	Value of whole-tumor histogram-based texture analysis of baseline ADC map in prediction of tumor response to neoadjuvant chemoradiotherapy in locally advanced rectal cancer.
		lanqing Yang[1] and bing Wu[1]
		[1]West China Hospital, Sichuan University, Chengdu, China
		There has been increasing interest in quantitative methods to excavate more information than traditional descriptive features, facilitated by the availability of texture analysis software platforms. By doing whole-tumor histogram-based texture analysis on pre-treatment ADC map, histogram parameters reflecting the pixel distribution of ROIs were derived. Our study found that LARC that achieved pCR after NCRT appeared less heterogeneous on ADC map and had lower high percentile pre-treatment ADC values. Whole-tumor histogram parameters of pre-treatment ADC map were feasible to predict pCR in LARC, including the absolute value of relative deviation, frequency size, quantile 75%, 90%, and 95% of ADC value histogram.

4711	Computer 84	Splenic MR Elastography in Prediction of Esophageal Varices Grading

		Chen-Te Chou[1,2] and Ran-Chou Chen[2,3]
		[1]Radiology, Chang-Hua Christian Hospital, Chang-Hua, Taiwan, [2]Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan, [3]Ministry of Health and Welfare, Taipei, Taiwan
		To investigate the relationship between splenic MR elastography (MRE) and esophageal varices (EV). 167 patients underwent endoscopy and abdominal MR examination within 3-months interval were enrolled. MRE was performed with passive driver on right and left chest wall separately. The mean stiffness value of liver and spleen was determined. A good correlation between splenic stiffness and EV, but no correlation for liver stiffness was found. Our results demonstrated that spleen stiffness measured by MRE was significant correlated with EV grading. With 9.77 kPa spleen stiffness might be helpful in predicting presence of EV for patients with chronic liver disease.

4712	Computer 85	Automated Localization and Segmentation of Locally-Advanced Rectal Cancer Based on T2, DWI and DCE Multi-Parametric MRI Using Deep Learning
		Yang Zhang[1], Liming Shi[2], Xiaonan Sun[2], Tianye Niu[2], Ning Yue[3], Peter Chang[4], Daniel Chow[1], Melissa Khy[1], Tiffany Kwong[1,3], Jeon-Hor Chen[1], Min-Ying Su[1], and Ke Nie[3]
		[1]Department of Radiological Sciences, University of California, Irvine, CA, United States, [2]Department of Radiation Oncology, Sir Run Run Shaw Hospital, Zhejiang University School of Medicine, Hangzhou, China, [3]Department of Radiation Oncology, Rutgers-The State University of New Jersey, New Brunswick, NJ, United States, [4]Department of Radiology, University of California, San Francisco, CA, United States
		A deep learning method using the convolutional neural network (CNN) was implemented to segment rectal cancer in 48 patients. Six sets of images (one T2, Two DWI, three DCE) were used as inputs. The Dice Similarity Coefficient (DSC) was used to evaluate results generated by the CNN algorithm compared to the manually outlined ground truth. When the search was done on the entire image the mean DSC was 0.64, and the errors were mainly from tissues outside the rectum. The rectum could be easily segmented, and when the search was confined within 1.5 times of rectal area, the DSC was improved to 0.75.

4713	Computer 86	Differentiation between Intestinal-type and Pancreatobiliary-type Periampullary Carcinoma and Prediction of Lymphatic Metastasis: Whole-Lesion Diffusion-Weighted Imaging Histogram Analysis
		Jingyu Lu[1], Zhen Li[1], and Daoyu Hu[1]
		[1]Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, Wuhan, China

		Pancreatobiliary versus intestinal histologic type of differentiation is an independent prognostic factor in resected periampullary adenocarcinoma. To differentiate these two histologic type proactively before surgery, we tried to use whole-lesion histogram analysis of apparent diffusion coefficient (ADC) derived from diffusion-weighted imaging . Entropy was significantly lower in pancreatobiliary-type periampullary carcinoma and achieved the best diagnostic performance. ADC value was relatively lower in pancreatobiliary-type. No significant difference was shown between lymph node metastasis positive and negative group. So we hypothesized that ADC histogram parameters might help to differentiate these two histologic type without the influence of lymph nodal involvement.

4714	Computer 87	Value of R2* for predicting the response of locally advanced rectal cancer to neoadjuvant chemoradiation therapy
		Hongliang Sun[1], Yanyan Xu[1], Queenie Chan[2], and Wu Wang[1]
		[1]Radiology, China-Japan Friendship Hospital, Beijing, China, [2]Philips Healthcare, Hongkong, China
		Neoadjuvant chemoradiation therapy (CRT) followed by surgery has been established as the standard for locally advanced rectal cancer. The treatment response after CRT is normally evaluated by MRI. However, MRI morphology techniques suffer from limitations in the interpretation of fibrotic scar tissue and inflammation. Several studies have demonstrated that sensitivity to chemoradiotherapy is related to the oxygenation status of the tumor. It has been shown that the slight increase in T2* signals from paramagnetic deoxyhemoglobin can be used for reflecting the tumor oxygenation status. Therefore, R2* (=1/T2*) might have the potential to be a predictor of prognosis and treatment response for patients with locally advanced rectal cancer.

4715	Computer 88	Evaluating Response of Locally Advanced Gastric Adenocarcinoma to Neoadjuvant Chemotherapy using Intravoxel Incoherent Motion MRI: A Preliminary study
		Yongjian Zhu[1], Liming Jiang[1], Ying Li[1], and Lizhi Xie[2]
		[1]Department Of Imaging Diagnosis, National Cancer Center / Cancer Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, China, [2]GE healthcare, China, Beijing, China
		Intravoxel incoherent motion (IVIM) diffusion-weighted magnetic resonance imaging (DW-MRI) has been applied in research of different cancers, however its potential in gastric cancer has not been fully explored. In this study, we explored the value of IVIM parameters in evaluating the response to chemotherapy in gastric cancer. We found that the D and f values showed good diagnostic performance by differentiating responders from nonresponders, this could provide effective help for the choice of clinical treatment.

4716	Computer 89	Conical Ultrashort TE (UTE) MRI in the evaluation of pediatric acute appendicitis

		Zhibo Xiao[1,2], Albert T Roh[1], Joseph Y Cheng[1], Shreyas S Vasanawala[1], and Andreas M Loening[1]
		[1]Radiology, Stanford University, Stanford, CA, United States, [2]Radiology, First Affiliated Hospital, Chongqing, China
		To reduce patient exposure to the ionizing radiation of CT, hospitals are increasing MRI usage in the evaluation of suspected acute appendicitis, particularly in the pediatric population. Our retrospective review of 84 pediatric patients assessed contrast-enhanced conical Ultrashort TE (UTE) of the pelvis. UTE demonstrated better qualitative Signal-to-Noise Ratio (SNR), fewer artifacts, and better overall image quality than both a 3D dual-echo SPoiled GRadient echo (SPGR) sequence and a free-breathing high-resolution 3D SPGR. Our study concluded that UTE is feasible in the evaluation of the pelvis for pediatric acute appendicitis.

4717	Computer 90	Direct visualization of physiological intestinal flow using unenhanced MR imaging with spin labeling
		Jun Isogai[1], Mitsue Miyazaki[2], Kenji Yodo[3], Michitaka Suzuki[3], Takashi Yamada[4], and Jun Kaneko[4]
		[1]Asahi General Hospital, Asahi, Japan, [2]University of California San Diego, San Diego, CA, United States, [3]Toshiba Medical Systems Corp, Tokyo, Japan, [4]Hasuda Hospital, Hasuda, Japan
		Assessment of motility and propagation of the small bowel has been reported using conventional contrast x-ray techniques with unavoidable ionizing radiation and recent MR imaging. However, MR enteroclysis and enterography require a discomforted nasoenteric intubation and an oral administration of large volumes of enteric contrast materials, respectively. Unenhanced MR imaging with a spin labeling technique provides direct visualization of physiological intestinal intraluminal flow related to bowel peristalsis.

4718	Computer 91	Increased small bowel permeability is associated with significantly increased T2 measures of the small bowel wall.
		Hannah G Williams[1], Robert Scott[2,3], Luca Marciani[2,3], Catherine Ortori[4], Guruprasad Aithal[2,3], Penny A Gowland[1,3], and Caroline L Hoad[1,2]
		[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]National Institute for Health Research (NIHR) Nottingham Biomedical Research Centre at the Nottingham University Hospitals NHS Trust and University of Nottingham, Nottingham, United Kingdom, [3]Nottingham Digestive Diseases Centre, University of Nottingham, Nottingham, United Kingdom, [4]Centre for Analytical Bioscience, School of Pharmacy, University of Nottingham, Nottingham, United Kingdom

		Available techniques to measure in-vivo bowel permeability are inadequate for stratifying patients to identify those at risk of complications. T_2 weighted measurements in Crohn's disease are sensitive markers of small bowel wall structural changes and could potentially be indicators of permeability. We have developed quantitative T_2 measures of the small bowel wall to characterize changes associated with increased permeability induced by indomethacin. We found a significant increase in quantitative measures of T_2 of the small bowel wall associated with increased permeability provoked by indomethacin.

4719	Computer 92	The Radiomic Signature as a Prognostic Biomarker for Locally Advanced Rectal Cancer
		Yuchen Zhang[1], Yankai Meng[2], Hongmei Zhang[2], Chunwu Zhou[2], Di Dong[3], Mengjie Fang[3], Yali Zang[3], Zhenyu Liu[3], Jie Tian[4], Di Dong[3], Di Dong[3], and Di Dong[3]
		[1]University of Electronic Science and Technology of China, Beijing, China, [2]Department of Radiology, National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, P.R. China., Beijing, China, [3]CAS Key Laboratory of Molecular Imaging, Institute of Automation, Chinese Academy of Sciences, Beijing P.R. China; University of Chinese Academy of Sciences, Beijing P.R. China., Beijing, China, [4]CAS Key Laboratory of Molecular Imaging, Institute of Automation, Chinese Academy of Sciences, Beijing, China
		Radiomics uses a large number of medical imaging features and can demonstrate voxel-wise intratumor heterogeneity. We calculated the radiomic signature for each patient using a weighted linear combination of the radiomic features selected by machine learning methods. The study endpoint was DFS, defined as the interval between TME surgery and disease progression, which included tumor local recurrence, distant metastasis, or death, or the date of the last follow-up visit (censored). The association between the radiomic signature and DFS was explored. Then, the three models were built to estimate the DFS in patients.

4720	Computer 93	Rectal Cancer: Comparison of MRI Characteristics and Texture Analysis Between Different Tumor KRAS Mutation Status
		Yanyan Xu[1], Hongliang Sun[1], Queenie Chan[2], and Wu Wang[1]
		[1]Radiology, China-Japan Friendship Hospital, Beijing, China, [2]Philips Healthcare, Hongkong, China
		KRAS mutations are well known as predictive markers of resistance to epidermal growth factor receptor-targeted antibodies in rectal cancers. Approximately 30%-40% colorectal cancers are observed with KRAS mutation, and rectal cancer accounts for 30%-35% among CRC. The pre-operative neoadjuvant therapy including anti-EGFR chemotherapy demonstrated robust value is the current trend in the management of rectal cancer. Therefore, it is important to select suitable patients who would benefit from the aggressive multimodality approaches and tailor individual treatment to better combat disease. Currently, few data are available regarding the potential relationship between MRI characteristics and genetic biomarkers.

4721	Computer 94	Rapid and noninvasive detection and dynamic quantification of gut bleeds with Magnetic Particle Imaging Elaine Yu[1], Prashant Chandrasekharan[1], Ran Berzon[1], Xinyi Y Zhou[1], Zhi Wei Tay[1], R Matthew Ferguson[2], Amit P Khandhar[2], Scott J Kemp[2], Bo Zheng[1], Patrick Goodwill[1,3], Michael F Wendland[1], Kannan M Krishnan[2,4], Spencer Behr[5], Jonathan Carter[6], and Steven Conolly[1,7] *[1]Department of Bioengineering, University of California, Berkeley, CA, United States, [2]Lodespin Labs, Seattle, WA, United States, [3]Magnetic Insight, Inc., Alameda, CA, United States, [4]Department of Material Science and Engineering, University of Washington, Seattle, WA, United States, [5]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [6]University of San Francisco Medical Center, San Francisco, CA, United States, [7]Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA, United States* Magnetic Particle Imaging (MPI) is a novel, high-contrast, and quantitative imaging modality that directly detects superparamagnetic iron oxide nanoparticle (SPIO) tracers. These SPIOs have been previously used as a MRI contrast agent. However, with MRI SPIOs are limited by poor specificity and difficulty associated with quantifying the negative signal. Due to its direct detection, high sensitivity and positive contrast, MPI is uniquely poised as a clinically translatable platform for vascular imaging, including gastrointestinal (GI) bleed detection. Here we present in vivo GI bleed detection using long-circulating SPIOs as the vascular agent in a mouse model of Familial Adenomatous Polyposis.

4722	Computer 95	Diffusion-Weighted MR Imaging of rectal cancer with A Fractional Order Calculus Model Yanfen Cui[1], Zhizheng Zhuo[2], and Xiaotang Yang[3] *[1]Department of Radiology, Shanxi Province Tumor hospital, Taiyuan, China, [2]MR Clinical Sciences, Philips Healthcare Greater China, Beijing, China, Beijing, China, [3]Shanxi Province Tumor Hospital, Taiyuan, China* A novel non-Gaussian diffusion model based on fractional order calculus (FROC) were successfully applied to diffusion MRI of rectal cancer. Statistically significant differences in D and β values are observed between rectal cancer and villous adenoma ($p < 0.001$), indicating that individual or combined parameters from the FROC diffusion model may be useful as imaging biomarkers in predicting the biological properties of rectal cancer in clinical practice.

4723	Computer 96	MRI Texture Analysis in Predicting Treatment Response to Neoadjuvant Chemoradiotherapy in Rectal Cancer yankai meng[1], hongmei zhang[1], and chunwu zhou[1]

[1]Department of Radiology, National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Peking, China

To evaluate the importance of MRI texture analysis in prediction and early assessment of treatment response before and early neoadjuvant chemoradiotherapy (nCRT) in patients with locally advanced rectal cancer (LARC). This retrospective study comprised of 59 patients. The tumoral texture parameters were compared between pre- and early nCRT. Area Under receiver operating characteristic (ROC) Curves [AUCs] were used to compare the diagnostic performance of statistically significant difference parameters and logistic regression analysis predicted probabilities for discriminating responders and nonresponders. Texture parameters as imaging biomarkers have the potential to prediction and early assessment of tumoral treatment response to neoadjuvant chemoradiotherapy in patients with LARC.

Electronic Poster

Hepatobiliary 2: Diffuse Liver Disease

Exhibition Hall	Wednesday 9:15 - 10:15

4724 Computer 97

Fully Automated Liver Fat Assessment using Multi-Atlas Segmentation

Joel Kullberg[1,2], Taro Langner[1], Filip Malmberg[1], Anders Hedström[2], Jonathan Andersson[1], Carl Sjöberg[2], Lars Lind[3], and Håkan Ahlström[1]

[1]Department of Radiology, Uppsala University, Uppsala, Sweden, [2]Antaros Medical, BioVenture Hub, Mölndal, Sweden, [3]Department of Medical Sciences, Uppsala University, Uppsala, Sweden

Non-alcoholic fatty liver disease (NAFLD) has become the most common liver disease with an estimated global prevalence of 25%. Its link to metabolic, cardiovascular, and more severe forms of liver disease presents a major challenge for future healthcare. MRI allows accurate quantification of liver fat concentration. Since manual delineation of the liver is time-consuming, measurements are typically performed in small subjectively selected regions of interest which limits accuracy and precision. This work presents an automated method for liver fat assessment using multi-atlas segmentation. Evaluation with measurements using manual liver segmentation (n=306) demonstrates excellent agreement (R=1.000, difference -0.03%, p=0.001).

4725 Computer 98

Effect of polyphenols during a high-fat diet enhanced with chemical shift-encoded MRI

Angéline Nemeth[1], Hélène Ratiney[1], Benjamin Leporq[1], Kévin Seyssel[2], Bérénice Segrestin[3], Pierre-Jean Valette[4], Martine Laville[3], and Olivier Beuf[1]

		[1]Univ. Lyon, INSA-Lyon, Université Claude Bernard Lyon 1, UJM-Saint Etienne, CNRS, Inserm, CREATIS UMR 5220, U1206, F69621, VILLEURBANNE, France, Lyon, France, [2]Department of Physiology, Faculty of Biology and Medicine, University of Lausanne, Lausanne, Lausanne, Switzerland, [3]Centre de Recherche en Nutrition Humaine Rhône-Alpes (CRNH-RA), Centre Hospitalier Lyon Sud, Pierre-Bénite, Lyon, France, [4]Hospices Civils de Lyon, Département d'imagerie digestive, CHU Edouard Herriot, Lyon, Lyon, France
		In this study, 42 healthy male underwent a randomized, double blinded, parallel-group trial with either polyphenols or placebo during 31 days of high-carbohydrate and high-fat overfeeding. Changes in visceral, subcutaneous adipose tissue volumes and liver fat were measured using multi-gradient echo sequence. Visceral, subcutaneous adipose tissue volumes and liver fat increased significantly during overfeeding. The ratio VAT/SAT increased during overfeeding for the placebo group whereas this ratio slightly decreased for the polyphenol group.

4726	Computer 99	Assessment of liver dysfunction with 1H-MRS and relaxometry in a murine model of cerebral malaria
		Teodora-Adriana PERLES-BARBACARU[1], Emilie PECCHI[1], Yann LE FUR[1], Alexandre VINTILA[1], Monique BERNARD[1], and Angèle VIOLA[1]
		[1]Centre de Résonance Magnétique Biologique et Médicale UMR CNRS 7339, CNRS-Aix Marseille Université, Marseille, France
		Cerebral malaria (CM) is the most lethal complication of Plasmodium infection and may be associated with multiple organ failure. We have investigated liver microstructure and metabolism in a widely-used murine model of CM induced with *Plasmodium Berghei* ANKA using in vivo anatomical MRI, relaxometry and localized proton spectroscopy at 11.75T. Our results show an increase in liver T_2 value with CM progression. This increase is apparently linked to a reduction in tissue water content and to lipid remodeling. These alterations could be related to the clinical degradation occurring at the severe stage of the disease as well as to a direct effect of the parasite on the liver.

4727	Computer 100	Validation of gadoxetate dynamic contrast-enhanced MRI to assess liver function in rats with liver fibrosis: comparison with shear wave elastography and indocyanine green test
		Jimi Huh[1], Su Jung Ham[2], Young Chul Cho[2], Seul-I Lee[2], Jisuk Park[2], Chul Woong Woo[2], Yoonseok Choi[3], Dong-Cheol Woo[2], and Kyung Won Kim[2]
		[1]Radiology, Ulsan University Hospital, Ulsan, Republic of Korea, [2]Asan Medical Center, Seoul, Republic of Korea, [3]Gangneng Asan Medical Center, Gangneng, Republic of Korea

		Non-invasive imaging evaluation of the liver fibrosis and liver function has been gaining emphasis currently. In preclinical trial with animal liver fibrosis model, the gadoxetate DCE-MRI is quite feasible to evaluate histopathologic liver fibrosis and physiologic liver function in a non-invasive and repeatable manner. The best MRI index would be the iAUC-15, which is better than kPa on SWE.

4728	Computer 101	Measuring hepatocyte transplant success using gadoxetate enhanced MRI
		Christiane Mallett[1,2], Jeremy Hix[1,2], Kate Hammond[1,2], Alexander Wolf[1], and Erik Shapiro[1,2]
		[1]Radiology, Michigan State University, East Lansing, MI, United States, [2]Institute for Quantitative Health Science and Engineering, Michigan State University, East Lansing, MI, United States
		We used gadoxetate-enhanced MRI to monitor a mouse model of liver failure and hepatocyte transplantation.

4729	Computer 102	PEG-FGF21 Variant Improves Hepatic Steatosis in a Mouse Model of NASH as Determined by Quantitative Water-fat MRI
		Haiying Tang[1], Matthew Fronheiser[1], Stephanie Boehm[2], Adrienne Pena[1], Shorts Andrea[1], Bradley Zinker[2], John Krupinski[2], Harold Malone[1], Patrick Chow[1], Edgar Charles[1], Shuyan Du[1], and Wendy Hayes[1]
		[1]Bristol-Myers Squibb, Lawrenceville, NJ, United States, [2]Bristol-Myers Squibb, Hopewell, NJ, United States
		Non-alcoholic fatty liver disease (NAFLD) ranges from simple fatty liver to steatohepatitis (NASH) to cirrhosis. In the present study, we implemented a water-fat MRI using the gradient-reversal technique to quantify the hepatic proton density fat-fraction (PDFF), for assessment of hepatic steatosis in a diet-induced mouse model of NASH. We compared the quantitative water-fat MRI technique with conventional Dixon method and single-voxel MR spectroscopy (MRS), and correlated the MRI-PDFF with histology and biochemical triglyceride (TG) content. Lastly, the effects of a PEGylated-FGF21 variant (PEG-FGF21v) on hepatic steatosis in the mouse model was evaluated using the water-fat MRI technique.

4730	Computer 103	Preliminary Study on the Feasibility of Simultaneously Measuring Hepatic Stiffness and Separate Water/Fat Signal Using Dual-Echo, Dixon, Spoiled-Gradient-Echo, Magnetic Resonance Elastography
		Yuan Le[1], Joshua Trzasko[2], Kevin Glaser[2], Yuxiang Zhou[3], William Pavlicek[1], Joseph M. Hoxworth[3], Bradley D. Bolster Jr.[4], Joel P. Felmlee[2], Richard L. Ehman[2], and Jun Chen[2]

		[1]Radiology, Mayo Clinic Arizona, Scottsdale, AZ, United States, [2]Radiology, Mayo Clinic, Rochester, MN, United States, [3]Radiology, Mayo Clinic Arizona, Phoenix, AZ, United States, [4]Siemens Medical Solutions USA, Inc., Salt Lake City, UT, United States
		A novel dual-echo, Dixon MR Elastography technique was developed to simultaneously measure the liver stiffness and separate fat/water signal. Phantom tests showed that the fat signal fraction and the stiffness measured with this technique were consistent with the values measured with separate MR spectroscopy and standard MR Elastography acquisitions. Promising results were also obtained in a healthy volunteer.

4731	Computer 104	Magnetic resonance cholangiopancreatography using optimized integrated combination with parallel imaging and compressed sensing technique compared with conventional MRCP.
		Nobuyuki Kawai[1], Satoshi Goshima[1], Kimihiro Kajita[2], Tomoyuki Okuaki[3], Masatoshi Honda[3], Hiroshi Kawada[1], Yoshifumi Noda[1], Yukichi Tanahashi[1], Shoma Nagata[1], and Masayuki Matsuo[1]
		[1]Department of Radiology, Gifu University School of Medicine, Gifu, Japan, [2]Department of Radiology Services, Gifu University Hospital, Gifu, Japan, [3]Philips Japan, Tokyo, Japan
		MR cholangiopancreatography (MRCP) plays an essential role in the noninvasive assessment of the biliary and pancreatic duct systems. The current respiratory-triggered three-dimensional turbo spin-echo MRCP sequence has an excellent duct-to-periductal tissue contrast, however, the long acquisition time and motion artifacts due to the various depth of patients' breathing limit the benefit of this sequence. We assessed prototype sequence using optimized integrated combination with parallel imaging and compressed sensing technique (Compressed-SENSE) for MRCP. Our results demonstrated that Compressed-SENSE technique enabled significant reduction of acquisition time without image quality degradation compared with conventional method.

4732	Computer 105	MR elastography as a noninvasive marker for liver fibrosis in chronic hepatitis B patients: Comparisons with serum fibrosis markers
		Bohyun kim[1], Hye Jin Kim[1], Jei Hee Lee[1], Hyo Jung Cho[2], and Jai Keun Kim[1]
		[1]Radiology, Ajou University Hospital, Suwon, Republic of Korea, [2]Internal Medicine, Ajou University Hospital, Suwon, Republic of Korea
		Among various noninvasive methods for liver fibrosis quantification, we compared liver stiffness measured from MR elastography and multiple serum fibrosis markers including APRI, FIB-4, and King' score for liver fibrosis prediction. Our results showed than MR elastography performed better than serum fibrosis indices in discerning clinically significant fibrosis (≥ F3) and liver cirrhosis (≥ F4) in chronic hepatitis B patients.

4733	Computer 106	Differential diagnosis of hepatic iron contents in simple steatosis and nonalcoholic steatohepatitis using multiecho Dixon magnetic resonance imaging Tae-Hoon Kim[1], Chang-Won Jeong[1], Hong Young Jun[1], Youe Ree Kim[2], Ju Young Kim[1], SiHyeong Noh[1], JiEon Kim[1], Young Hwan Lee[2], and Kwon-Ha Yoon[2] *[1]Medical Convergence Research Center, Wonkwang University, Iksan, Republic of Korea, [2]Radiology, Wonkwang University School of Medicine, Iksan, Republic of Korea* Non-invasive monitoring liver iron content (LIC) is critical for clinical management or effective therapeutic strategy of patients because the increment of iron accumulation within the liver may contribute to liver disease via the production of reactive oxygen species. Non-alcoholic fatty liver disease (NAFLD) is the most common liver disease in the United States and is reported to between 10% and 30%, with similar rates reported from Europe and Asia. However, it is difficult to distinguish the sub-groups in NAFLD, especially simple steatosis (SS) and non-alcoholic steatohepatitis (NASH), unless by liver biopsy. Therefore, it is important to monitor liver iron content (LIC) in NASH patients for clinical management or effective therapeutic strategy of patients.

4734	Computer 107	Feasibility of Assessing the Nonlinear Mechanical behaviors of Liver with MR Elastography (MRE) Ziying Yin[1], Bogdan Dzyubak[1], Jiahui Li[1], Kevin J. Glaser[1], Sudhakar Venkatesh[1], Armando Manduca[1], Richard L Ehman[1], and Meng Yin[1] *[1]Radiology, Mayo clinic, Rochester, MN, United States* This is a feasibility study for assessing the nonlinear mechanical behaviors of the liver while experiencing different degrees of mechanical preloads. The different loading conditions were induced by 1) diaphragm movement in a view-sharing free-breathing 2D-EPI-MRE acquisition; 2) end-expiration versus end-inspiration states in a breath-held 3D-EPI-MRE acquisition. We observed intriguing stiffness variation synchronized with the breathing pattern in the free-breathing MRE, and a difference between end-expiration and end-inspiration liver stiffness in the breath-held MRE. The promising results demonstrated that the free-breathing and/or breath-hold liver MRE at different breathing states can be useful for the assessment of nonlinear mechanical tissue behaviors.

4735	Computer 108	Cross-validation of Multi-parametric MRI in Characterizing Steatosis, Inflammation, and Fibrosis in Nonalcoholic Steatohepatitis (NASH) and Alcohol Hepatitis (AH) Mouse Models Ziying Yin[1], Rosa Martin Mateos[2], Jiahui Li[1], Vikas K. Verma[2], Kevin J. Glaser[1], Amy S. Mauer[2], Harmeet Malhi[2], Vijay Shah[2], Richard L Ehman[1], and Meng Yin[1] *[1]Radiology, Mayo clinic, Rochester, MN, United States, [2]Gastroenterology and Hepatology, Mayo clinic, Rochester, MN, United States*

		In this preliminary study, we cross-validated the usefulness of multi-parametric MRI (fat fraction, liver stiffness, and damping ratio) in assessing the disease development and treatment response in both NASH and AH mouse models. Fat fraction has excellent agreement with the steatosis changes in both progressive and regressive AH and NASH models. In AH models, hepatic inflammation indicators have shown promising trends that well agreed each other in ALT and damping ratio. For the NASH model, both liver stiffness and damping ratio increased progressively in the fast-food-diet group, and the changes of stiffness was consistent with the end-point histology of fibrosis.

4736	Computer 109	MRI markers of liver related outcomes
		Chris R Bradley[1], Eleanor F Cox[1,2], Martin W James[2], Guru P Aithal[2], Neil Guha[2], and Susan T Francis[1,2]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Nottingham Biomedical Research Centre, University of Nottingham, Nottingham, United Kingdom
		We used quantitative MR measures to assess changes in microstructure and haemodynamics in the liver and kidney of 60 patients with compensated cirrhosis (CC), 9 patients with decompensated cirrhosis (DC) and 40 healthy volunteers (HV). Liver T_1 and perfusion was significantly reduced and renal T_1 significantly increased with disease severity. In this prospective study, 1 in 6 CC patients have since had a Liver Related Outcome (LRO). These patients showed significant changes in baseline MR measures suggesting these MR measures in our multi-parametric MRI protocol can be used as a marker of LRO.

4737	Computer 110	Transducer-Free Hepatic Magnetic Resonance Elastography using Cardiac Wave Induction at 0.3ms Temporal Resolution
		Marian A Troelstra[1,2], Alessandro Polcaro[1], Omar Darwish[1], Jose de Arcos[1], Torben Schneider[3], Khaled Z Abd-Elmoniem[4], Ahmed M Gharib[4], Jurgen Runge[1,2], and Ralph Sinkus[1]
		[1]Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Department of Radiology and Nuclear Medicine, Academic Medical Center, Amsterdam, Netherlands, [3]Philips Healthcare, Guildford, United Kingdom, [4]Biomedical and Metabolic Imaging Branch, The National Institute of Diabetes and Digestive and Kidney Diseases, The National Institutes of Health, Bethesda, MD, United States

		Hepatic MRE is a promising non-invasive tool for diagnosing liver fibrosis. To facilitate clinical translation, we developed a method to eliminate the need for mechanical actuators for wave generation. Propagation of the transient cardiac shear waves within the liver caused by cardiac-valve closure can be imaged at a very high temporal resolution (0.3ms) using a 2D motion-sensitised pencil beam, with total data acquisition time fitting into four consecutive breath holds. These images were used to estimate liver stiffness, with a high temporal resolution allowing for reliable fitting to the space-time images and thus robust speed estimates.

4738	Computer 111	Comparison of different multi-fat peak models for the assessment of hepatic iron and fat
		Christian Kremser[1], Michaela Plaikner[1], Heinz Zoller[2], Werner Jaschke[1], and Benjamin Henninger[1]
		[1]Dept. of Radiology, Medical University of Innsbruck, Innsbruck, Austria, [2]Dept. of Internal Medicine, Medical University of Innsbruck, Innsbruck, Austria
		The evaluation of hepatic iron and fat by MR techniques is of increasing interest for clinical routine. The purpose of our study was to investigate the influence of different multi-peak fat models on the obtained R_2*, PDFF and goodness of fit values in patients with suspicion of diffuse liver disease. It is shown that the use of multi-peak fat spectrum modeling is highly recommended for accurate quantification of R_2* and PDFF . A 6-peak model resulted in the best goodness of fit. The use of a higher number of peaks seems to offer no additional advantage.

4739	Computer 112	Selective detection of liver fibrosis: Perfusion with hypercapnia challenge rather than T1 mapping.
		John J Connell[1], Thomas A Roberts[1], May Zaw-Thin[1], P Stephen Patrick[1], Rajiv Ramasawmy[1], Daniel J Stuckey[1], Manil D Chouhan[2], Daniel Antoine[3], Jack A Wells[1], Mark F Lythgoe[1], and Tammy L Kalber[1]
		[1]Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom, [2]Centre for Medical Imaging, University College London, London, United Kingdom, [3]University of Liverpool, Liverpool, United Kingdom
		Quantitative T1 mapping is starting to be used clinically as a measure of liver fibrosis, but is confounded by the presence of inflammation in the liver. Work presented here describes the development of a new quantitative MRI measure, “change in perfusion in response to CO_2 gas challenge”, in mice. This vasoactive challenge takes advantage of the pathological hallmarks of perivascular collagen seen in fibrosis, which is hypothesised to attenuate increases in tissue perfusion during hypercapnia.

4740	Computer 113	The preliminary study of staging liver fibrosis in patients with chronic hepatitis B using MR T1ρ
		Qing Li[1], Shuangshuang Xie[1], Hanxiong Qi[1], Zhizheng Zhuo[2], Yue Cheng[1], and Wen Shen[1]

		[1]Radiology department, Tianjin First Center Hospital, Tianjin, China, [2]Philips healthcare, Beijing China, Beijing, China
		This study explored the value of MR T1ρ in patients with chronic hepatitis B. Twenty normal control subjects and forty-eight patients with chronic hepatitis B, including twenty-two patients who were confirmed by liver biopsy (F1/F2/F3=8/8/6) took the MR T1ρ scan. T1ρ value showed significant increase in patients with chronic hepatitis B compared with normal control subjects, significant correlation with liver fibrosis staging and higher sensitivity and specificity in identifying F1 to F3 of liver fibrosis. We conclude that MR T1ρ can provide reliable T1ρ values and can be used to assess liver fibrosis.

4741	Computer 114	Relevance of susceptibility weighted imaging with phase (SWIp) in Cholelithiasis
		Jaladhar Neelavalli[1], Rakesh Kumar Gupta[2], Anandh Kilpattu Ramaniharan[1], Pradeep Kumar Gupta[2], Karthick Raj Rajendran[3], and Rupsa Bhattacharjee[3]
		[1]Philips Innovation Campus, Philips India Limited, Bengaluru, India, [2]Fortis Memorial Research Institute, Gurugram, India, [3]Philips India Limited, Gurugram, India
		Cholelithiasis, which is presence of stones in the biliary anatomy, is a common clinical condition with an incidence of up to 15% worldwide. Magnetic resonance cholangiopancreatography (MRCP) is a standard MR technique used for diagnosing this condition. However, MRCP's sensitivity is low when the stones are smaller than 5mm. These stones often contain trace amounts of minerals that are dia/paramagnetic. SWI is highly sensitive to susceptibility differences and hence we hypothesized that it may play a role in clinical evaluation of presence of gallstones. In this work we evaluated this hypothesis by imaging patients with Cholelithiasis using a modified SWI sequence.

4742	Computer 115	GRASE Revisited: Breath-hold Three-dimensional (3D) Magnetic Resonance Cholangiopancreatography using a Gradient and Spin Echo (GRASE) Technique at 3T
		Ju Gang Nam[1,2], Jeong Hee Yoon[3], Jeong Min Lee[3], Hyo-Jin Kang[4], Sang Min Lee[5], Johannes M. Peeters[6], and Eunju Kim[7]
		[1]Radiology, Seoul National University Hostpital, Seoul, Republic of Korea, [2]Radiology, Seoul National University, Seoul, Republic of Korea, [3]Seoul National University Hospital, Seoul, Republic of Korea, [4]Seoul National University Hostpital, Seoul, Republic of Korea, [5]Hallym University Sacred Heart Hospital, Gyeonggi-do, Republic of Korea, [6]Philips MR Clinical Science, Best, Netherlands, [7]Philips Healthcare Korea, Seoul, Republic of Korea

		We evaluate the clinical feasibility and image quality of breath-hold (BH) three-dimensional (3D) MRCP using a gradient and spin-echo (GRASE) technique compared to the conventional 3D respiratory-triggered (RT)-MRCP using a turbo spin-echo (TSE) sequence at 3T. Sixty-six patients underwent both 3D RT-TSE-MRCP and 3D BH-GRASE-MRCP at 3T and three radiologists independently reviewed the images. The 3D BH-GRASE-MRCP had a significantly better image quality. In detail, 3D BH-GRASE-MRCP better depicted the common bile duct, cystic duct, and bilateral 1st intrahepatic duct. The number of scans with nondiagnostic or poor image quality significantly decreased with 3D BH-GRASE-MRCP compared with 3D RT-TSE-MRCP.

4743	Computer 116	Comparison of Respiratory Motion Artifacts in T1-Weighted Liver Magnetic Resonance Imaging using End-expiration and End-inspiration Breath-Holds
		Kim Nhien Vu[1], Albert Tae-Hun Roh[1], Anshul Haldipur[2], Peter Lindholm[1], and Andreas Markus Loening[1]
		[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Radiology, Dignity Health Medical Foundation, San Francisco, CA, United States
		Respiratory motion artifact is a common pitfall in MRI of the liver and no standard of practice currently exists for breath-hold imaging techniques. This retrospective observational study compared image quality between end-inspiration and end-expiration breath-holding techniques. Precontrast T1-weighted 3D spoiled gradient recalled echo imaging of the liver obtained using the two techniques were compared in 50 consecutive subjects, along with postcontrast sequences in a subset of 47. Three radiologists performed blinded evaluations of respiratory motion in the sequences. Breath-holding technique at end-expiration was significantly better at reducing respiratory motion artifacts, yielding fewer images of nondiagnostic quality than end-inspiration breath-holding technique.

4744	Computer 117	4D Flow MRI: A Preliminary Analysis of Changes in Arterial Flow During Liver Embolization In Swine
		Carson Anthony Hoffman[1], Ece Meram[2], Paul Laeseke[2], and Oliver Wieben[1,2]
		[1]Medical Physics, University of Wisconsin Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin Madison, Madison, WI, United States
		Transarterial embolization is a common treatment for liver tumors. Currently, radiographic techniques are used clinically to provide anatomical and qualitative hemodynamic information in assessment and treatment of liver tumors. The addition of 4D Flow MRI has the potential to provide functional information about the hemodynamic changes occurring pre, during and post treatment. We completed a feasibility study in a swine, in which clear flow changes were seen in the hepatic vascular system. The additional information provided by 4D Flow MRI has potential to improve the care of cancer patients.

4745	Computer 118	Incorporating Motion-Sorting Technique into Keyhole and k-t GROWL Compound System for Rapid Golden-angle Liver DCE Imaging
		Zhifeng Chen[1], Liyi Kang[1], Ling Xia[1], Xia Kong[2], Allan Jin[3], Zhongbiao Xu[4], Yaohui Wang[5], and Feng Liu[6]
		[1]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Wuhan Institute of Physics and Mathematics (WIPM) of Chinese Academy of Sciences, Wuhan, China, [3]Philips Healthcare, Shanghai, China, [4]School of Biomedical Engineering, Guangdong Provincial Key Laborary of Medical Image Processing, Southern Medical University, Guangzhou, China, [5]South China University of Technology, Guangzhou, China, [6]School of Information Technology and Electrical Engineering, The University of Queensland, Brisbane, Australia
		Liver DCE imaging plays an increasingly important role in the diagnosis of liver diseases, including hepatic cirrhosis, hepatocellular carcinoma, etc. Motion is an inevitable problem in liver imaging, which often leads to motion artifacts and blurring on image details. We propose to incorporate motion-sorting technique into parallel imaging GROWL and Keyhole compound system for golden-angle radial dynamic contrast-enhanced MRI. The experimental results demonstrated that the proposed scheme can generate better image quality than non-motion-sorting techniques. Compared to the tested motion-sorting techniques, similar image quality can be offered with greatly reduced computational cost.

4746	Computer 119	Evaluation of Fat-Only Self Gated Signal for Respiratory Motion Detection and Compensation in the Liver
		Thomas Martin[1], Tess Armstrong[1], Alibek Danyalov[1], Eunice Lee[1], Ely Felker[1], James Sayre[1], Steven Raman[1], Holden Wu[1], and Kyunghyun Sung[1]
		[1]Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States
		A dual-echo 3D golden angle radial gradient echo sequence can be used for generating a fat-only self-gated signal for respiratory motion detection. We have demonstrated that respiratory motion extraction and compensation in the liver can be achieved using fat-only self-navigated signal with minimal error in the fat-water separation (< 15%). Using this technique has implications of a more robust motion correction for liver DCE-MRI due to its inherent separation between respiratory motion signal and contrast uptake.

4747	Computer 120	Gd-EOB-DTPA-Enhanced MRI for Assessment of Liver Function: Comparison between Signal Intensity and T1 Relaxation Time-Based Indices
		Xueqin ZHANG[1], Jian LU[1], Jifeng JIANG[1], and Weibo CHEN[2]
		[1]Department of Radiology, the Third People's Hospital of Nantong, Nantong, China, [2]Philips Healthcare Shanghai, Shanghai, China

The purpose of this study was to compare the ability of Gd-EOB-DTPA-enhanced signal intensity (SI) and T1 relaxation time-based indices for evaluation of liver function. We used Gd-EOB-DTPA-enhanced MRI and Look-Locker sequences to acquire conventional MRI and T1mapping images. The SI values of the liver, paravertebral muscle, T1 relaxation times of the liver before Gd-EOB-DTPA administration and in HBP were measured, the relative enhancement of the liver, increase rates of liver-to-muscle ratio, reduction rates of T1 relaxation time and ΔR1 were calculated, our study showed that the indices derived from T1 relaxation time were superior to SI-based indices.

Electronic Poster

Novel Techniques & Methods

Exhibition Hall	Wednesday 13:45 - 14:45

4748 Computer 1

Respiratory motion-corrected simultaneous myocardial viability PET and coronary MR angiography: initial clinical validation

Camila Munoz[1], Karl P Kunze[2], Radhouene Neji[3], Christoph Rischpler[2], René M Botnar[1], Stephan G Nekolla[2], and Claudia Prieto[1]

[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Nuclear Medicine, TU Munich, Munich, Germany, [3]MR Research Collaborations, Siemens Healthcare, Frimley, United Kingdom

Cardiac PET-MR imaging has shown promising results for the comprehensive assessment of coronary artery disease. Here we present an initial clinical validation of a recently demonstrated respiratory motion-corrected PET-MR framework in patients with chronic total occlusion. Simultaneous visualization of the coronary lumen by Coronary MR Angiography (CMRA) and myocardial viability by 18F-FDG PET was compared against X-ray angiography and LGE-MRI. We demonstrate that the proposed framework produces diagnostic images in both modalities in a short and time-efficient examination of ~12 minutes. Motion correction improved visible length and sharpness of the coronary arteries by CMRA and delineation of the myocardium and noise reduction by 18F-FDG PET, resulting in good agreement with X-ray angiography and LGE-MRI.

4749 Computer 2

Non-invasive MR-based blood oximetry via multi-parametric, non-linear estimation: initial multi-center experience in adult and pediatric patients

Juliet Varghese[1], Lajja Desai[2], Rizwan Ahmad[1,3], Lee C Potter[4], Ning Jin[5], Cynthia K Rigsby[2], Paul Tannous[2], Aimee K Armstrong[6], Michael Markl[7], Kan N Hor[6], Subha Raman[1,8,9], and Orlando P Simonetti[1,8,9]

		[1]Dorothy M. Davis Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States, [2]Northwestern University School of Medicine, Ann and Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [3]Department of Biomedical Engineering, The Ohio State University, Columbus, OH, United States, [4]Department of Electrical and Computer Engineering, The Ohio State University, Columbus, OH, United States, [5]Cardiovascular MR R&D, Siemens Medical Solutions USA, Inc, Columbus, OH, United States, [6]The Heart Center, Nationwide Children's Hospital, Columbus, OH, United States, [7]Departments of Radiology and Biomedical Engineering, Northwestern University Feinberg School of Medicine, Chicago, IL, United States, [8]Division of Cardiovascular Medicine, Department of Internal Medicine, The Ohio State University, Columbus, OH, United States, [9]Department of Radiology, The Ohio State University, Columbus, OH, United States
		Non-invasive estimation of blood oxygen (O2) saturation by magnetic resonance (MR) imaging would be useful in evaluating shunt severity in congenital heart disease, and oxygen delivery and consumption energetics in heart failure and pulmonary hypertension. A T2-based, non-linear, multi-parameter method has been developed to non-invasively determine O2 saturation in the heart and great vessels. In this multi-center study, the feasibility and accuracy of the technique is evaluated against gold-standard catheterization measurements in the cardiac chambers and vessels in a preliminary cohort of adult and pediatric patients with cardiovascular disease.

4750	Computer 3	Imaging inflammation following MI using hyperpolarized pyruvate and 3D Spectral-Spatial EPI
		Jack J J J Miller[1,2,3], Andrew J Lewis[1,3], Carolyn A Carr[3], Oliver Rider[1], Stefan Neubauer[1], and Damian J Tyler[1,3]
		[1]Oxford Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom, [2]Department of Physics, University of Oxford, Oxford, United Kingdom, [3]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, United Kingdom
		Current clinical imaging techniques offer only limited assessment of innate immune cell driven inflammation, which is an emerging therapeutic target in myocardial infarction. However, macrophages have a defined metabolic phenotype and are highly glycolytic when activated following injury. Here we show that hyperpolarized [1-$^{13}$C]pyruvate imaging specifically detects this phenotype, which is altered by pharmacological blockade that modulates monocyte/macrophage inflammatory function both in vitro and in vivo. We conclude that cardiac hyperpolarized [1-$^{13}$C]lactate several days post insult reflects immunology, and not necessarily ischaemia.

4751	Computer 4	Simultaneous 3D whole-heart bright-blood and black blood imaging for cardiovascular anatomy and wall assessment with interleaved T2prep-IR
		Giorgia Milotta[1], Giulia Ginami[1], Radhouene Neji[2], Claudia Prieto[1], and René Botnar[1]
		[1]King's College London, London, United Kingdom, [2]Siemens Healthcare, London, United Kingdom

		Visualization of cardiovascular anatomy is important for diagnosis, risk stratification and planning of interventional procedures both in patients with congenital and non-congenital heart disease. This study proposes a novel free-breathing 3D whole-heart flow-independent approach for bright-blood visualization of coronary lumen and cardiac structures and for black-blood delineation of aortic, atrial, and coronary artery walls. The use of image-based navigation and non-rigid respiratory motion correction allows for 100% scan efficiency, predictable scan time and improved image sharpness.

4752	Computer 5	Accelerated Coronary 4D-Flow MRI: towards noninvasive functional assessment of stable coronary artery disease
		Zixin Deng[1], Michael Loecher[2], Anthony Christodoulou[1], Christopher Nguyen[1], Zhengwei Zhou[1], Jaime Shaw[1], Yibin Xie[1], Xiaoming Bi[3], Zhaoyang Fan[1], Daniel Ennis[2], and Debiao Li[1]
		[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [3]Siemens Healthcare R&D, Los Angeles, CA, United States
		In patients with suspected coronary artery disease (CAD), invasive catheterization is commonly used to determine the need for coronary revascularization. However, recent studies have shown that >50% of patients who undergo invasive catheterization have non-significant coronary lesions, hence the procedure was unnecessary. Recent work using 4D-Flow and the Navier-Stokes equations has shown promise for the noninvasive assessment of CAD, but still requires long scan times. This work explored coronary 4D-Flow using a stack-of-stars acquisition and compressed sensing to achieve 2-3x acceleration. The goal was to develop a more clinically feasible noninvasive pressure gradient measurement method for the assessment of CAD.

4753	Computer 6	Surveillance of abdominal aortic aneurysm using accelerated 3D non-contrast black-blood MRI with compressed sensing (CS-DANTE-SPACE)
		Chengcheng Zhu[1], Lizhen Cao[1,2], Zhaoying Wen[1,3], Sinyeob Ahn[4], Esther Raithel[5], Christoph Forman[5], Michael D Hope[1], and David Saloner[1]
		[1]Radiology, University of California, San Francisco, San Francisco, CA, United States, [2]Radiology, Xuanwu Hospital, Beijing, China, [3]Radiology, Anzhen Hospital, Beijing, China, [4]Siemens Healthcare, San Francisco, CA, United States, [5]Siemens Healthcare, Erlangen, Germany
		Although 3D non-contrast high-resolution black-blood MRI (DANTE-SPACE) is a promising tool for the surveillance of abdominal aortic aneurysm (AAA), it requires lengthy scans (~7 minutes). We implemented a compressed sensing method (CS-DANTE-SPACE) to reduce the scan time by 41% (to ~4 minutes), and tested its feasibility in 20 AAA patients undergoing routine follow-up. We found CS-DANTE-SPACE achieved accurate diameter/area measurements and intraluminal thrombus (ILT) identification, and provided better contrast and vessel sharpness. CS-DANTE-SPACE is a promising tool for AAA surveillance in the clinical setting.

4754	Computer 7	Imaging lower extremity vein thrombosis using a 3D FSE with novel modulated flip angle scheme and random k-space undersampling
		Ling Zhang[1], Jie Zhang[2], Rui Li[3], Shuo Chen[3], Chaohong Wang[4], Nan-Jie Gong[4], Guobin Li[4], and Ruchen Peng[1]
		[1]Department of Radiology, Beijing Luhe Hospital, Capital Medical University, Beijing, China, [2]Department of Vascular Surgery, Beijing Luhe Hospital, Capital Medical University, Beijing, China, [3]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China, [4]United Imaging Healthcare Co. Ltd, Shanghai, China
		Accurate detection of lower extremity vein thrombosis (LEVT) and assessment of its stage are crucial for treatment decision-making. Challenges such as long scan time and requirement for dark-blood, exist in T2-weighted MR imaging of LEVT. A 3D FSE with novel modulated refocusing flip angles and random undersampling is introduced and applied to imaging of LEVT.

4755	Computer 8	Late gadolinium enhancement by cardiovascular magnetic resonance, combined with right ventricle ejection fraction, for assessing the severity and predicting the prognosis of chronic thromboembolic pulmonary hypertension
		Ming-xi Liu[1], Juan-ni Gong[2], Xiao-juan Guo [1], Zhan-hong Ma[3], Tao Jiang[3], Jing An[4], Lu Liang[1], Yuan-hua Yang[2], and Tu-guang Kuang[2]
		[1]Radiology, Beijing Chaoyang Hospital, Beijing, China, [2]Respiratory, Beijing Chaoyang Hospital, Beijing, China, [3]Beijing Chaoyang Hospital, Beijing, China, [4]Siemens Healthcare, Beijing, China
		The aim of this study was to assess the severity and predict the prognosis of chronic thromboembolic pulmonary hypertension (CTEPH) using cardiovascular magnetic resonance with late gadolinium enhancement (LGE) combined with the right ventricle ejection fraction. Based on right heart catheterization, the percentages of the myocardial fibrosis volume (pFV＞7.00%) and right ventricle ejection fraction (RVEF＜34.34%) cut-off values were determined to assess the severity and predict the prognosis of 30 patients with CTEPH. The pFV and LGE are complementary to the RVEF for assessing the severity of the condition and can be a strong prognostic factor in patients with CTEPH.

4756	Computer 9	Volumetric black-blood fast spin echo with variable refocusing pulses for the visualization of whole-heart and great vessels
		Markus Henningsson[1], Gerald Greil[2], Riad Abou Zahr [2], Animesh Tandon[2], Barbara Burkhardt[2], and Tarique Hussain[2]

		[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Department of Pediatrics and Radiology, UT Southwestern Medical Center, Dallas, TX, United States
		We describe the use of black-blood 3D fast spin echo with variable refocusing flip angles for whole-heart imaging. The technique allows efficient, volumetric high-resolution imaging of the heart and great vessels, and improves aortic vessel wall delineation compared to conventional 2D double-inversion recovery. It also provides complementary diagnostic information to 3D bright-blood bSSFP, particularly for the visualization of pulmonary veins. This was demonstrated in a study of 8 patients with congenital heart disease.

4757	Computer 10	Significant Improvement of Blood Suppression in Cardiac Dark-Blood T1-TSE Imaging By Combining the T2-TSE Blood Nulling Strategy with Dummy Acquisitions for Myocardial T1-Weighting – A Comparison of Conventional and Novel TSE Techniques for Blood Signal Suppression and Overall Image Quality at 3T
		Wolfgang G Rehwald[1,2], Louis Klem[2], Stephen Darty[2], Nestor Mena[2], George Gamoneda[2], and Raymond J Kim[2]
		[1]MR R&D Collaborations, Siemens Healthineers, Malvern, PA, United States, [2]Duke Cardiovascular MR Center, Duke University, Durham, NC, United States
		Cardiac dark-blood (DB) T1-turbo-spin echo (TSE) imaging frequently suffers from poor blood suppression due to its short effective TR required for good myocardial T1-weighting. We present a novel DB T1-TSE sequence that simultaneously applies a long effective TR as in T2-TSE to blood and a short effective TR as in conventional T1-TSE to myocardium, by means of dummy readouts. We ran conventional T1-TSE, T2-TSE, and novel T1-TSE sequences in 53 patients and scored the images for DB performance and overall image quality. Quality and blood suppression were drastically improved by novel T1-TSE.

4758	Computer 11	MRI-Based Stress Analyses of Abdominal Aortic Aneurysms With Resolved Intraluminal Thrombus Heterogeneity
		Joseph R Leach[1], Chengcheng Zhu[1], David Saloner[1], and Michael D Hope[1]
		[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States

		Computational stress analyses of abdominal aortic aneurysms (AAA) are of great interest for individual aneurysm rupture risk assessment. The vast majority of patient-specific stress analyses are based on features seen at computed tomography, which is incapable of resolving material heterogeneity within intraluminal thrombus. Using T1-weighted black blood MRI, we imaged and explicitly modeled MRI-discerned intraluminal thrombus heterogeneity in multiple AAA stress analyses. Results demonstrate a limited effect of thrombus heterogeneity on the predicted vessel wall stresses, but suggest a possible role for MRI to inform thrombus material stiffness assignment in stress computations.

4759	Computer 12	Proton magnetic resonance spectroscopy to assess lipid content in cardiac amyloidosis
		Mareike Gastl[1,2,3], Sophie Peereboom[1], Alexander Gotschy[1,2], Maximilian Fuetterer[1], Constantin von Deuster[1], Florian Bönner[3], Malte Kelm[3], Andreas Flammer[2], Robert Manka[1,2,4], and Sebastian Kozerke[1]
		[1]Institue for Biomedical Engineering, ETH Zürich, Zürich, Switzerland, [2]Department of Cardiology, University Heart Center, University Hospital Zurich, Zürich, Switzerland, [3]Department for Cardiology, Pneumology and Angiology, Heinrich Heine University, Düsseldorf, Düsseldorf, Switzerland, [4]Institute of Diagnostic and Interventional Radiology, University Hospital Zürich, Zürich, Switzerland
		Amyloidosis is a multisystemic disorder frequently affecting the heart and causing heart failure. In this work, MR imaging and spectroscopy was implemented and applied to characterize myocardial structure and function as well as changes in fatty acid storage of the heart. We found that myocardial triglyceride-to-water ratio was significantly decreased in amyloidosis compared to age-and body mass index-matched controls. Myocardial triglyceride-to-water ratio showed a negative tendency with increasing markers of heart failure. It is concluded that proton spectroscopy may provide an additional biomarker to gauge progression of cardiac amyloidosis.

4760	Computer 13	Practical implementation of SMS bSSFP in the Heart
		Vanessa Landes[1], Terrance Jao[2], and Krishna Nayak[3]
		[1]Biomedical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [3]Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States
		Cardiac MRI frequently relies on balanced stead-state free precession (bSSFP) for its beneficial contrast and SNR efficiency. Simultaneous multi-slice (SMS) imaging, specifically blipped controlled aliasing in parallel imaging, faces two major challenges with cardiac bSSFP: 1) artifacts from non-uniform signal in the through-slice direction and 2) spuriously excited side-lobes from imperfect multi-band excitation. We carefully evaluate both challenges using simulations and phantom experiments, and demonstrate practical SMS bSSFP imaging with 3-slice coverage (apical, mid, and basal short axis slices) at 3 Tesla, with good image quality in both transient-state and steady-state.

4761	Computer 14	Reconstruction of the 12-lead ECG using a novel MR-compatible ECG sensor network Jesus E Dos Reis[1,2], Paul Soullié[2], Grégory Petitmangin[1], Freddy Odille[2,3], and Jacques Felblinger[2,3] *[1]Schiller Medical SAS, Wissembourg, France, [2]IADI, INSERM U947 and Université de Lorraine, Nancy, France, [3]CIC-IT 1433, INSERM, Université de Lorraine and CHRU Nancy, Nancy, France* Currently patient monitoring and sequence triggering during MR imaging are achieved using a low bandwidth ECG of 1Hz-60 Hz. Such devices provide a limited number of ECG leads and thus do not provide the same diagnostic information as the standard 12-lead ECG. In this work we developed a high-bandwidth MR-compatible ECG sensor (0.05Hz – 150 Hz) that integrates real-time signal processing for ECG denoising. Several individual sensors are combined to reconstruct a 12-lead ECG during MR imaging. The system was tested on a volunteer at 1.5T and could be used during MR-guided intervention or for inverse ECG imaging.

4762	Computer 15	A Normalized Segmented T2STIR-bSSFP Technique for High Resolution Edema Imaging Lixian Zou[1], Yanjie Zhu[1], Dong Liang[1], and Xin Liu[1] *[1]Shenzhen Institutes of Advanced Technology,Chinese Academy of Sciences, Shenzhen, China* High resolution edema image is highly desired for reducing particle volume effect (PVE) on thin myocardium. In this work, we proposed a normalized segmented T_2STIR-bSSFP to improve base resolution from 192 to 320 in edema imaging as well as maintain high contrast of edema to myocardium. The results show that the proposed method can reduce PVE on thin myocardium and makes edema imaging for the right ventricle myocardium being possible.

4763	Computer 16	5D cardiac MRI on mouse models : preliminary results Julia Labrune[1], Aurélien J Trotier[1], Emeline J Ribot[1], and Sylvain Miraux[1] *[1]CRMSB UMR5536, CNRS-Univ.Bordeaux, Bordeaux, France* Until now, the data acquired during breathing period are not used to obtain 4D cardiac images on mouse models. Consequently, the purpose of the work presented here is to evaluate the impact of breathing on the movement of the mouse's heart and to develop a method for reconstructing the cardiac self-gating signal during respiration. Finally, preliminary results of 5D image reconstruction (3D images during the heart rate and according to respiratory movement) will be shown in mice.

4764	Computer 17	Tracking of PLGA-PFCE-labeled Cardiac Stem Cells Seeded on Novel Biodegradable Poly(3-hydroxyoctanoate) Scaffolds Implanted on the Murine Myocardium using 1H and 19F MRI/MRS Chris Constantinides[1], Pooja Basnett[2], Barbara Lukasiewicz[2], Ricardo Carnicer Hijazo[1], Mangala Srinivas[3], Carolyn Carr[1], and Ipsita Roy[2] *[1]U. Oxford, Oxford, United Kingdom, [2]U. Westminster, London, United Kingdom, [3]Radboud University Medical Center, Nijmegen, Netherlands* Controlled administration of cardiac progenitor stem cells (CPCs), and their visualization and tracking and release, still present tremendous challenges in cellular/tissue therapy, yet fundamental and necessary tasks towards a therapeutically successful approach. In this work, we propose the synthesis and use of novel, functional biodegradable, biocompatible, Polyhydroxyalkanoate (PHA) and Poly-caprolactone (PCL) polymer blend scaffolds to: a) achieve controlled delivery of CPCs, thereby prolonging the viability, and maximizing retention of delivered stem cells to the murine myocardium, and b) the use of 19F MRI/MRS to noninvasively detect, and monitor the cells temporally.

4765	Computer 18	T1-mapping Cardiac-Manganese Enhanced MRI: Assessment of Calcium Homeostasis and Ischemic Injury in Mice Nur Hayati Jasmin[1,2], Laurence H Jackson[3], Thomas A Roberts[4], Valerie Taylor[1], Mark F Lythgoe[1], and Daniel J Stuckey[1] *[1]Division of Medicine, UCL Centre for Advanced Biomedical Imaging, London, United Kingdom, [2]School of Medical Imaging, Universiti Sultan Zainal Abidin, Terengganu Darul Iman, Malaysia, [3]Biomedical Engineering, Kings College London, London, United Kingdom, [4]Perinatal Imaging & Health, Kings College London, London, United Kingdom* Intracellular MR contrast agents can provide essential information on cell viability. Manganese (Mn^{2+}) is an efficient intracellular MR contrast agent. As an analogue of Calcium, Mn^{2+}-induced changes in T1 and can be used as an indicator of the rate of Ca^{2+} influx into cardiomyocytes in vivo and could provide additional information to that routinely acquired using late Gd-enhanced MRI. By preloaded the myocardium with Mn^{2+} prior to coronary occlusion, we showed that MEMRI T1-mapping allows sensitive in vivo detection of subtle changes and accumulation of Mn^{2+} in viable myocytes in the early phase of myocardial injury.

4766	Computer 19	Detection of early phase of deep vein thrombosis with diffusion-weighted magnetic resonance imaging. Yasuyoshi Kuroiwa[1,2], Atsushi Yamashita[2], Toshihiro Gi[2], Yuko Mizutani[3], Taketoshi Asanuma[3], Tosiaki Miyati[4], Takuroh Imamura[5], and Yujiro Asada[2]

		[1]Department of Radiological Technology, Koga general hospital, Miyazaki, Japan, [2]Department of Pathology, Faculty of Medicine, University of Miyazaki, Miyazaki, Japan, [3]Department of Radiology, Faculty of Veterinary Medicine, University of Miyazaki, Miyazaki, Japan, [4]Faculty of Health Sciences, Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan, [5]Department of Internal Medicine, Koga General Hospital, Miyazaki, Japan
		To detect and characterize deep vein thrombus (DVT), we performed diffusion weighted magnetic resonance imaging (MRI) in 8 patients and a rabbit model of DVT. All patients were detected DVT as high or mixed high and iso signal intensity on diffusion weighted MRI. The rabbit venous thrombi showed high signal intensity on diffusion weighted MRI at 4 hours, or mixed iso to high and low signal intensity at 1, 2, 3 weeks. The signal intensity was positively correlated with erythrocyte contents. Diffusion weighted MRI can detect DVT and high signal intensity on the sequence may reflect early phase of DVT.

4767	Computer 20	Feasibility of EPI for cardiac diffusion at 7T
		Elizabeth M Tunnicliffe[1], Jesper L R Andersson[2], Aaron T Hess[1], and Matthew D Robson[1]
		[1]Oxford Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom, [2]Oxford Centre for Functional MRI of the Brain, University of Oxford, Oxford, United Kingdom
		Cardiac diffusion imaging promises new insights into myocardial microstructure and integrity, but is an SNR-starved technique. Imaging at 7T may enable fewer signal averages, but most cardiac diffusion implementations use an EPI readout, which suffers from spatial distortion at higher field strengths. In this work we demonstrate distortion-corrected, EPI-based, cardiac diffusion tensor imaging at 7T using images acquired with forward and reversed phase encoding directions. We find myocardial ADC and FA consistent with previously published 3T data and that, with this acquisition protocol, distortion correction does not lead to statistically significant changes in ADC and FA.

4768	Computer 21	Assessing the optimal preparation strategy to minimize variability of pyruvate dehydrogenase flux measurements with hyperpolarized [1-13C]pyruvate MRS in control and type 2 diabetic rats
		Kerstin N Timm[1], Andrew Apps[2], Vicky Ball[1], Jack J Miller[1,2,3], Michael S Dodd[1], and Damian J Tyler[1,2]
		[1]Department of Physiology Anatomy and Genetics, University of Oxford, Oxford, United Kingdom, [2]Oxford Center for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom, [3]Department of Physics, University of Oxford, Oxford, United Kingdom

		Hyperpolarized [1-^{13}C] pyruvate MRS measures pyruvate dehydrogenase (PDH) flux in vivo in the heart through ^{13}C-label incorporation into bicarbonate. Substrate availability modulates PDH flux; clinical protocols attempt to standardize flux with oral glucose loading prior to scanning, while rodents in preclinical studies are scanned in the fed state. We set out to establish whether feeding or glucose loading leads to more reproducible measurements of PDH flux in control rats, and found a variability of 45.1% in fed and 50.0% in glucose-loaded animals. Furthermore, glucose loading did not alter the low PDH flux seen in type II diabetic rats.

4769	Computer 22	Quantitative modeling and detection of flux through pyruvate dehydrogenase in human myocardium
		Jeffry R. Alger[1], Jian-xiong Wang[1], Jeannie Baxter[1], Jeff Liticker[2], Crystal Harrison[1], Vlad Zaha[3], Albert Chen[4], Salvador Pena[1], Lucy Christie[1], Richard Martin[1], Kelley Derner[1], Carol Parcel[1], A. Dean Sherry[1], and Craig R. Malloy[1]
		[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [2]Simmons Cancer Center, UT Southwestern Medical Center, Dallas, TX, United States, [3]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States, [4]University of Toronto, Toronto, ON, Canada
		Flux through pyruvate dehydrogenase, a key regulatory enzyme, may be detected in human myocardium by hyperpolarization (HP) technology. A previously-validated model for quantitation of pyruvate metabolism in isolated hearts was extended to human myocardium. HP [^{13}C]bicarbonate and HP[1-^{13}C]lactate were detected from heart muscle after injection of ~0.43 mL/kg of 250mM HP[1-^{13}C]pyruvate in four healthy subjects. All subjects tolerated the procedure well. Kinetic modeling yielded a rate constant for oxidation of pyruvate to bicarbonate of 0.005 sec^{-1}, lower than that reported for isolated rodent hearts. Assessment of PDH flux in human myocardium is feasible with hyperpolarization technology.

4770	Computer 23	Fast multi-slice myocardial T1 mapping (FAST1)
		Li Huang[1], Radhouene Neji[1,2], Reza Razavi[1], and Sébastien Roujol[1]
		[1]School of Biomedical Engineering and Imaging Sciences, Faculty of Life Sciences and Medicine, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Frimley, United Kingdom
		Myocardial T1 mapping shows promise for the detection of cardiomyopathy. The widely-used inversion recovery based approaches, such as MOdified Look-Locker Inversion recovery (MOLLI), can only generate a single T1 map from one breathhold scan. In this study, we developed a novel FASt multi-slice myocardial T1 mapping (FAST1) approach in a single breathhold using slice-selective inversion recovery, two inversion times per slice and an advanced reconstruction approach. This technique was evaluated in a phantom as well as in healthy volunteers, and provided similar repeatability, limited precision penalty and increased spatial coverage compared to MOLLI.

4771	Computer 24	A New Myocardial T1-Mapping Technique: MOSHA
		Majid Sohani[1,2], Sébastien Roujol[3], Andrew J. Powell[1], Andreas Maier[2], and Mehdi H. Moghari[1]
		[1]Departments of Cardiology and Pediatrics, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States, [2]Department of Pattern Recognition, University of Erlangen-Nuremberg, Erlangen, Germany, [3]School of Biomedical Engineering and Imaging Sciences, Faculty of Life Sciences and Medicine, King's College London, London, United Kingdom
		To develop an accurate and precise T1-mapping sequence, we combined the modified Look-Locker inversion recovery (MOLLI) and saturation recovery single-shot acquisition (SASHA) sequences--MOSHA. Compared to SASHA, MOSHA had similar accuracy and higher precision. Compared to MOLLI, MOSHA had better accuracy and lower precision.

Electronic Poster

Cardiovascular Image Processing

Exhibition Hall	Wednesday 13:45 - 14:45

4772	Computer 25	Combined fractal and connected component analysis for characterization of cardiac fibrosis distribution in end stage renal disease patients on routine hemodialysis
		Zeynep Ali[1], Bonnie Lam[1], and Moriel Vandsburger[1]
		[1]Bioengineering, UC Berkeley, Berkeley, CA, United States
		A magnetization transfer based MRI technique for measurement of cardiac fibrosis was applied to 34 end stage renal disease patients on routine hemodialysis and 19 controls. Short axis maps of changes in tissue magnetization transfer properties were combined to create 3D domains in which anatomical connectivity of voxels in the myocardium was linearized. Connected component analysis was used to isolate distinct spatially connected sub-regions of myocardium and fractal analysis of magnetization transfer changes was applied to the whole myocardium as well as these sub-regions. The measured fractal dimensions show tissue-level structural differences between the different tissue types and patient populations.

4773	Computer 26	Towards automatic analysis of 4D Flow MRI: Automatic cardiac segmentation
		Mariana Bustamante[1,2], Vikas Gupta[1,2], Daniel Forsberg[2,3], Carl-Johan Carlhäll[1,2,4], Jan Engvall[2,4], and Tino Ebbers[1,2]

[1]Department of Medical and Health Sciences, Division of Cardiovascular Medicine, Linköping University, Linköping, Sweden, [2]Center for Medical Image Science and Visualization (CMIV), Linköping University, Linköping, Sweden, [3]Sectra AB, Linköping, Sweden, [4]Department of Clinical Physiology, Department of Medical and Health Sciences, Linköping University, Linköping, Sweden

One of the most important post-processing steps in the analysis of cardiac MR images is the segmentation of the blood pool, usually relying on manual delineation of the cardiac anatomy by an expert observer. Obtaining high quality segmentations of 4D Flow MR images acquired without the use of blood pool agents is especially challenging due to the low contrast between the blood and the myocardium present in these images. We propose an automatic multi-atlas segmentation technique that generates four-dimensional segmentations of the cardiac chambers and great thoracic vessels in 4D Flow MR images.

4774 Computer 27

A Simple Method for Post-Processing Correction of 3D Radial Trajectory Imperfections in 5D Cardiac MRI

Lorenzo Di Sopra[1], Jérôme Yerly[1,2], John Heerfordt[1,3], Davide Piccini[1,3], and Matthias Stuber[1,2]

[1]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [3]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland

Three-dimensional radial trajectories have shown important benefits for multidimensional MR imaging of the heart. However, the performance of radial scanning approaches is sensitive even to small trajectory imperfections, which can induce significant artifacts in the reconstructed images. Here, we implemented a simple and flexible post-processing technique for trajectory inaccuracy artifact compensation that does not require any pre-scan calibration or pulse sequence modification. The technique proved effective when applied to *in silico* and *in vitro* phantom datasets, and preliminarily results suggest good feasibility *in vivo* for fully self-gated and motion-resolved 5D cardiac imaging.

4775 Computer 28

Robust tissue tracking from cardiac cine MRI with deep-learning-based fully automatic myocardium segmentation

Xue Feng[1], Nicholas J Tustison[2], Kun Qing[2], Christopher M Kramer[2,3], and Craig H Meyer[1,2]

[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Radiology, University of Virginia, Charlottesville, VA, United States, [3]Medicine, University of Virginia, Charlottesville, VA, United States

		Tissue tracking post processing from cardiac cine MRI can be used to calculate myocardial deformation parameters without additional scans. One major drawback of the processing is reduced reliability due to interference from blood and trabecular muscle signals and varying image contrast. Manual segmentation of LV myocardium can improve the robustness but is time consuming. We developed a deep convolutional neural network to automatically segment myocardium and used symmetric deformable registration to obtain the tracking information from the resulting binary masks. The segmentation and tracking worked reliably well, resulting in accurate pixel movement trajectories.

4776	Computer 29	Strain elastography using a feature- tracking of cine cardiac magnetic resonance imaging: assessment of liver fibrosis in Fontan patients and tetralogy of Fallot
		Ryoko Ohashi[1], Michinobu Nagao[1], Umiko Ishizaki[1], Yuka Matsuo[1], Kenji Fukushima[1], Yasuhiro Goto[2], Yumi Shiina[3], Kei Inai[3], Seiko Simizu[4], Yuichiro Sano[4], Masami Yoneyama[5], and Shuji Sakai[1,2]
		[1]Department of Diagnostic imaging & Nuclear Medicine, Tokyo Women's Medical University, Tokyo, Japan, [2]Department of Radiological service, Tokyo Women's Medical University, Tokyo, Japan, [3]Department of Pediatric Cardiology, Tokyo Women's Medical University, Tokyo, Japan, [4]Toshiba Medical Systems Corporation, Tochigi, Japan, [5]Philips Electronics Japan, Tokyo, Japan
		We propose a new strain elastography to quantify hepatic fibrosis using feature tracking method of cardiac cine MRI, and investigate the strain elasticity in long-term post-operative patients after Fontan and intracardiac repair (ICR) for tetralogy of Fallot (TOF). The strain elasticity was lower for Fontan patients than that for TOF patients and controls, suggesting that liver fibrosis progresses after Fontan operation. The strain elastography using feature tracking method of cardiac cine MRI is a noninvasive new method for prediction of liver fibrosis.

4777	Computer 30	Automatic Quantification of Left Ventricular Non-compaction using Fractal Dimension and Parametric Ratio as Geometric Markers: Numerical Simulation and Clinical Evaluation
		Amol S. Pednekar[1], Carter Chu[2], Tobias Schlingmann[3], Zili David Chu[1], Siddharth Jadhav[1], Cory Noel[3], and Prakash Masand[1]
		[1]Radiology, Texas Children's Hospital, Houston, TX, United States, [2]Clements High School, Sugar Land, TX, United States, [3]Cardiology, Texas Children's Hospital, Houston, TX, United States
		BSSFP distinguishes the non-compacted trabeculation (NC) from compacted myocardium (C), however the current diagnostic criterion (NC/C>2.3) for left ventricular non-compaction (LVNC) suffers from subjective variability and tends to over-diagnose, especially in pediatric patients where LV trabeculation varies on a continuous spectrum. Numerical simulations estimate exponential relationship between fractal dimension (FD) and perimetric ratio (PR) with 11 times higher dynamic range for PR for the observed FD range in 30 LVNC positive and 20 negative controls. Both FD and PR indices distinguish LVNC positive from negative (p<0.0001), while the PR and FD*PR provided 6 and 11 times higher dynamic ranges respectively.

4778	Computer 31	CMRDiffTools: A Processing and Analysis Tool for Cardiac Diffusion MR images William A. Romero R.[1], Magalie Viallon[1], Martijn Froeling[2], Christian Stoeck[3], Sebastian Kozerke[3], Elizabeth Tunnicliffe[4], Andrew Scott[5], Pedro Ferreira[5], Eric Aliotta[6], Daniel Ennis[6], Kévin Moulin[6], and Pierre Croisille[1] *[1]Université de Lyon, UJM-Saint-Etienne, INSA, CNRS UMR 5520, INSERM U1206, CREATIS, F-42023, Saint Etienne, France, [2]Department of Radiology, The University Medical Centre Utrecht, Utrecht, Netherlands, [3]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [4]Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom, [5]Cardiovascular Research Centre, Royal Brompton Hospital, London, United Kingdom, [6]Department of Radiological Sciences, University of California, Los Angeles, CA, United States* *CMRDiffTools* is an OsiriX/Horos plug-in for simplifying and streamlining the processing and analysis tasks of Cardiac Diffusion MR images. This tool includes state-of-the-art methods in image processing of diffusion weighted images, assembled in suitable workflows to be executed in a single pipeline. The *CMRDiffTools* plug-in empowers the user with interactive data exploration and visualization of specific cardiac fiber metrics such as helix, transverse and sheet angle.

4779	Computer 32	Methodology for Non-Diseased Myocardium Part Segmentation of Delayed Enhancement 3D MRI by Using Watershed and Shape Priors Dominika Kruk[1], Arnaud Boucher[1], Alain Lalande[1,2], Alexandre Cochet[1,2], and Tadeusz Sliwa[1] *[1]Le2i FRE2005, CNRS, University of Burgundy, Auxerre, France, [2]Service de Spectroscopie-RMN, CHU de Dijon, Dijon, France* Previous approaches on left ventricle segmentation from DE-MRI have focused on the extraction of myocardium or just diseased region in short axis orientation. However these studies are not well suited for the segmentation of non-diseased myocardium region on DE-MRI. This paper presents a novel semi-automatic segmentation method of non-diseased myocardium region segmentation on diseased patient heart from DE-MRI based on watershed algorithm with shape priors application. To assess the results segmented images were compared with gold standard images performed by an experienced user. Novel solution for DE-MRI segmentation has been proposed, which brought promising results of measured parameters.

4780	Computer 33	Automatic labeling of cerebral vessels in time-resolved contrast enhanced angiography Oren Geri[1,2], Shelly I. Shiran[3], and Dafna Ben Bashat[1,2,4]

[1]Functional Brain Center, The Wohl Institute for Advanced Imaging, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [2]Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel, [3]Department of Radiology, Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, [4]Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

This study proposes a fully automatic labeling algorithm detecting up to 32 cerebral vessels including arteries and veins, based on 20 data sets of time-resolved contrast-enhanced angiography. The cerebral vessels include: internal carotid arteries (3-segments), middle cerebral arteries (M1), anterior cerebral artery (ACA,A1), ACA (A2), vertebral arteries, basilar artery, posterior cerebral arteries, external carotid, occipital arteries, superficial temporal arteries, internal jugular veins, and the sigmoid, transverse, superior sagittal and straight sinuses. The algorithm's performance was validated on another 20 data sets demonstrating high precision including for the identification of the fetal posterior communicating artery, a common variant of the blood vessels.

4781 Computer 34

Influence of contrast, sequence, threshold, and observer on 3D segmentation of the right ventricular outflow tract for intervention planning

Barbara Elisabeth Ursula Burkhardt[1,2], Nicholas K. Brown[2], Jaclyn E. Carberry[3], Marí Nieves Velasco Forte[3], Nicholas Byrne[3], Tarique Hussain[2,3], Gerald Greil[2,3], and Animesh Tandon[2]

[1]Pediatric Heart Center, Cardiology, University Children's Hospital Zurich, Zurich, Switzerland, [2]Pediatrics, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom

Three-dimensional reconstructions of cardiac magnetic resonance (CMR) datasets vary with contrast, image sequence, segmentation threshold, and manual post-processing. These influences need to be assessed before CMR-based models are used for interventional planning.

Three-dimensional segmentations of the right ventricular outflow tract (RVOT) from twelve patients with three different angiography sequences were compared between and within observers using different or the same thresholds.

Thresholding was sequence-dependent and did not significantly change object volumes. Minimal diameters of 3D reconstructed RVOTs showed clinically significant variation with different thresholds and between observers.

Interventional planning should rely on source images, not three-dimensional reconstructions, for quantitative information.

4782 Computer 35

Aortic 4D Flow MRI Data Analysis in Bicuspid Aortic Valve Disease in Under 15 Minutes

Amer Ahmed Syed[1], Daniel Zachary Gordon[1], Jeremy D Collins[1], Alireza Sojoudi[2,3], Qiao Wei[2], Xuexin Gao[2], Michael B Scott[1], Bradley D Allen[1], James C Carr[1], and Michael Markl[1,4]

		[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Circle Cardiovascular Imaging Inc., Calgary, AB, Canada, [3]Circle Cardiovascular Imaging, Calgary, AB, Canada, [4]Department of Biomedical Engineering, Northwestern University, Evanston, IL, United States
		One of the main challenges to the efficient application of 4D flow MRI is related to cumbersome, time-consuming, and non-standardized data analysis. The purpose of this study was to test the efficiency and inter-observer reproducibility of a dedicated analysis workflow by using a 4D flow MRI tool in a cohort of 20 BAV patients. We showed that 4D flow MRI can visualize BAV mediated changes on aortic outflow and quantify associated changes in flow dynamics. We demonstrated the potential of an optimized data analysis workflow to perform standardized 4D flow MRI processing in a short time and with good-to-excellent reproducibility.

4783	Computer 36	Deep Learning and Compressed Sensing: Automated Image Quality Assessment in Iterative Respiratory-Resolved Whole-Heart MRI
		Robin Demesmaeker[1,2], Jérôme Yerly[3,4], John Heerfordt[1,3], Tobias Kober[1,3,5], Pier Giorgio Masci[6], Dimitri Van De Ville[2,7], Matthias Stuber[3,4], and Davide Piccini[1,3,5]
		[1]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [2]Institute of Bioengineering/Center for Neuroprosthetics, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [3]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [5]LTS5, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [6]Division of Cardiology and Cardiac MR Center, University Hospital of Lausanne (CHUV), Lausanne, Switzerland, [7]Department of Radiology and Medical Informatics, University Hospital of Geneva (HUG), Geneva, Switzerland
		We aim at creating a link between compressed sensing (CS) reconstruction and automated image quality (IQ) assessment using deep learning. An automated image quality assessment algorithm based on a deep convolutional neural regression network trained to evaluate the quality of whole-heart MRI datasets is used to assess IQ at every iteration of a respiratory motion-resolved CS reconstruction. Not only IQ evolution as assessed by the network visually correlates with the CS cost function, but the neural network is able to distinguish the image quality of different respiratory phases with high correlation to visual expert assessment.

4784	Computer 37	Deep Learning for Automated Medical Image Quality Assessment: Proof of Concept in Whole-Heart Magnetic Resonance Imaging
		Robin Demesmaeker[1,2], John Heerfordt[1,3], Tobias Kober[1,3,4], Jérôme Yerly[3,5], Pier Giorgio Masci[6], Dimitri Van De Ville[2,7], Matthias Stuber[3,5], and Davide Piccini[1,3,4]

		[1]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [2]Institute of Bioengineering/Center for Neuroprosthetics, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [3]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]LTS5, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [5]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [6]Division of Cardiology and Cardiac MR Center, University Hospital of Lausanne (CHUV), Lausanne, Switzerland, [7]Department of Radiology and Medical Informatics, University Hospital of Geneva (HUG), Geneva, Switzerland
		We aim at developing a fully automated algorithm which quantitatively gauges the quality of medical images using deep learning to mimic human perception. An automated image quality assessment algorithm based on a deep convolutional neural regression network is designed, optimized, trained, validated and tested on a clinical database of 3D whole-heart cardiac MRI scans. The algorithm was successfully trained and validated, yielding a regression performance in the range of the intra- and inter-observer agreement. These results show the relevance of deep learning concepts to image quality analysis, in particular to volumetric cardiac MR imaging.

4785	Computer 38	Real-World Clinical Performance of Deep Learning for Quantification and Segmentation of Biventricular Cardiac Size and Function
		Tara Retson[1], Evan Masutani[2], Courtney Chen[2], Jesse Lieman-Sifry[3], Felix Lau[3], Matthieu Le[3], Sean Sall[3], Daniel Golden[3], and Albert Hsiao[2]
		[1]Radiology, UC San Diego, San Diego, CA, United States, [2]UC San Diego, San Diego, CA, United States, [3]Arterys, Inc, San Francisco, CA, United States
		In this study of routine clinical cardiac MRIs performed for a typical range of clinical indications, we examined the effectiveness of deep learning (DL) for real-world automated quantitative analysis of cardiac size and biventricular function. We find that automated measurements correlate well with skilled readers. While the variation between DL quantification and experts lie within the range seen between experts, there remain several observed failure modes which may benefit from expert supervision. The combination of DL automation with specialist oversight may reduce the time burden of manual segmentation, improve physician efficiency, and promote technique accessibility.

4786	Computer 39	Cloud-based, GPU-accelerated computation of Lagrangian Coherent Structures in 4D flow enables near-instant blood flow visualization
		Johannes Töger[1], Einar Heiberg[1], and Christos Xanthis[1]
		[1]Skane University Hospital, Department of Clinical Sciences Lund, Clinical Physiology, Lund University, Lund, Sweden

		Intracardiac blood flow dynamics depicted using 4D flow magnetic resonance imaging is increasingly used for analysis of cardiac health. Lagrangian Coherent Structures (LCS) is a powerful blood flow analysis tool, with applications in diastolic dysfunction and separating flowing blood with different behavior. However, use of LCS has been limited by long computation times. Therefore, a cloud-based computation engine for LCS analysis was developed, incorporating acceleration with graphical processing units (GPU:s). A speedup factor of up to 23 times is realized, enabling sub-second LCS computation times. Furthermore, the cloud platform makes rapid LCS analysis possible without investing in expensive GPU hardware.

4787	Computer 40	Deep Learning Image Classification for Automatic Frequency Adjustment in High Field Cardiac MR Imaging
		James W Goldfarb[1] and Jie Jane Cao[1]
		[1]Research and Education, St Francis Hospital, Roslyn, NY, United States
		Deep learning using a 3D CNN is a viable solution for the determination of the center frequency at high fields for cardiac imaging. It can quickly provide similar results to an expert observer. In the future, the strategy may be applicable to improved frequency resolution and to frequency adjustments outside of the frequency scout range. This strategy should make 3T cardiac MR imaging accessible to a wider audience.

4788	Computer 41	Augmenting the interpretation of cardiac MRI by biomechanical modeling: Application to tetralogy of Fallot
		Radomir Chabiniok[1,2,3], Reagan M. Tompkins[4], Maria Gusseva[1], Animesh (Aashoo) Tandon[4], Gerald Greil[3,4], Philippe Moireau[1,2], Dominique Chapelle[1,2], and Tarique Hussain[3,4]
		[1]Inria, Paris-Saclay University, Palaiseau, France, [2]LMS, Ecole Polytechnique, Paris-Saclay University, Palaiseau, France, [3]School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom, [4]Department of Pediatrics, UT Southwestern Medical Center, Dallas, TX, United States
		We propose connecting the acquisition and processing of cardiovascular MR (CMR) data with biomechanical cardiac modeling. Physical and physiological character predisposes biomechanical models to predictivity, and CMR data turn them into patient-specific regime. A high computational demand is addressed by applying a spatially-reduced model: the geometry and kinematics are simplified, but all other physical properties kept. The approach is illustrated by example of Tetralogy of Fallot patients, in whom we are able to access the myocardial contractility pre- and post-pulmonary valve replacement aiming at deciding on optimal therapy timing – the problem that has not been completely solved by sole CMR.

4789	Computer 42	Implementation of Cardiac MRF in Gadgetron for Online Reconstruction James Ahad[1], Wei-Ching Lo[2], Jesse Hamilton[2], Dominique Franson[2], Yun Jiang[3], and Nicole Seiberlich[2] *[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Case Western Reserve University, Cleveland, OH, United States, [3]Radiology, University Hospitals, Cleveland, OH, United States* Cardiac MRF is a unique MRF technique that requires a new dictionary for each acquisition to account for heart rate variability. Dictionary simulation presents a barrier for accessibility to cardiac MRF techniques due to the lack of tools at the scanner. To this end, Bloch simulation tools were developed on the Gadgetron platform to allow for online dictionary simulation and pattern matching reconstruction. Results between prior MATLAB implementations and Gadgetron implementation were in agreement. Future work in optimization may allow for data feedback from the scanner, reducing the need for additional scan time for accurate quantification of T1 and T2 maps.

4790	Computer 43	Improved motion correction for myocardial T1 map and ECV map Pan ki Kim[1], Chul Hwan Park[2], Yoo Jin Hong[1], and Byoung Wook Choi[1] *[1]Department of Radiology and Research Institute of Radiological Science, Severance Hospital, Yonsei University Medical Center, Seoul, Republic of Korea, [2]Department of Radiology and Research Institute of Radiological Science, Gangnam Severance Hospital, Yonsei University Medical Center, Seoul, Republic of Korea* Chemical Exchange Saturation Transfer (CEST) has been attracting attention as a molecular imaging method to investigate myocardial muscle energetics according to creatine changes. In this study, we proposed a robust CEST imaging technique from cardiac and respiratory motion using golden angle radial readout to achieve CEST imaging at the heart of the rat. We investigated the feasibility of the proposed method for the creatine phantom and a normal rat.

4791	Computer 44	Python graphical user interface with deep learning-based segmentation for cardiac LV analysis Yoon-Chul Kim[1], Kwanghee Choi[2], and Yeon Hyeon Choe[1] *[1]Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea, [2]Department of Computer Science and Engineering, Sogang University, Seoul, Republic of Korea*

		The purpose of this study is to develop a deep learning algorithm for myocardial segmentation and apply it to a Python graphical user interface for cardiac MR image processing and analysis. We used a U-net architecture to simultaneously segment endocardial and epicardial borders. For training data, we used publicly available data and our internal data, both of which are from cardiac cine imaging. When the trained model was used in our Python GUI, myocardial segmentation exhibited moderate accuracy in cine data as well as in perfusion data.

4792	Computer 45	A powerful Matlab software platform for assessment of streamlined methods involved in quantification of MR myocardial perfusion
		Clément Daviller[1], Thomas Grenier[1], Carole Frindel[1], Pierre Croisille[2], and Magalie Viallon[2]
		[1]Univ Lyon, INSA-Lyon, Université Claude Bernard Lyon 1, UJM-Saint Etienne, CNRS, Inserm, CREATIS UMR 5220, U1206, F-69621, Villeurbanne, France, Villeurbanne, France, [2]Univ Lyon, INSA-Lyon, UJM-Saint Etienne, Université Claude Bernard Lyon 1,CNRS, Inserm, CREATIS UMR 5220, U1206, F-42023, SAINT-ETIENNE, France, Saint-Etienne, France
		Quantification of myocardial perfusion by MRI requires a wise combination of advanced and complex techniques from images acquisition, segmentation, deconvolution and/or modelling prior deriving perfusion indexes estimations. Accuracy/reproducibility of measures are crucial for medical diagnostic but rely on the optimization of many algorithms. Hence, the latter techniques at each step shall be made available to the community, challenged and improved for optimal state-of-the-art implementation. We propose a software platform that can easily integrate any methods addressing issues or limitations at each step of the process, integrating sharpened tools for precise assessment of individual step to global pipeline performances.

4793	Computer 46	Magnetic resonance imaging of the right ventricle: a simple scheme for self-correction of partial volume effect
		Bård Andre Bendiksen[1,2], Lili Zhang[1,2], Ivar Sjaastad[1,2], and Emil Knut Stenersen Espe[1,2]
		[1]Institute for Experimental Medical Research, Oslo University Hospital, Oslo, Norway, [2]KG Jebsen Center for Cardiac Research, University of Oslo, Oslo, Norway
		Magnetic resonance imaging (MRI) of the right ventricle (RV) offers important diagnostic information. However, analysis of RV MRI images is hampered by the crescent shape of the RV. In particular, pixels at the blood-myocardium border may contain signal from both blood and myocardium, hindering accurate analysis of ventricular volumes or mass. Here, we propose an easily implementable correction algorithm for analysis of standard CINE MRI image stacks, without the need for special acquisition. The proposed algorithm offers improved accuracy, in addition to more consistent RV mass estimates from CINE images of the heart in end systole and end diastole.

4794	Computer 47	4D Segmentation of Whole-heart Cine Cardiovascular Magnetic Resonance Imaging in Congenital Heart Disease
		Jay B. Patel[1], Ruizhi Liao[2], Andrew J. Powell[3], Polina Golland[2], and Mehdi Hedjazi Moghari[3]
		[1]Health Sciences & Technology, Massachusetts Institute of Technology, Cambridge, MA, United States, [2]Electrical Engineering & Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [3]Boston Children's Hospital and Harvard Medical School, Boston, MA, United States
		3D cine whole-heart cardiovascular magnetic resonance (MR) imaging promises to enable more accurate quantitative evaluation of cardiac function. To extract volumetric measurements of heart chambers and vascular structures from 3D cine datasets, we utilize a graph cuts segmentation algorithm and a deformable registration method. Our measurements differ from those acquired from the conventional 2D cine images, suggesting measurements of ventricular volume based on 2D cine lack accuracy. Clinical evaluation of heart function can therefore be improved by using 3D cine cardiovascular MR imaging coupled with automatic whole heart segmentation.

4795	Computer 48	Rigid co-registration for MOLLI, a clinical test.
		Yadong Cui[1], Min Zhang[1], Xiaoqi Wang[2], and Min Chen[1]
		[1]Radiology Department, Beijing Hospital, Beijing, China, [2]Philips Healthcare, Beijing, China
		T1 quantification requires acquisition of multiple images at a sequence of delay times to derive the T1 recovery curve. Modified look-locker inversion recovery (MOLLI) is one of the most commonly used techniques. However, motion between these image acquisitions, especially at different heartbeats, often results in artifacts. In this work, we evaluated motion correction via a novel rigid co-registration based on images at a series time of delay along the T1 relaxation to eliminate the respiratory and cardiac motion artifacts.

Electronic Poster

Neurovascular Imaging

Exhibition Hall	Wednesday 13:45 - 14:45

4796	Computer 49	4D high-resolution Angiography maps obtained by combining low-resolution time-resolved ASL with static high-resolution Time-of-Flight data
		Thomas Lindner[1], Naomi Larsen[1], Olav Jansen[1], and Michael Helle[2]

		[1]*Department of Radiology and Naeuroradiology, University Hospital Schleswig-Holstein, Kiel, Germany,* [2]*Tomographic Imaging Department, Philips Research Laboratories, Hamburg, Germany*
		In this study a method to post-process Arterial Spin Labeling (ASL) and Time-of-Flight (TOF) data is presented. The time-resolved low-resolution images of ASL are mapped onto static high-resolution TOF images to create high-resolution time-resolved angiograms.

4797	Computer 50	Improving Cerebrovascular Reactivity Assessment Using High-Resolution MB-EPI Multi-Delay PCASL Imaging
		Xiufeng Li[1], Nicholas Evanoff [2], Lynn E. Eberly [3], David Tupper[4], Anne M. Murray [5], Gregory J. Metzger [1], and Donald R. Dengel [2]
		[1]*Center for Magnetic Resonance Research, School of Medicine, University of Minnesota, Minneapolis, MN, United States,* [2]*Laboratory of Integrative Human Physiology, School of Kinesiology, University of Minnesota, Minneapolis, MN, United States,* [3]*Division of Biostatistics, School of Public Health, University of Minnesota, Minneapolis, MN, United States,* [4]*Neuropsychology Section, Hennepin County Medical Center, Minneapolis, MN, United States,* [5]*Berman Center for Clinical Research, Hennepin County Medical Center, Minneapolis, MN, United States*
		Arterial spin labeling (ASL) imaging with a respiratory challenge can provide both quantitative baseline cerebral blood flow and the assessment of the cerebrovascular reactivity (CVR), an index for cerebrovascular function. However, to date, low-resolution and single-delay ASL imaging is primarily applied to assess CVR, and therefore limited. We proposed and successfully applied high-resolution multi-delay pseudo-continuous ASL (PCASL) imaging using a slice accelerated EPI readout for respiratory challenge studies. The study results suggest that the respiratory challenge can induce significant changes in arterial transit time (ATT), and that the estimates of ATT from the multi-delay imaging protocol are critical to achieve unbiased CVR measurements.

4798	Computer 51	Reduced cerebral blood flow and oxygen consumption in asymptomatic unilateral carotid stenosis patients assessed by arterial spin labeling and multi-parametric quantitative BOLD imaging
		Jens Goettler[1,2], Stephan Kaczmarz[1,2], Claus Zimmer[1], Christian Sorg[1], Christine Preibisch[1,3], and Fahmeed Hyder[2]
		[1]*Department of Neuroradiology, Technische Universität München, Munich, Germany,* [2]*Department of Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States,* [3]*Clinic for Neurology, Technische Universität München, Munich, Germany*

		Assessing cerebral hemodynamics and oxygen consumption in patients with clinically asymptomatic, high-grade internal carotid artery stenosis is crucial to estimate risk of stroke and cognitive impairment. Here, 23 patients with unilateral high-grade carotid stenosis and 24 age-matched healthy controls underwent a range of MRI scans, including quantitative BOLD, DSC and pCASL imaging to assess relative oxygen extraction (OEF), blood flow (CBF) and oxygen consumption ($CMRO_2$). Both CBF and $CMRO_2$ were reduced on the stenosis side, indicating that the proposed easily applicable MR-protocol is useful to estimate even subtle CBF and $CMRO_2$ changes in carotid stenosis patients.

4799	Computer 52	4D Flow MRI analysis of cerebral blood flow before and after high-flow EC-IC bypass surgery for ICA aneurysm
		Erika Orita[1], Tetsuro Sekine[1], Yasuo Murai[2], Ryo Takagi[3], Yasuo Amano[3], Takahiro Ando[1], Kotomi Iwata[1], Makoto Obara[4], Yoshio Matsumura[1], and Shin-ichiro Kumita[1]
		[1]Radiology, Nippon Medical School, Tokyo, Japan, [2]Neurological surgery, Nippon Medical School, Tokyo, Japan, [3]Radiology, Nihon University School of Medicine, Tokyo, Japan, [4]Healthcare, Philips Electronics Japan, Tokyo, Japan
		The purpose of this study was to clarify the change of hemodynamics after high-flow extracranial-intracranial (EC-IC) bypass surgery for ICA aneurysm by using time-resolved 3D-phase contrast (4D Flow) MRI. We enrolled 11 patients who underwent high-flow EC-IC bypass surgery. They underwent 4D Flow MRI before and after the surgery. We evaluated the blood flow direction of the circle of Willis. We measured blood flow volume (BFV) of bilateral ICAs, BA, and bypass artery. Seven of 11 patients exhibited collateral retrograde flow in the circle of Willis after surgery. The BFV of contralateral ICA and BA, and total brain BFV statistically increased after surgery. While, there was no evidence of post-operative hyperperfusion in any cases. 4D Flow MRI could quantify the change of hemodynamics after the high-flow bypass surgery.

4800	Computer 53	Prominent vessels on quantitative susceptibility maps indicate microvascular pathology after experimental cerebral ischemia and reperfusion
		Markus Vaas[1], Andreas Deistung[2,3,4], Jürgen R Reichenbach[2,5], Annika Keller[6], Anja Kipar[7], and Jan Klohs[1]
		[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland, [2]Institute of Diagnostic and Interventional Radiology, University Hospital Jena, Jena, Germany, [3]Department of Neurology, Essen University Hospital, Essen, Germany, [4]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Duisburg-Essen, Essen, Germany, [5]Michael Stifel Center for Data-driven and Simulation Science Jena, Friedrich Schiller University Jena, Jena, Germany, [6]Division of Neurosurgery, University Hospital Zurich, Zurich, Switzerland, [7]Institute of Veterinary Pathology, University of Zurich, Zurich, Switzerland

		We tested the utility of quantitative susceptibility mapping (QSM) to assess vascular abnormalities in a mouse model of experimental stroke. We acquired high resolution gradient echo data of mice at different time points after ischemia/reperfusion for computation of susceptibility maps. Prominent vessels with increased magnetic susceptibility values were detected surrounding the ischemic lesion at all times, indicating an increase in oxygen extraction. Immunohistochemistry revealed narrowed capillaries and dilated larger vessels. Thus, prominent vessels are an important indicator of underlying microvascular pathology and may by pivotal for diagnosis and therapeutic decision making in stroke patients.

4801	Computer 54	Analyzation and Optimization of Simultaneous Non-Contrast Angiography and intraPlaque Hemorrhage (SNAP) Magnetic Resonance Angiography in Intracranial Vascular Imaging
		Yuhui Xiong[1], Le He[1], Yu Ma[2], Xihai Zhao[1], Chun Yuan[1,3], and Hua Guo[1]
		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [2]Tsinghua University Yuquan Hospital, Beijing, China, [3]Vascular Imaging Laboratory, Department of Radiology, University of Washington, Seattle, WA, United States
		In this study, we used theoretical simulation and in-vivo scan validation to explore the relationship between intracranial SNAP-MRA signal and blood flow velocity to explain why the performance of SNAP-MRA may vary greatly between healthy people and patients with neurodegenerative diseases. We also found the way to re-optimize the scan parameters (TI and flip angle) to enhance the SNAP-MRA signal and acquire high quality intracranial SNAP-MRA.

4802	Computer 55	3D high resolution Black Blood(BB) Multiple Echo(ME) T2* Imaging Technique for Quantitative Ferumoxytol Imaging on Delayed Scans
		Seong-Eun Kim[1], J Scott Scott McNalley[1], Adam de Havenon [2], Dennis L Parker[1], and Gerald S Treiman [3]
		[1]UCAIR, Department of Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States, [2]Department of Neurology, University of Utah, Salt Lake City, UT, United States, [3]Department of Veterans Affairs, VASLCHCS, Salt Lake City, UT, United States
		The purpose of this work was to develop a 3D BB ME T2* Imaging technique to to allow quantitative ferumoxytol imaging on delayed scans by measuring T2* in intracranial atherosclerotic plaque(ICAD). Post-gadoliniun enhancement in ICAD may be related to endothelial dysfunction or breakdown or secondary to plaque inflammation. Delayed ferumoxytol imaging allows intravascular clearance with retention in the macrophages present in vulnerable atherosclerotic plaque. We developed a 3D BB ME T2* imaging technique to allow quantitative ferumoxytol imaging on delayed scans by measuring T2* in ICAD.

4803	Computer 56	Influences of smoking on cerebral arteriolar vasomotor function: evaluation by using magnetic resonance signal fluctuation Yusuke Nitanda[1], Minghui Tang[2], and Toru Yamamoto[2] *[1]Graduate School of Health Sciences, Hokkaido University, Sapporo, Japan, [2]Faculty of Health Sciences, Hokkaido University, Sapporo, Japan* The vasodilation and vasoconstriction properties of cerebral arterioles (arteriolar vasomotor function) would be a biomarker of early diagnosis of dementia. Although the vasodilation ability has been studied by using vasodilators such as Diamox, these vasodilators cause non-natural extreme vasodilation. Focusing on the natural arteriolar vasomotion induced by respiratory variation of blood CO_2, we have reported a method to evaluate cerebral arteriolar vasomotor function by spectral analysis of fluctuation of venous MRI signal. In this study, we improved our method and applied it to young smokers, and demonstrated the degeneration of arteriolar vasomotor function after a few years of chronic smoking.

4804	Computer 57	Dynamic Susceptibility Contrast and Dynamic Contrast Enhanced Perfusion Performed in a Single Acquisition Using mDIXON Quant Brian Johnson[1], Sandeep Ganji[2,3], and Ivan Dimitrov[2,4] *[1]Philips, Dallas, TX, United States, [2]Philips Healthcare, Gainesville, FL, United States, [3]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [4]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, DALLAS, TX, United States* This work investigates the use of mDIXON Quant as a perfusion technique to acquire dynamic susceptibility contrast (DSC) and dynamic contrast enhanced (DCE) scans in a single acquisition. The use of multi-echo mDIXON Quant for assessment of perfusion can be used to eliminate the need for split dosing and allows for acquiring DCE and DSC in a single acquisition. Elimination of a split contrast dose will remove contamination from changes in T1, T2, and T2*. This technique can potentially simplify the workflow for the DCE- based perfusion MRI imaging and reduce overall scan time.

4805	Computer 58	Initial experience using combined quantitative susceptibility mapping and quantitative bold oxygen level dependent imaging (QSM+qBOLD) oxygen extraction fraction for evaluation of acute ischemic stroke Shun Zhang[1,2], Junghun Cho[3], Thanh D. Nguyen[2], Pascal Spincemaille[2], Wenzhen Zhu[1], and Yi Wang[2,3] *[1]Radiolgy, Tongji Hospital, Tongji Medical College, HUST, Wuhan, China, [2]Radiolgy, Weill Cornell Medical College, NewYork, NY, United States, [3]Biomedical Engineering, Cornell University, Ithaca, NY, United States*

		Oxygen extraction fraction (OEF) reflects tissue oxygen consumption, which is very useful to predict the outcome of ischemic stroke in metabolic level. In this work, we evaluate a combined quantitative susceptibility mapping (QSM) and quantitative bold oxygen level dependent (qBOLD) method for measuring OEF based on MRI multi echo gradient echo (GRE) imaging in 11 acute ischemic stroke patients. OEF maps displayed various patterns both in the lesion and in the ASL-CBF/DWI mismatch area, consistent with previous PET studies. OEF with a heterogeneous increase within the lesion or in the CBF/DWI mismatch area may represent salvageable ischemic tissue, while OEF decrease may suggest irreversible infarct.

4806	Computer 59	Myelin imaging may reveal ischemic microstructural damage correlated with neurocognitive dysfunction in patients with moyamoya disease
		Shoko Hara[1,2], Masaaki Hori[2], Yasuaki Tsurushima[3], Yoji Tanaka[1], Taketoshi Maehara[1], Shigeki Aoki[2], and Tadashi Nariai[1]
		[1]Neurosurgery, Tokyo Medical and Dental University, Tokyo, Japan, [2]Radiology, Juntendo University, Tokyo, Japan, [3]Radiology, Kenshinkai Tokyo Medical Clinic, Tokyo, Japan
		To investigate myelin structural damage caused by chronic ischemia, we applied myelin imaging using magnetization transfer saturation (MTsat) method to 15 patients with moyamoya disease (36.6±11.6-year-old) and 10 normal volunteers (28.4±5.2-year-old). Although many patients received bypass surgery in the past and currently had good hemodynamic status, we found myelin volume fraction (MVF) was significantly lower and g-ratio was significantly higher in the patient group compared to normal controls. Moreover, regional MVF values showed some correlation with neurocognitive tests. This finding suggests myelin damage occurs in moyamoya disease, is associated with neurocognitive dysfunction, and is perhaps irreversible.

4807	Computer 60	The relationship between advanced perfusion MRI and measurements of vessel size in human gliomas using image-guided stereotactic biopsies and quantitative immunohistochemistry
		Ararat Chakhoyan[1,2], Kevin Leu[1,2], Robert J. Harris[1,2], Mitra D. Harati[3], William Yong[3], Albert Lai[4], Phioanh Nghiemphu[4], Linda Liau [5], Noriko Salamon[2], Whitney B. Pope[2], Timothy F. Cloughesy[6], and Benjamin Ellingson[7]
		[1]Brain Tumor Imaging Laboratory, UCLA, Los Angeles, CA, United States, [2]Dept. of Radiological Sciences, UCLA, Los Angeles, CA, United States, [3]Division of Neuropathology, Department of Pathology and Laboratory Medicine, UCLA, Los Angeles, CA, United States, [4]Department of Neurology, UCLA, Los Angeles, CA, United States, [5]Department of Neurosurgery, UCLA, Los Angeles, CA, United States, [6]Neurology, UCLA, Los Angeles, CA, United States, [7]Radiological Science, UCLA, Los Angeles, CA, United States

		Following an accurate sampling of glioma tissues with 3D T1w-MRI coordinates, we quantified VSI from multi-echo spin-and-gradient echo DSC perfusion as well as from CD31 staining. Eleven patients were included in this retrospective study with in total 30 evaluated targets. We demonstrated the robustness of VSI quantification by MRI. These maps showed a high sensibility and specificity for tumor grading. Finally, in comparison with classical DSC approaches for rCBV estimations, the quantification of VSI could be automated in clinical settings and enhance our understanding of micro and macro-vessel evolution in glioma patients.

4808	Computer 61	Atherosclerotic Diseases in Entire Craniocervical Arteries and Aortic Arch and Stroke Risk: A 3D Multicontrast MR Vessel Wall Imaging Study
		Dongye Li[1,2], Wei Dai[3], Ying Cai[4], Yongjun Han[1], Guoen Yao[3], Huijun Chen[2], Chun Yuan[5], and Xihai Zhao[2]
		[1]Centre for Brain Disorders Research, Capital Medical University and Beijing Institute for Brain Disorders, Beijing, China, [2]Center for Biomedical Imaging Research, Tsinghua University, Beijing, China, [3]Department of neurology, The first affiliated hospital of the PLA general Hospital, Beijing, China, [4]Department of Radiology, Taizhou People's Hospital, Taizhou, China, [5]Department of Radiology, University of Washington, Seattle, WA, United States
		Vulnerable atherosclerotic plaque in intracranial and extracranial carotid arteries and aortic arch is one of major causes of ischemic stroke. This study investigated the characteristics of atherosclerotic plaques in the craniocervical arteries and aortic arch and their relationships with stroke risk using 3D multicontrast MR vessel wall imaging. We found that high risk atherosclerotic plaques were most prevalent in intracranial arteries among three vascular beds. Combination of the maximum wall thickness in intracranial with extracranial carotid arteries might be a stronger predictor for cerebral acute ischemic lesions than that in each vascular bed alone.

4809	Computer 63	Magnetic Susceptibility Mapping Reveals Altered Vein Oxygenation in Patients with Brain Arteriovenous Malformations: A Preliminary Study
		Emma Biondetti[1], Alvaro Rojas Villabona[2,3], Hans Rolf Jäger[4,5], David L Thomas[6,7], and Karin Shmueli[1]
		[1]Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]The Gamma Knife Centre at Queen Square, National Hospital for Neurology and Neurosurgery, London, United Kingdom, [3]Department of Neurosurgery, National Hospital for Neurology and Neurosurgery, London, United Kingdom, [4]The Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, United Kingdom, [5]Academic Neuroradiological Unit, Department of Brain Repair and Rehabilitation, University College London, London, United Kingdom, [6]Academic Neuroradiological Unit, Department of Brain Repair and Rehabilitation, Institute of Neurology, University College London, London, United Kingdom, [7]Leonard Wolfson Experimental Neurology Centre, Institute of Neurology, University College London, London, United Kingdom

		Arteriovenous malformations (AVMs) are vascular anomalies characterised by arteriovenous shunting with the lack of a capillary bed. Since the veins that drain an AVM contain arterialised blood, they would be expected to have a higher venous oxygen saturation (SvO_2) than normal veins. Due to the paramagnetic properties of deoxyhaemoglobin, SvO_2 can be calculated using magnetic susceptibility mapping (SM). Here, we calculated SM-based SvO_2 in five patients with a brain AVM. We found higher SvO_2 in the AVM draining veins compared to normal veins, showing that SM might be a valuable tool to study AVM physiology.

4810	Computer 64	Surveillance of unruptured intracranial saccular aneurysms using non-contrast 3D black blood MRI: comparison of 3D TOF and CE-MRA with DSA
		Chengcheng Zhu[1], Xinrui Wang[2], Bing Tian[2], Qi Liu[2], Christopher Hess[1], David Saloner[1], and Jianping Lu[2]
		[1]Radiology, University of California, San Francisco, San Francisco, CA, United States, [2]Radiology, Changhai Hospital, Shanghai, China
		Patients with unruptured intracranial aneurysms (UIAs) routinely undergo surveillance imaging to monitor the growth. CTA and CE-MRA provide good accuracy in measuring size relative to gold standard 3D DSA, but require contrast agent and/or have radiation, which is undesirable for repeated imaging. We compared three MRI techniques on 58 aneurysms: 1) 3D non-contrast black blood MRI (SPACE), 2) 3D TOF 3) CE-MRA, against gold standard 3D DSA. SPACE was in excellent agreement with DSA, better than CE-MRA and TOF. Our results support the use of non-contrast SPACE for surveillance of UIA in the clinical setting.

4811	Computer 65	Hypertension induces changes in brain network organization
		Guixiang Ma[1], Bokai Cao[1], Philip S. Yu[1,2], and Ann Ragin[3]
		[1]Department of Computer Science, University of Illinois at Chicago, Chicago, IL, United States, [2]Shanghai Institute for Advanced Communication and Data Science, Fudan University, Shanghai, China, [3]Department of Radiology, Northwestern University, Chicago, IL, United States
		Hypertension is a risk factor for dementia and age-related neurological disorders. Analysis of resting state fMRI for brain network organization may capture early changes induced by hypertension. This investigation examined characteristic network metrics in young, otherwise asymptomatic adults (n=27; mean age 34) classified for hypertension. Path length was the most discriminating global metric. Differences in node clustering were identified using machine learning, including for subcortical regions that have been identified as brain network hubs (thalamus, hippocampus and putamen). These are critical structures for memory, supporting a potential role in cognitive deterioration and dementia and the premise of hub vulnerability.

4812	Computer 66	Oxygen Extraction Fraction and R2* Mapping in Cerebrovascular Disease using an Acetazolamide Challenge.
		Christopher Leatherday[1], Seena Dehkharghani[1], Fadi Nahab[2], Jason W. Allen[1], Junjie Wu[1], Ranliang Hu[1], and Deqiang Qiu[1]
		[1]Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States, [2]Neurology, Emory University, Atlanta, GA, United States
		Increased cerebral oxygen extraction fraction (OEF) in cerebrovascular disease is linked with a greatly elevated risk of recurrent ischemic stroke. The current gold standard for OEF imaging is Oxygen-15 PET; which is less widely available and more expensive than MRI, and includes an ionizing radiation dose. We studied quantitative susceptibility mapping derived OEF maps and R2* mapping combined with an Acetazolamide challenge in a group of unilateral CVD patients, and found increased OEF and reduced cerebrovascular reactivity in the disease-affected hemisphere using these methods. With further refinement, these techniques may provide a clinical alternative to ^{15}O-PET for OEF imaging.

4813	Computer 67	Effects of physical exercise on hippocampal volume and vasculature in young adults
		Antonia Kaiser[1,2,3], Michelle M Solleveld[1,2,3], Linda Knutsson[4], Matthias JP van Osch[5], Liesbeth Reneman[1,2], Paul J Lucassen[2,3], and Anouk Schrantee[1,2,3,6]
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		The underlying neurobiological changes of exercise-induced hippocampal volume increases are poorly understood, but a substantial role for vascular plasticity, such as perfusion and angiogenesis, has been suggested. We here studied the effect of a high and low intensity exercise intervention on the hippocampal volume and vasculature. Exercise did not induce hippocampal volume changes, despite a baseline association between fitness and volume. Interestingly, improved fitness resulted in increased hippocampal cerebral blood flow (CBF) ($p=0.01$) and gray matter CBF ($p=0.07$). No effect on cerebral blood volume was found. This may suggest that perfusion effects are not hippocampus-specific.

4814	Computer 68	New vision of tuberous sclerosis complex on 7-Tesla MRI
		Kaibao Sun[1,2], Jianfei Cui[3], Bo Wang[1], Tao Jiang[4], Zhongwei Chen[1], Fei Cong[1,2], Yan Zhuo[1,2], Rong Xue[1,2], Shuli Liang[3], and Lin Chen[1,2]

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Tuberous sclerosis complex is a multisystem genetic disorder characterized by the growth of numerous tuberous lesions in brain. However, few in vivo studies on TSC have focused on venous structure changes, their association with TSC lesions, and iron accumulation in basal ganglia. 7T susceptibility weighted imaging was performed on eleven TSC patients in comparison with fifteen age- and sex-matched healthy controls. The tubers might develop along penetrating veins. There might be coexistence of iron deposition and calcification in basal ganglia. These in vivo 7T MRI findings provided new perspectives for better understanding the brain pathology in patients with TSC.

4815 | Computer 69

Increased intracellular volume fraction, orientation dispersion and diffusion kurtosis in the brain are associated with poor functional outcome in comatose cardiac arrest patients

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Cardiac arrest patients who are comatose after restoration of spontaneous circulation were prospectively studied to determine whether changes to intracellular volume fraction (ICVF), orientation dispersion and diffusion kurtosis imaging (DKI) can be used to discriminate patients likely to recover consciousness. Subjects who failed to wake up had greater median ICVF, and DKI compared to subjects who woke up. Increases in ICVF, and DK are associated with more severe acute ischemic brain injury. Multi-shell diffusion imaging may help identify patients that may recover consciousness.

4816 | Computer 70

Hemodynamic Biomarkers to Assess Disease Severity in Patients with Intracranial Atherosclerotic Disease using Dual-Venc 4D Flow MRI

Alireza Vali[1], Maria Aristova[1], Sameer A. Ansari[2,3], Ayesha Muzaffar[1], Shyam Prabhakaran[2], Michael Markl[1], and Susanne Schnell[1]

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		To conduct a comprehensive assessment of hemodynamics in patients with intracranial atherosclerotic disease (ICAD), an automated analysis tool was developed to quantify 4D flow MRI data, including extraction of pressure gradient and flow resistance across the ICAD stenosis and flow and peak velocity asymmetry indices. For three ICAD cases with identical degree of stenosis, the results demonstrated variability in both flow resistance and flow asymmetry indices. With the inclusion of more patients spanning a spectrum of stenosis degrees, it may be possible to demonstrate the utility of flow resistance as a new metric for characterizing the hemodynamic impacts of ICAD.

4817	Computer 71	Rapid Quantitative Susceptibility Mapping of Intracranial Hemorrhage using Echo Planar Imaging
		Ashmita De[1], Hongfu Sun[1], Ahmed Elkady[1], Derek Emery[2], Kenneth Butcher[3], and Alan H Wilman[1]
		[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada, [2]Radiology & Diagnostic Imaging, University of Alberta, Edmonton, AB, Canada, [3]Division of Neurology, University of Alberta, Edmonton, AB, Canada
		Intracranial hemorrhage(ICH) accounts for about 20% of strokes. Quantitative Susceptibility Mapping (QSM) may be valuable for tracking iron changes in ICH. Here we apply Echo Planar Imaging (EPI) for rapid QSM at 3.0 T in hemorrhage patients. The acquisition time is only 9 sec without parallel imaging and 27 sec if parallel imaging is considered to maintain high resolution, appropriate echo time and minimize blurring effects. High correlation was observed for ICH area and mean susceptibility between standard QSM and EPI-QSM in hemorrhage. Hence EPI-QSM method has potential for clinical ICH studies when time is a limiting factor.

4818	Computer 72	A comparison of cerebrovascular reactivity at 1.5 and 3T in cerebral small vessel disease patients
		Michael S Stringer[1,2,3], Gordon W Blair[1,2,3], Yulu Shi[1,2,3], Iona Hamilton[1,2,3], Ian Marshall[1,2,3], Fergus Doubal[1,2,3], Michael J Thrippleton[1,2,3], and Joanna M Wardlaw[1,2,3]
		[1]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom, [2]Edinburgh Dementia Research Centre in the UK Dementia Research Institute, Edinburgh, United Kingdom, [3]Fondation Leducq Network for the Study of Perivascular Spaces in Small Vessel Disease, University of Edinburgh, Edinburgh, United Kingdom
		Cerebrovascular reactivity can be measured using blood oxygen level dependent (BOLD) MRI and is a potential mechanism in cerebral small vessel disease (SVD). Investigations of the effect of field strength on CVR have been limited, particularly in patient groups. In this study CVR measurements within a series of preselected regions in SVD patients were assessed at 1.5 and 3T. Mean CVR was greater at 3T in 12 of the 14 regions, however differences, as assessed with Bland-Altman plots, were within reasonable limits. These results point to the importance of considering other scanner specific factors beyond field strength when measuring CVR.

Electronic Poster

Ischemia & Stroke

Exhibition Hall	Wednesday 13:45 - 14:45

4819	Computer 73	Motor recovery after initial severe stroke: confronting kinematics with brain activations
		Liesjet E.H. van Dokkum[1,2], Isabelle Laffont[2], Denis Mottet[3], Jerome Froger[4], Alain Bonafe[5], Nicolas Menjot-de Champfleur[1], and Emmanuelle le Bars[1]
		[1]Division of interventional Neuroradiology, I2FH, Gui de Chauliac, Montpellier University Hospital, Montpellier, France, [2]Physical Medicine and Rehabilitation, Lapeyronie, Montpellier University Hospital, Montpellier, France, [3]EuroMov, University of Montpellier, Montpellier, France, [4]Physical Medicine and Rehabilitation, le Grau du Roi, Nimes University Hospital, Nimes, France, [5]Division of interventional Neuroradiology, Gui de Chauliac, Montpellier University Hospital, Montpellier, France
		To maximize motor recovery of the upper-limb post-stroke, rehabilitation should be adapted to the individual patient. This requires the identification of motor recovery markers in relation to corresponding brain activations. During elbow flexion/extension, kinematic analysis was confronted with corresponding fMRI activations, comparing 21 participants post-stroke with 13 controls. This provided insight into the underlying functioning and organisation of motor control, switching between ‘automatic’ feed-forward and ‘conscious’ feedback control. Post-stroke, the latter strategy was applied with an additional role for visualisation and the contralesional hemisphere, whereby different kinematic profiles were related to different brain activations, opening doors to personalized rehabilitation.

4820	Computer 74	Monitoring diabetic stroke response to novel p38 MAPK inhibitor therapy using dynamic contrast enhanced magnetic resonance imaging (DCE-MRI)
		Yu Cai[1] and Shenghong Ju[1]
		[1]Department of Radiology, Zhongda Hospital,Medical School, Southeast University, Nanjing, China
		We monitored the increased disruption of blood brain barrier (BBB) by DCE-MRI at acute-stage of ischemic stroke in T2DM mice non-invasively. Furthermore, administration of novel P38 inhibitor is a promising way to promote BBB recovery in diabetic stroke and the therapeutic efficacy can be monitored by DCE-MRI.

4821	Computer 75	Prognostication of stroke recovery using structural connectivity
		Xiaopei Xu[1], Kui Kai Lau[2], Leonard SW Li[2,3], Yuen Kwun Wong[2], Christina Yau[4], Henry KF Mak[1,5], Queenie Chan[6], and Edward S Hui[1,5]

		[1]*Department of Diagnostic Radiology, The University of Hong Kong, HKSAR, China,* [2]*Department of Medicine, The University of Hong Kong, HKSAR, China,* [3]*Department of Rehabilitation Medicine, Tung Wah Hospital, HKSAR, China,* [4]*Department of Occupational Therapy, Tung Wah Hospital, HKSAR, China,* [5]*The State Key Laboratory of Brain and Cognitive Sciences, The University of Hong Kong, HKSAR, China,* [6]*Philips Healthcare, HKSAR, China*
		We aim to investigate the longitudinal changes in the structural brain network of patients with acute subcortical ischemic infarct in the motor system, and the relation between motor recovery and network measures. Our results showed that the nodal degree of parahippocampus, amygdala, calcarine fissure, cuneus and fusiform gyrus increased with time after stroke, and that network topology measured at acute phase was associated with the recovery of motor function at 6 months after stroke. These findings suggested that network topology could potentially be a prognostic indicator of motor recovery for patients with acute subcortical ischemic infarct in the motor system.

4822	Computer 76	A cost effective, 3D printed vasculature phantom for MR imaging of stroke
		Rashmi Rao[1], Priyanka Harish[1], Nithin N Vajuvalli[1], Arush Honnedevasthana Arun[1], Ashwini Kumnoor[1], and Sairam Geethanath[1,2]
		[1]*Medical Imaging Research Centre, Dayananda Sagar Institutions, Bangalore, India,* [2]*Department of Radiology, Columbia University Medical Centre, New York, NY, United States*
		Stroke is mainly caused due to hemorrhage or ischemia due to infarct. Current work aims to develop a phantom which can mimic structure and function of a human brain stroke using 3D print technology. The normal human brain vasculature was printed using Poly Lactic Acid. An ischemic infarct was mimicked using Poly Vinyl Alcohol and a cerebral aneurysm was integrated to the vasculature to demonstrate simultaneous onset of hemorrhagic and ischemic stroke. Waterflow to the phantom was introduced by integrating the peristaltic pump. T1, T2 , DW images and T 1and T2maps were generated which depict the stroke vasculature

4823	Computer 77	Reproducibility of BOLD delay perfusion measurements in acute stroke patients
		Ahmed A Khalil[1,2,3], Ayse Ceren Tanritanir[1], Ulrike Grittner[1,4], Arno Villringer[2,3], Jochen Fiebach[1], and Ralf Mekle[1]
		[1]*Center for Stroke Research Berlin, Charité Universitätsmedizin Berlin, Berlin, Germany,* [2]*Berlin School of Mind & Brain, Humboldt Universität zu Berlin, Berlin, Germany,* [3]*Department of Neurology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany,* [4]*Department of Biostatistics and Clinical Epidemiology, Charité Universitätsmedizin Berlin, Berlin, Germany*

		To assess perfusion in ischemic stroke is an important task in clinical diagnosis. In this context, a technique sensitive to the delay of blood-oxygenation-level-dependent (BOLD) oscillations at rest called BOLD delay has been proposed. In this study, the reproducibility of this technique in acute stroke patients was examined. Magnitude differences between perfusion measurements from two timepoints were calculated and evaluated in a statistical model. In particular, the effect of head motion was considered. Reproducibility was found to be limited by motion, but the magnitude of the observed variations was small compared to delays observed due to hypoperfusion in stroke patients.

4824	Computer 78	Multi-parametric MR Microscopy of Cerebral Thrombi as a Tool for Prediction of Thrombectomy Procedure Times in Stroke Therapy
		Franci Bajd[1], Jernej Vidmar[2], Eduard Kralj[3], Andrej Fabjan[2], Fajko Bajrović[4], Igor Kocijančič[5], Zoran Miloševič[5], Miran Jeromel[6], and Igor Serša[1]
		[1]Jožef Stefan Institute, Ljubljana, Slovenia, [2]Universitiy of Ljubljana, Institute of Physiology, Ljubljana, Slovenia, [3]Universitiy of Ljubljana, Institute of Forensic Medicine, Ljubljana, Slovenia, [4]University of Ljubljana, Institute of Patophysiology, Ljubljana, Slovenia, [5]University Medical Center Ljubljana, Clinical Institute of Radiology, Ljubljana, Slovenia, [6]General hospital Slovenj Gradec, Department for interventional and diagnostic radiology, Slovenj Gradec, Slovenia
		In this study human cerebral thrombi were quantitatively characterized after their acquisition by mechanical thromectomy. The characterization was based on multi-parametric MRI using 3D T_1-weighted imaging and ADC and T_2 mapping. In the study it was shown that thrombi complex structure can be assessed by ADC and T2 mapping MRI mapping techniques and that the MRI maps of thrombi can be used for prognosis of the mechanical thrombectomy procedure times prior to the interventions.

4825	Computer 79	Can susceptibility weighted imaging indicate the ischemic penumbra in patients with acute infarction in middle cerebral artery?
		Yu Luo[1], Linglei Meng[2], Yongming Zhou[1], Shuang Xia[3], and E.Mark Haacke[4]
		[1]Radiology Department, Shanghai Forth People's Hospital, Shanghai, China, [2]Shanghai Forth People's Hospital, Shanghai, China, [3]Tianjin First Central Hospital, Tianjin, China, [4]Wayne State University, Detroit, MI, United States

		1.Purpose to evaluate the penumbra in acute ischemic stroke by quantitative mismatch between susceptibility weighted imaging(SWI) and diffusion weight imaging(DWI) in comparison with perfusion weighted imaging(PWI) and diffusion weight imaging(DWI) mismatch. 2.**Method** 85 eligible patients were enrolled with acute ischemic stroke who underwent MR scan including DWI, SWI and PWI before treatment within 12 hours after symptom onset. SWI-DWI mismatch was demarcated by the volume of asymmetrical prominent cortical veins（APCV）region in SWI MIP extending beyond the volume of infarct core segmentation of ADC maps. PWI-DWI mismatch was determined by using infarct core and perfusion deficits segmented from ADC and Tmax maps. 3.**Result** 41 cases have SWI-DWI mismatch，while 43 cases have PWI-DWI mismatch in totally 85 patients. 42 cases have neither SWI-DWI mismatch nor PWI-DWI mismatch. Only 2 cases have PWI-DWI mismatch without SWI-DWI mismatch. None has SWI-DWI mismatch without PWI-DWI mismatch. There is no a significant difference between SWI-DWI and PWI-DWI in showing mismatch with MCA stroke($P<0.01$).The NIHSS of patients with SWI-DWI mismatch was statistically higher compared to the patients without SWI-DWI mismatch ($t=-4.956$, $P<0.01$). The NIHSS of patients was also statistically higher with PWI-DWI mismatch in comparison with none PWI-DWI mismatch（$t=-4.481$, $P<0.01$）. 4.**Conclusion** APCV in SWI might to be a good instrument to indicate the ischemic penumbra as well as PWI. SWI may be an alternative to PWI in some stroke cases.

4826	Computer 80	Oxygen extraction fraction is elevated in acute stroke with evidence of preserved metabolism: a quantitative susceptibility MRI study
		Audrey P. Fan[1], Ahmed A. Khalil[2], Jochen Fiebach[2], Arno Villringer[3], Greg Zaharchuk[1], Kersten Villringer[2], and Claudine J. Gauthier[4]
		[1]Stanford University, Stanford, CA, United States, [2]Charité Universitätsmedizin Berlin, Berlin, Germany, [3]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [4]Concordia University, Montreal, QC, Canada
		We utilized a novel MRI susceptibility method to quantify oxygen extraction fraction (OEF) in cortical vessels of 22 patients with acute stroke. The observed OEF ratio between affected and contralateral hemispheres depended on patient perfusion status, and tended to normalize (decrease) in follow-up scans on average 3 days later. Stroke cases with substantial perfusion-diffusion mismatch (indicative of potentially salvageable penumbra) showed the greatest OEF elevation (OEF ratio = 1.2 ± 0.1). Patients with large mismatch also showed an inverse relationship between OEF and relative cerebral blood flow (from dynamic susceptibility contrast), suggestive of mechanisms to maintain tissue oxygen metabolism even in ischemic tissue.

4827	Computer 81	Unruptured Intracranial Aneurysms: Relationship between Wall Enhancement and Rupture Risk Factors Based on High-resolution Magnetic Resonance Imaging
		Chengcheng Zhu[1], Xinrui Wang[2], Qi Liu[2], Christopher Hess[1], David Saloner[1], and Jianping Lu[2]

		[1]Radiology, University of California, San Francisco, San Francisco, CA, United States, [2]Radiology, Changhai Hospital, Shanghai, China
		Wall enhancement (AWE) of intracranial aneurysms (IAs) on high-resolution black blood MRI has been described in ruptured aneurysms. This study investigated 103 unruptured saccular IAs and aims to assess the association between AWE and traditional risk factors and estimated one-year and five-year rupture risk estimated from previous large trails. We found aneurysms with AWE had more than 3 times higher estimated rupture risk (one-year and 5-year, 2.2% and 6.7%) than aneurysms without AWE (0.6% and 2.0%), and AWE was associated with traditional risk factors (size, location, symptoms). Identifying AWE may improve the risk assessment of IAs.

4828	Computer 82	Quantifying dynamic CBF changes in 4-day follow up after carotid endarterectomy using 3D pCASL
		Ting Wang[1], Bo Bu[2], Bing Wu[3], Lin Ma[1], and Xin Lou[1]
		[1]Department of Radiology, Chinese PLA General Hospital, Beijing, China, [2]Department of neurosurgery, Chinese PLA General Hospital, Beijing, China, [3]GE healthcare China, Beijing, China
		Hyperperfusion syndrome was a severe complications of carotid endarterectomy (CEA), the routine measurement for preventing this was to take antihypertensive drugs for at least one week after operative. But there were no definite criteria to assess whether this method was reasonable and appropriate; our objective was to detect dynamic CBF changes in 4-day follow up after CEA using 3D pCASL technique. It is seen that compared to patients before CEA, both the ipsilateral and opposite CBF values were increased in various time points after CEA ($P<0.05$), whereas, the bilateral CBF values shows no significant differences ($P>0.05$). This shown that 3D pCASL is sensitive to temporal hemodynamic changes after CEA and may provide a quantitative criterion for assessing antihypertensive drugs taken. Also the observed increases shortly in the first and the second day after operations may suggest for potential drug intervention in case of post-CEA complications.

4829	Computer 83	The Value of Magnetic Resonance Black-blood Imaging in Differentiating Acute and Chronic Cerebral Venous Thrombosis
		Xiaoxu Yang[1], Fang Wu[1], Ye Wu[1], Tianyi Qian[2], Xianggong Duan[1], Xiangying Du[1], Xunming Ji[3], and Qi Yang[1]
		[1]Radiology, Xuanwu Hospital, Capital Medical University, Beijing, China, [2]MR Collaboration NEA, Siemens Healthcare, Beijing, China, [3]neurosugery, Xuanwu Hospital, Capital Medical University, Beijing, China

		This study aims to demonstrate the value of magnetic resonance black-blood imaging （MRBTI） for differentiating acute and chronic cerebral venous thrombosis (CVT) as well as the diagnosis accuracy of CVT in segment levels. The SNR and CNR of the acute CVT group were significantly higher than that of the chronic group. The sensitivity and specificity of MRBTI were 95.6% (152 /159) and 98.0% (352 /359), respectively. Furthermore, the sensitivity of MRBTI in detecting acute thrombus is up to 100%, compared with 88.5% in the chronic group, which means MRBTI has high sensitivity for early diagnosis.

4830	Computer 84	Vessel Encoded Arterial Spin Labeling Evaluation of Collateral Circulation in Symptomatic and Asymptomatic Patients with Internal Carotid Artery or Middle Cerebral Artery Occlusion
		Jinhao Lyu[1], Xiaoxiao Ma[1], Yina Lan[1], Lin Ma[1], and Xin Lou[1]
		[1]Department of Radiology, Chinese PLA General Hospital, Beijing, China
		Symptomatic and asymptomatic patients with internal carotid artery (ICA) or middle cerebral artery (MCA) occlusion have the different prognosis. The present study had evaluated collateral circulation by Vessel Encoded Arterial Spin Labeling (VE-ASL) and cerebral vasoreactivity by mean transit time (MTT) obtained by Dynamic susceptibility contrast in symptomatic and asymptomatic patients with unilateral ICA and/or MCA occlusion. The study had found that the intensity of collateral in asymptomatic patients was significantly better than symptomatic patients while MTT showed no significant differences, which indicate that hemodynamic impairments in symptomatic patients with ICA/MCA occlusion may be mainly induced by the insufficiency of collateral circulation.

4831	Computer 85	Proximal Internal Carotid Artery Stenosis Associates with Diffuse Wall Thickening in Petrous Arterial Segment of Moyamoya Disease Patients: A 3D MR Vessel Wall Imaging Study
		Xiaoyi Chen[1,2], Jian Wang[3], Bing Zhang[4], Dongye Li[1,2], Huiyu Qiao[2], Shuai Liu[2], Yongjun Han[1], Hualu Han[2], Yongbo Yang[3], Fei Zhou[4], Xueping Li[4], and Xihai Zhao[2]
		[1]Center for Brain Disorders Research, Capital Medical University, Beijing, China, [2]Center for Biomedical Imaging Research, Tsinghua University, Beijing, China, [3]Department of Neurosurgery, Affiliated Drum Tower Hospital of Nanjing University Medical School, Nanjing, China, [4]Department of Radiology, Affiliated Drum Tower Hospital of Nanjing University Medical School, Nanjing, China
		It has been shown that rapid reduction of lumen diameter at the proximal ICA can be seen in moyamoya disease (MMD) patients. The arterial wall thickness at downstream of proximal ICA may aggravate cerebral ischemia and affect the outcome of revascularization. This study sought to investigate the association between proximal ICA stenosis and diffuse wall thickening in ipsilateral petrous ICA in MMD patients. We found that proximal ICA stenosis was significantly associated with wall thickness ($r = 0.434$, $p<0.001$) and presence of diffuse wall thickening (odds ratio=4.433, 95% confidence interval 1.980–9.925, $p<0.001$) in ipsilateral petrous ICA in MMD patients.

4832	Computer 86	Cerebrovascular resistance responses to CO2 improve after revascularization surgery
		Larissa McKetton[1], Olivia Sobczyk[2], Julien Poublanc[1], Kevin Sam[3], Adrian P. Crawley[1], Lakshmikumar Venkat Raghavan[4], James Duffin[4,5], Joseph A. Fisher[2,4,5], and David J. Mikulis[1,4,5]
		[1]Division of Neuroradiology, Joint Department of Medical Imaging, University Health Network, Toronto, ON, Canada, [2]Institute of Medical Science, University of Toronto, Toronto, ON, Canada, [3]The Russell H. Morgan Department of Radiology & Radiological Science, The John Hopkins University School of Medicine, Baltimore, MD, United States, [4]Department of Anaesthesia and Pain Management, University Health Network, Toronto, ON, Canada, [5]Department of Physiology, University of Toronto, Toronto, ON, Canada
		The cerebral hemodynamics of patients undergoing revascularization surgery for intracranial steno-occlusive disease (IC-SOD) were assessed by deriving an estimate of their cerebrovascular resistance response to CO_2 from their BOLD response to CO_2. Significant improvements were found in the sigmoid parameters describing their resistance responses.

4833	Computer 87	Predicting Hyperperfusion syndrome by measurement of leptomenigeal collateral and preoperative cerebral blood flow in patients with unilateral internal carotid artery stenosis
		Yina Lan[1], Jinhao Lyu[1], Jianxun Qu[2], Lin Ma[1], and Xin Lou[1]
		[1]Radiology and Imaging, Chinese People's Liberation Army (PLA) General Hospital, Beijing, China, [2]General Electric Healthcare, Shang hai, China
		Hyperperfusion syndrome (HPS) is a rare but potentially fatal postoperative complication after revascularization, while preoperative predictor of HPS had not been fully established. We used pseudo continuous arterial spin labeling (pCASL) to investigate the correlation between the collateral flow proportion and the elevated cerebral blood flow (CBF) ratio relative to the preoperative CBF in patients with unilateral internal carotid artery (ICA) stenosis. A significant correlation was observed between the collateral flow proportion and the elevated CBF ratio . (r =0.588, P =0 .01). As an indication, HPS are likely to occur in patients with low preoperative CBF and good collateralization.

4834	Computer 88	Carotid stenosis: a risk factor for white matter disease even at presymptomatic stage
		Pedro Henrique Rodrigues da Silva[1], Ana Paula Afonso Camargo[2], Antonio Carlos Santos Senra Filho[3], Luiz Otavio Murta Junior[3], Octávio Marques Pontes Neto[2], and Renata Ferranti Leoni[1]
		[1]Department of Physics, FFCLRP, University of São Paulo, Ribeirão Preto, Brazil, [2]Department of Neurosciences and Behavioral Science, FMRP, University of São Paulo, Ribeirão Preto, Brazil, [3]Department of Computing and Mathematics, FFCLRP, University of São Paulo, Ribeirão Preto, Brazil

		Studies have suggested that cerebral white matter hyperintensity (WMH) is due to hypertension and is associated with carotid artery stenosis (CAS). However, it is unclear whether this association is attributable to effects on WM and how asymptomatic CAS contributes to it. Therefore, we aimed to assess the association between ACAS and WMH lesions and its relationship with cognitive decline using MRI to provide information that may help predicting cases at risk of brain ischemia. Our data showed that ACAS is associated with WMH lesions and cognitive decline, indicating that ACAS, in addition to age, is likely to cause WM lesions.

4835	Computer 89	Brain morphometric changes and functional connectivity alterations in post-stroke fatigue
		Milanka Visser[1], Thomas Lillicrap[1], Carlos Garcia-Esperon[1], Bénédicte Maréchal[2], Mark Parsons[1], Christopher Levi[1], and Andrew Bivard[1]
		[1]Faculty of Health and Medicine, University of Newcastle, Newcastle, Australia, [2]Department of Radiology, Lausanne University Hospital, Lausanne, Switzerland
		Debilitating fatigue is the most common consequence of stroke, however there are no known clinical or radiological biomarkers associated with post-stroke fatigue. We assessed differences in regional brain volumes obtained from T1-weighted, high-resolution structural scans between stroke survivors with and without severe fatigue. Differences were observed in the volume of the globus pallidus and putamen, as well as the ipsilesional temporal, parietal and frontal lobe. The mentioned morphological differences between stroke survivors with and without severe fatigue have also been reported in multiple sclerosis and Parkinson's-related fatigue, suggesting a possible common mechanism.

4836	Computer 90	Preoperative predictors of hyperperfusion after CEA: a study using vessel selective ASL
		Tianye Lin[1], Zhichao Lai[2], Yuelei Lyu[2], Zhentao Zuo[3], Bing Wu[4], Jianxun Qu[4], Hui You[2], Bo Hou[2], Changwei Liu[2], and Feng Feng[2]
		[1]Radiology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, China, [2]Peking Union Medical College Hospital, Beijing, China, [3]Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [4]GE Healthcare, MR Research China, Beijing, China
		To identify preoperative predictors for cerebral hyperperfusion (CHS) after CEA based on vessel selective ASL. The perfusion volume of each brain feeding artery and the corresponding mean CBF in each perfusion volume before and after CEA were calculated. It was found that the sum of perfusion volumes corresponding to LICA, RICA and VBA (TotalPerVol) and the preoperative territory perfusion of the surgery side (preCBF_surg) was inversely correlated with the degree of CBF increase. The result indicated that tASL and ASL were useful in predicting cerebral hyperperfusion.

4837	Computer 91	Evaluation of Tranvascular Water Exchange Index (WEI) in post Thrombectomy Patients Young Ro Kim[1] and Jerold L. Boxerman[2] *[1]Radiology, Martinos Center for Biomedical Imaging MGH/HMS, Charlestown, MA, United States, [2]Diagnostic Imaging, Rhode Island Hospital and Warren Alpert Medical School of Brown University, Providence, RI, United States* The dynamic evolution of vascular impairment following thrombotic stroke has important clinical implications for designing effective management and treatment strategies. In the current study, we quantified the rate of water exchange across the blood-brain barrier (BBB) via water exchange index (WEI) in clinical patients undergone thrombectomy. Although extravasation of Gd-DTPA was not observed in most of the patients, the WEI was significantly elevated in both infarct and peri-infarct areas, revealing compromised integrity of the BBB.

4838	Computer 92	Correlation between Intracranial Artery Atherosclerotic Disease and the Integrity of Circle of Willis in Symptomatic Patients: A 3D MR Vessel Wall Imaging Study. Yilan Xu[1], Dongye Li[2,3], Zhuozhao Zheng[1], Chun Yuan[2,4], and Xihai Zhao[2] *[1]Department of Radiology, Beijing Tsinghua Changgung Hospital, Tsinghua University, Beijing, China, [2]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University School of Medicine, Beijing, China, [3]Center for Brain Disorders Research, Capital Medical University and Beijing Institute for Brain Disorders, Beijing, China, [4]Department of Radiology, University of Washington, Seattle, WA, United States* This study investigated the correlation between intracranial artery atherosclerotic disease and the integrity of communicating arteries in circle of Willis in symptomatic patients using MR imaging. We found that the intracranial artery stenosis was significantly associated with presence of anterior and posterior communicating arteries. Our findings suggest that the intracranial artery stenosis might be an independent indicator for the integrity of circle of Willis. Our data also suggest that, with the progression of intracranial artery stenosis, collateral circulation tends to be integrated from the anterior to posterior communicating arteries.

4839	Computer 93	Brain Perfusion and Structure Variation of Patients with Unilateral Middle Cerebral Artery Stenosis Shuang Yan[1], Tianyi Qian[2], Mingli Li[1], Li Zhang[3], and Zhengyu Jin[1] *[1]Radiology, Peking Union Medical College Hospital, Peking Union Medical College, Beijing, China, [2]Siemens Healthcare, MR Collaborations NE Asia, Beijing, China, [3]Peking Union Medical College Hospital, Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing, China*

		To investigate the brain structure variation of patients with chronic unilateral middle cerebral artery (MCA) stenosis, a volume-based quantitative segmentation method was used to measure the morphological changes of brain structure. A correlation analysis was performed to find the relationship between the morphometry and cerebral blood perfusion. The results showed that the patients had atrophy in many brain regions within the MCA territory. And the perfusion status may have impact on the atrophy process.

4840	Computer 94	Quantitative Cerebral Blood Flow Measured with Arterial Spin Labeling MRI in the Unaffected Contralateral Brain Hemisphere Predicts Outcome in Acute Ischemic Stroke
		Thoralf Thamm[1,2], Jia Guo[1], Jarrett Rosenberg[1], Tie Liang[1], Michael P Marks[1], Soren Christensen[1], Huy M Do[1], Stephanie M Kemp[1], Emily A Ryan[1], Tudor G Jovin[3], Bart P Keogh[4], Jenny Chen[5], Maarten G Lansberg[1], Greg W Albers[1], and Greg Zaharchuk[1]
		[1]Stanford University, Stanford, CA, United States, [2]Center for Stroke Research Berlin, Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]University of Pittsburgh Medical Center (UPMC), Pittsburgh, PA, United States, [4]Swedish Medical Center, Seattle, WA, United States, [5]Eden Medical Center, Castro Valley, CA, United States
		During acute stroke, perfusion of the ischemic penumbra might be sustained by both collaterals and elevated systemic blood pressure. Arterial Spin Labeling (ASL) is an MR imaging tool to quantify Cerebral Blood Flow (CBF) non-invasively. We focused on the non-affected brain hemisphere and utilized this contralateral CBF (cCBF) as an imaging biomarker for late neurological outcome prediction. Stroke patients were dichotomized by the median cCBF into high (>39 mL/100g/min) and low (<39 mL/100g/min) cCBF. Our analysis revealed that high cCBF predicts good neurological outcome at day 90 after stroke.

4841	Computer 95	Association between Diffusion Weighed Imaging Measured Pretreatment Ischemic Volume and Functional Outcome in Ischemic Stroke
		Yu XIE[1], Catherine Oppenheim[2], Francis Guillemin[3], Vincent Gautheron[2], Benjamin Gory[4], Hélène Raoult[5], Sébastien Soize[6], Bailiang CHEN[7], Jacques Felblinger[1,7], Gabriela Hossu[7], and Serge Bracard[1,8]
		[1]IADI, U947, INSERM, Université de Lorraine, CHRU Nancy, Nancy, France, [2]Department of Neuroradiology, Sainte-Anne Hospital and Paris-Descartes University, INSERM U894, Paris, France, [3]CIC 1433 Epidémiologie Clinique, INSERM, Université de Lorraine, CHRU Nancy, Nancy, France, [4]INSERM U1237, "Physiopathology and Imaging for Neurological Disorders (PhIND)", GIP Cyceron, Caen, France, [5]Department of Neuroradiology, University Hospital of Rennes, Rennes, France, [6]Department of Neuroradiology, University Hospital of Reims, Reims, France, [7]CIC 1433 Innovation Technologique, INSERM, Université de Lorraine, CHRU Nancy, Nancy, France, [8]Department of Diagnostic and Interventional Neuroradiology, CHRU Nancy, Nancy, France

		The association between pretreatment ischemic volume (PIV) measured on diffusion weighted images (DWI) and functional outcome after mechanical thrombectomy is of great clinical importance but has yet to be determined. We analyzed 298 ischemic stroke patients from the multicentric study THRACE. Our results showed that increased PIV was an independent predictor for a lower probability of functional independence, a less favorable degree of disability, and a higher mortality rate. PIV measured on DWI is a valuable early predictor for functional outcome in ischemic stroke patients, and thus can contribute to patient selection for optimal therapeutic intervention.

4842	Computer 96	Comparison of ASL-MRA and 3D TOF-MRA in patients with transit ischemic attack
		Yan Wang[1], Jing Chen[1], Chuanchen Zhang[1], Jianxun Qu[2], and Mingzhen Wu[1]
		[1]Radiology, Liaocheng People's Hospital, Liaocheng, China, [2]GE Healthcare, Shanghai, China
		A comparison of ASL-MRA and TOF-MRA was performed for patients suffered from TIA. TOF-MRA is superior to ASL-MRA in morphological assessment of the stenosis arteries. However, ASL-MRA can reflect more hemodynamic information of the blood supply arteries for the hypoperfusion area.

Electronic Poster

Brain Tumours

Exhibition Hall	Wednesday 13:45 - 14:45

4843	Computer 97	MRI-derived Oxygen Metabolism and Neovascularization Characterization for Grading and IDH Gene Mutation Detection of Gliomas
		Andreas Stadlbauer[1,2], Max Zimmermann[1], Arnd Dörfler[3], Stefan Oberndorfer[4], Michael Buchfelder[1], Gertraud Heinz[2], and Karl Rössler[1]
		[1]Department of Neurosurgery, University of Erlangen-Nürnberg, Erlangen, Germany, [2]Institute of Medical Radiology, University Clinic of St. Pölten, St. Pölten, Austria, [3]Department of Neuroradiology, University of Erlangen-Nürnberg, Erlangen, Germany, [4]Department of Neurology, University Clinic of St. Pölten, St. Pölten, Austria

		The purpose was to explore the diagnostic performance of combined physiological MRI of oxygen metabolism and neovascularization for glioma grading and characterization of isocitrate-dehydrogenase-1 (IDH1) gene mutation status. 83 patients with glioma WHO°II-IV were examined using vascular architecture mapping (VAM) and multiparametric quantitative BOLD (mp-qBOLD). Neovascularization correlated with increasing WHO° and microvessel type indicator (MTI) had the best diagnostic performance (AUC=0.782) for differentiation between glioma WHO°III and IV. IDH1-mutation was associated with significantly decreased cerebral metabolic rate of oxygen ($CMRO_2$; P=0.037) in glioma WHO°II and significantly increased (P=0.013) MTI in glioma WHO°III, resulting in best diagnostic performance for IDH1-mutation detection.

4844	Computer 113	Vascular Hysteresis Loops and Vascular Architecture Mapping in Patients with Glioblastoma treated with Antiangiogenic Therapy
		Andreas Stadlbauer[1,2], Max Zimmermann[1], Stefan Oberndorfer[3], Arnd Dörfler[4], Michael Buchfelder[1], Gertraud Heinz[2], and Karl Rössler[1]
		[1]Department of Neurosurgery, University of Erlangen-Nürnberg, Erlangen, Germany, [2]Institute of Medical Radiology, University Clinic of St. Pölten, St. Pölten, Austria, [3]Department of Neurology, University Clinic of St. Pölten, St. Pölten, Austria, [4]Department of Neuroradiology, University of Erlangen-Nürnberg, Erlangen, Germany
		Glioblastoma are among the most vascularized of all solid tumors and attractive targets for antiangiogenic therapies. Antiangiogenic therapy response assessment in glioblastoma is challenging due to decreased vessel permeability and diminished contrast agent extravasation. Here, we investigated the variability of vascular hysteresis loop (VHL) shapes and the spatial heterogeneity of neovascularization using vascular architecture mapping (VAM) in patients with recurrent glioblastoma during bevacizumab mono-therapy. Responding, non-responding, progressive, and remote-progressive tumor areas were observed. Analysis of VHLs in combination with VAM biomarkers may lead to a new perspective on investigating the spatial heterogeneity of neovascularization in glioblastoma during antiangiogenic therapy.

4845	Computer 98	Diagnostic Accuracy of 2-Hydroxyglutarate Magnetic Resonance Spectroscopy in Newly-Diagnosed Brain Mass and Suspected Recurrent Gliomas
		Alexander P. Lin[1], Min Zhou[1], Huijun Liao[1], and Raymond Huang[1]
		[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States

		Previous studies have reported the utility of 2-hydroxyglutarate magnetic resonance spectroscopy (2HG MRS) in diagnosing isocitrate dehydrogenase (IDH) status, which is of great value for patient management. We determined the optimal thresholds of single voxel spectroscopy (SVS) and chemical shift imaging (CSI) 2HG MRS in differentiating IDH-mutant gliomas from non-IDH-mutant controls, and then determined the diagnostic accuracy in two prospective cohorts of patients. We show that 2HG MRS provided diagnostic utility for IDH-mutant gliomas both preoperatively and at time of suspected tumor recurrence. Our findings may provide guidance for devising optimal MRS imaging protocol tailored to specific clinical settings.

4846	Computer 99	Mutual Information: Depicting the Interdependence of Perfusion and Diffusion Magnetic Resonance Imaging in Glioblastoma Patients
		Chao Li[1,2], Shuo Wang[3], Turid Torheim[4], Florian Markowetz[4], and Stephen J Price[1]
		[1]Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [2]Department of Neurosurgery, Shanghai General Hospital, Shanghai, China, [3]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [4]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom
		The mismatch between energy demands of tumor growth and heterogeneous blood supply may cause variations is associated with tumor aggressiveness. Multi-parametric imaging may enable incorporation of complementary imaging modalities. However, finding validated surrogates to depict the interrelation between imaging modalities remains a challenge. We used the mutual information to describe the interrelation between the perfusion and diffusion imaging. The results showed that the higher values of mutual information may contribute to a worse patient survival. The chemical shift imaging results suggested that the higher mutual information may be correlated with a more migratory phenotype.

4847	Computer 100	Radiomics of MRI at Diagnosis is Predictive of Extreme Survival in Glioblastoma Multiforme
		Olya Stringfield[1,2], Mahmoud Abdalah[1,2], Sandra Johnston[3,4], Nicolas Rognin[2], Yoganand Balagurunathan[2], John Arrington[5], Kristin Swanson[3], Kathleen M. Egan[6], Robert A. Gatenby[5], and Natarajan Raghunand[2]
		[1]Image Response Assessment Team Core, Moffitt Cancer Center, Tampa, FL, United States, [2]Department of Cancer Imaging & Metabolism, Moffitt Cancer Center, Tampa, FL, United States, [3]Department of Neurologic Surgery, Mayo Clinic, Phoenix, AZ, United States, [4]Department of Radiology, University of Washington, Seattle, WA, United States, [5]Department of Diagnostic & Interventional Radiology, Moffitt Cancer Center, Tampa, FL, United States, [6]Department of Cancer Epidemiology, Moffitt Cancer Center, Tampa, FL, United States

		We retrospectively analyzed pre-treatment MR scans in two cohorts diagnosed with Glioblastoma. The Long-Term Survival (LTS) group survived >36 months post-diagnosis, while the Short-Term Survival (STS) group survived ≤18 months. The discovery cohort included 22 LTS patients and 22 STS patients and the validation cohort consisted of 15 patients, each. Tumor voxels were clustered on post-contrast T1w and FLAIR sequences into 6 distinct “habitats”. Radiomic features were extracted from both sequences. The enhancement value on T1w and fraction of Habitat 6 (high signal on T1w and FLAIR) were significantly higher in the LTS groups compared to the STS groups.

4848	Computer 101	Radiological Assessment of Vascular Supply of Intracranial Meningeomas by Superselective Arterial Spin Labelling.
		Ulf Jensen-Kondering[1], Michael Helle[2], Thomas Lindner[1], Arya Nabavi[3], and Olav Jansen[1]
		[1]University Hospital Center of Schleswig-Holstein, Campus Kiel, Department of Radiology and Neuroradiology, Kiel, Germany, [2]Philips Research, Hamburg, Germany, [3]University Hospital Center of Schleswig-Holstein, Campus Kiel, Department of Neurosurgery, Kiel, Germany
		Detailed information on the extent and ratio of blood supply is required to assess the feasibility of presurgical embolisation procedures of intracranial meningeomas. This study investigates the feeding vasculature to intracranial meningeomas using superselective ASL. In 31 prospectively included patients harboring a total of 42 meningeomas, superselective ASL was performed to visualize the contribution of blood supply to the tumor and rated by two readers. We demonstrated that superselective ASL is capable of identifying and quantifying the contribution of feeding arteries in intracranial meningeomas. Agreement with gold standard DSA is also demonstrated.

4849	Computer 102	Autopsy analysis of the overlap of radiomic profiles associated with poor overall survival and predictive maps of tumor cellularity in glioblastoma patients
		Sarah L Hurrell[1], Sean McGarry[2], Elizabeth Cochran[3], Jennifer Connelly[4], Scott Rand[1], Wade Mueller[5], and Peter S LaViolette[1]
		[1]Radiology, The Medical College of Wisconsin, Milwaukee, WI, United States, [2]The Medical College of Wisconsin, Milwaukee, WI, United States, [3]Pathology, The Medical College of Wisconsin, Milwaukee, WI, United States, [4]Neurology, The Medical College of Wisconsin, Milwaukee, WI, United States, [5]Neurosurgery, The Medical College of Wisconsin, Milwaukee, WI, United States
		Multiparametric MRI radiomic profiles (RPs) of de novo glioblastoma (GBM) brain tumors have been shown to predict patient prognosis prior to treatment. This study compares prognostic RPs to predictive maps of tumor cellularity derived from radiological-pathological (rad-path) correlation to determine the convergence of both imaging biomarkers. We find that RPs associated with poor prognosis co-localize with high cellularity, both predicted and pathologically confirmed in 6 patients assessed at autopsy.

4850	Computer 103	Amide proton transfer-weighted imaging of glioblastoma and metastatic brain tumor: histogram analysis in enhancing tumors and peritumoral regions
		Kiyohisa Kamimura[1], Masanori Nakajo[1], Tomohide Yoneyama[1], Hirofumi Hirano[2], Takashi Iwanaga[3], Yuta Akamine[4], Jochen Keupp[5], and Takashi Yoshiura[1]
		[1]Radiology, Kagoshima University Graduate School of Medical and Dental Sciences, Kagoshima, Japan, [2]Neurosurgery, Kagoshima University Graduate School of Medical and Dental Sciences, Kagoshima, Japan, [3]Clinical engineering department radiation section, department radiation section, Kagoshima, Japan, [4]Philips Japan, Tokyo, Japan, [5]Philips GmbH Innovative Technologies Research Laboratories, Aachen, Germany
		To determine whether amide proton transfer-weighted imaging (APTWi) is useful for distinguishing glioblastomas (GBMs) from metastatic brain tumors (Mets), we compared APT-related signal intensity (APTSI) between the two tumor types in the areas of enhancing tumor and peritumoral high signal intensity areas (PHAs) using histogram analysis. In the enhancing tumor, the mean and 90,75,50,25 and 10 percentiles of APTSI histogram were significantly higher in GBMs than in Mets, whereas no APTSI histogram parameters in PHA showed significant difference between GBMs and Mets. APTSI in the areas of enhancing tumor, not in PHA is useful for differentiation between GBMs and Mets.

4851	Computer 104	The Influence of Heterogenous Subregions on Predicting MGMT Methylation Status of Glioblastomas: A Radiomics Analysis on Multimodal MRI
		Qiang Tian[1], Xi Zhang[2], Lin-feng Yan[1], Yu-chuan Hu[1], Yu Han[1], Ying-zhi Sun[1], Wen Wang[1], and Guang-bin Cui[1]
		[1]Radiology, Tangdu Hospital, the Fourth Military Medical University, Xi'an, China, [2]Biomedical Engineering, the Fourth Military Medical University, Xi'an, China
		MGMT promoter methylation is associated with longer survival and better treatment response of GBM patients. Intratumor heterogeneity is partly responsible for inaccurate detection of MGMT status. Therefore, assessing the effect of different heterogenous subregion of GBM on MGMT status would be critical. In this study, a radiomics approach integrated optimal features of heterogenous subregions in multimodal MRI and machine learning model was proposed for effectively predicting MGMT methylation, and meanwhile assessing the prediction efficiency of subregions or subregion combinations. The proposed approach achieved a promising MGMT methylation detection performance and indicated that rNEC may play a role in this issue.

4852	Computer 105	High-resolution Deuterium MR Spectroscopic Imaging of the Warburg Effect in Brain Tumor
		Ming Lu[1], Xiao-Hong Zhu[1], Yi Zhang[1], Walter Low[2], and Wei Chen[1]

		[1]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Neurosurgery Department, University of Minnesota, Minneapolis, MN, United States
		The best-known metabolic abnormality in brain cancer is the Warburg effect, which shifts the fuel consumption from oxidation towards glycolysis. Recently, we developed a novel *in vivo* Deuterium (^{2}H) MR spectroscopic imaging (DMRSI) approach for simultaneously assessing brain glycolysis and oxidation at 16.4 T. In this study, we aimed to image the Warburg effect in a rat model with gliosarcoma using DMRSI with improved resolution. High-resolution quantitative image using the ratio of [lactate] to [glutamate/glutamine] showed a huge contrast between brain tumor and intact tissue and promise to study the decoupling relationship between glycolysis and oxidation in tumor.

4853	Computer 106	Edge Contrast of the FLAIR Hyperintense Region Predicts Survival in Patients with High Grade Gliomas Following Treatment with Bevacizumab
		Naeim Bahrami[1], David Piccioni[1], Roshan Karunamuni[1], Nate White[1], Yu-Hsuan Chang[1], Tyler Seibert[1], Rachel Delfanti[1], Jona jhattangadi-gluth[1], Nikdokht Farid[1], Anders M Dale[1], and Carrie McDonald[1]
		[1]University of California, San Diego, San Diego, CA, United States
		Treatment with bevacizumab is standard of care for recurrent high grade gliomas (HGGs) and the level of border distinctness is a major parameter to monitor the therapy. Previously, the level of border distinctness was defined qualitative. In this study, we calculated the distinctness of the fluid-attenuated inversion recovery (FLAIR) hyperintense border—edge contrast (EC)—and showed it improves the evaluation of response to bevacizumab in patients with HGG. We showed that after bevacizumab, lower EC of the FLAIR hyperintense region was associated with poorer survival among HGG patients. We developed a quantitative parameter to characterize the border of the tumor.

4854	Computer 107	True-Diffusion Coefficient Retracted from Intra-Voxel Incoherent Motion (IVIM) Can Stratify Biopsy-Approved Infiltrative Edema from Normal Tissue and Active Tumor in Diffuse Brain Gliomas
		Anahita Fathi Kazerooni[1], Nima Gilani[1], Mahnaz Nabil[2], Mehdi Zeinalizadeh[3], Kavous Firouznia[4], Farid Azmoudeh-Ardalan[5], Mohammad Peikari[6], Mohammadreza Alviri[1], Mehrdad Hadavand[1], and Hamidreza Saligheh Rad[1]

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Infiltration of tumorous cells in the normal brain parenchyma is an intrinsic characteristic of diffuse gliomas and is a determinant factor in tumor recurrence, transformation into malignant form, and poor prognosis. The objective of this study was to investigate the role of intra-voxel incoherent motion (IVIM) imaging in characterizing tumor infiltration through localized biopsies. Histopathologically-approved regions of active tumor, infiltrative glioma (edema), and normal tissues were accurately discriminated by true (perfusion-free) diffusion coefficient (*D*).

4855 Computer 108

Characterization of Active and Infiltrative Tumorous Subregions from Normal Tissue in Brain Gliomas Using Multi-Parametric MRI

Anahita Fathi Kazerooni[1], Mahnaz Nabil[2], Mohammadreza Alviri[1], Mehdi Zeinalizadeh[3], Kavous Firouznia[4], Farid Azmoudeh-Ardalan[5], and Hamidreza Saligheh Rad[1]

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In this preliminary work, a variety of MRI techniques, including conventional high-resolution T1-weighted, T2-weighted, and T2-FLAIR, as well as quantitative techniques comprising of T2-relaxometry, DWI, DTI, DSC-MRI, and IVIM derived features were acquired from patients with gliomas. The features extracted from the mentioned images were explored for their potential in stratification of histopathologically-approved samples, labelled as active tumor, infiltrative glioma (edema) and normal brain tissue. Furthermore, the most accurate combination of the features for discrimination of tissue subregions was generated through a machine learning technique.

4856 Computer 109

Combined Diffusion Kurtosis Imaging and Dynamic Susceptibility Contrast Magnetic Resonance Perfusion Imaging for In Vivo Molecular Profiling of Human Glioma.

Johann-Martin Hempel[1], Jens Schittenhelm[2], Nils Nüssle[1], Cornelia Brendle[1], Benjamin Bender[1], Ghazaleh Tabatabai[3], Marco Skardelly[4], Salvador Castaneda Vega[5], Ulrike Ernemann[1], and Uwe Klose[1]

		[1]Neuroradiology, Eberhard Karls University Tübingen, Tübingen, Germany, [2]Neuropathology, Eberhard Karls University Tübingen, Tübingen, Germany, [3]Neurology, Eberhard Karls University Tübingen, Tübingen, Germany, [4]Neurosurgery, Eberhard Karls University Tübingen, Tübingen, Germany, [5]Preclinical Imaging; Nuclear Medicine, Eberhard Karls University Tübingen, Tübingen, Germany
		The purpose of this study was to assess the diagnostic performance of combined DKI and DSC-MRI maps for in vivo assessment of the 2016 WHO integrated glioma grades. Histogram parameters of DKI show a higher diagnostic performance than those of DSC-MRI in stratifying gliomas according to the integrated molecular approach of 2016 CNS WHO. However, DSC-MRI may provide additional insight into the MGMT methylation profile of primary IDH wild-type GBM. Thus, combined DKI and DSC-MRI provide promising potential biomarkers for glioma.

4857	Computer 110	Deep-learned 3D black-blood imaging using automatic labeling technique and 3D convolutional neural networks for detection of metastatic brain tumors
		Yohan Jun[1,2], Taejoon Eo[1], Taeseong Kim[1], Hyungseob Shin[1], Dosik Hwang[1], Sohi Bae[3], Yaewon Park[4], Hojoon Lee[3], Byoungwook Choi[3], and Sungsoo Ahn[3]
		[1]Electrical and Electronic Engineering, Yonsei University, Seoul, Republic of Korea, [2]Philips Korea, Seoul, Republic of Korea, [3]Radiology and Research Institute of Radiological Science, Yonsei University College of Medicine, Seoul, Republic of Korea, [4]Department of Radiology, Ewha Womans University College of Medicine, Seoul, Republic of Korea
		Black-blood (BB) imaging has complementary roles in addition to contrast-enhanced 3D gradient-echo (CE 3D-GRE) imaging for detection of brain metastases. We proposed deep-learned 3D BB imaging with an auto-labeling technique and 3D convolutional neural networks (CNNs) for detecting metastatic brain tumors. On deep-learned BB imaging, vessel signals of the brain were effectively suppressed in all patients. According to per lesion analysis, overall sensitivities were 90.3% for deep-learned BB and 100% for original BB. There were eight false positive nodules on original BB and only one on deep-learned BB. Deep-learned 3D BB imaging can be effectively used for detecting metastatic tumors in the brain.

4858	Computer 111	High Resolution T1-Perfusion using Compressed-SENSE for Glioma Grading
		Rakesh Kumar Gupta[1], Indrajit Saha[2], Anup Singh[3], Pradeep Kumar Gupta[1], Rupsa Bhattacharjee [2], Anandh K Ramaniharan [4], Rana Patir[5], Sunita Ahlawat[6], Jitender Saini[7], and Marc Van Cauteren[8]

		[1]Department of Radiology and Imaging, Fortis Memorial Research Institute, Gurgaon, India, [2]Philips Health Systems, Philips India Limited, Gurgaon, India, [3]Center for Biomedical Engineering, Indian Institute of Technology Delhi, Delhi, India, [4]Philips Innovation Campus, Philips India Limited, Bangalore, India, [5]Department of Neurosurgery, Fortis Memorial Research Institute, Gurgaon, India, [6]SRL Diagnostics, Fortis Memorial Research Institute, Gurgaon, India, [7]Department of Neuroimaging & Interventional Radiology, National Institute of Mental Health and Neurosciences, Bangalore, India, [8]Philips HealthTech Asia Pacific, Tokyo, Japan
		T1-perfusion MRI derived relative cerebral blood volume (rCBV) is a key bio-marker for pre-surgical grading of gliomas; however, acquiring clinically relevant higher resolution T1-perfusion data with whole brain coverage is challenging due to possible loss in temporal resolution. This study takes the advantage of combining compressed-sensing with SENSE parallel-imaging i.e., Compressed-SENSE (CSENSE), to develop high-resolution whole brain T1-perfusion with improved temporality. The CSENSE enabled T1-perfusion derived rCBV values successfully differentiated high and low grade gliomas and matched with the histopathological grading. The rCBV cut-off value from CSENSE assisted T1-perfusion was similar to the routine T1-perfusion without-CSENSE of histopathology-matched gliomas.

4859	Computer 112	Lactate-weighted Chemical Exchange Saturation Transfer (Lactate-CEST) Imaging in Glioma Patients at 7 Tesla
		Daniel Paech[1], Jan-Eric Meissner[2], Markus Wennmann[1], Andreas Korzowski[2], Alexander Radbruch[1], Martin Bendszus[3], Wolfgang Wick[4], Andreas Unterberg[5], Peter Bachert[2], Mark Edward Ladd[2], and Heinz-Peter Schlemmer[1]
		[1]Radiology, German Cancer Research Center, Heidelberg, Germany, [2]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany, [3]Neuroradiology, University Hospital Heidelberg, Heidelberg, Germany, [4]Neurology, University Hospital Heidelberg, Heidelberg, Germany, [5]Neurosurgery, University Hospital Heidelberg, Heidelberg, Germany
		Non-invasive imaging of lactate is of enormous significance, particularly in oncologic diseases or metabolic disorders. In this work, we applied Lactate-weighted Chemical Exchange Saturation Transfer (Lactate-CEST) magnetic resonance imaging (MRI) at 7 Tesla (7T) to newly-diagnosed glioma patients. Lactate-CEST MRI revealed increased levels of lactate production in brain tumors of patients with glioma and could therefore serve as an additional imaging biomarker in diagnostic oncology with implications for biopsy targeting, patient therapy and response monitoring.

4860	Computer 114	Advanced MRI and MRS precursors to progression in Grade II and III Glioma
		Tracy L Luks[1], Yan Li[1], Marisa LaFontaine[1], Angela Jakary[1], Michael Wahl[2], Susan M Chang[3], and Sarah J. Nelson[1]

[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Radiation Oncology, University of California San Francisco, San Francisco, CA, United States, [3]Neurological Surgery, University of California San Francisco, San Francisco, CA, United States

The goal of this project is to identify serial advanced imaging markers that reveal tumor progression in grade II and III gliomas prior to the Response Assessment in Neuro-Oncology Criteria (RANO) criteria for progression. Serial advanced imaging demonstrated significant changes associated with tumor activity prior to the clinical determination of tumor progression. In diffusion imaging, there were declines in nFA, and an increase in nADC in the contrast enhancing lesions. In spectroscopic imaging, there were declines in nNAA and nCRE, and increases in nCho, nLIP and nLAC.

4861 | Computer 115

Volumetric Amide Proton Transfer-Weighted (APTw) Image Metrics as Biomarkers for the Identification of Tumor Progression in Patients with Post-treatment Glioblastoma

Shanshan Jiang[1,2], Hye-Young Heo[1], Yi Zhang[1,3], and Jinyuan Zhou[1]

[1]Johns Hopkins University, Baltimore, MD, United States, [2]Zhujiang Hospital, Southern Medical University, Guangzhou, China, [3]Center for Brain Imaging Science and Technology, Department of Biomedical Engineering, Zhejiang University, Hangzhou, China

We quantified the accuracy of volumetric APTw image derived metrics in identifying recurrent malignant glioma. 31 patients with suspected recurrent glioblastoma underwent a volumetric APTw imaging sequence at 3T. Volumes with Gd-enhancing, FLAIR abnormality and APTw hyperintensity were drawn as regions of interest (ROIs). Ratios and APTw histogram parameters of volumetric ROIs were calculated and analyzed. There were significant differences in multiple parameters between treatment effects and recurrent tumor. APT/Gd and Gd-$APT_{10\%}$ showed the highest diagnostic performance. FLAIR-Mean showed reasonable diagnostic performance with great operation simplicity.

4862 | Computer 116

Predicting efficacy of a novel immune stimulator in an animal model of glioblastoma with ferumoxytol cell tracking MRI

Runze Yang[1], A. Max Hamilton[1], Susobhan Sarkar[2], Reza Mirzaei[2], V. Wee Yong[2], and Jeff F. Dunn[1]

[1]Radiology, University of Calgary, Calgary, AB, Canada, [2]Clinical Neuroscience, University of Calgary, Calgary, AB, Canada

		Treatment of malignant gliomas with immunotherapy has become an important area of exploration. However, one of the major problems in glioma immunotherapy is the lack of sensitive imaging techniques to differentiate tumor progression (detrimental) from pseudoprogression (beneficial, caused by stimulated macrophages). We hypothesized that tracking macrophages is a sensitive way to detect immunotherapy treatment response. We used a novel drug that stimulates the innate immune system and showed that ferumoxytol based cell tracking MRI is a sensitive way to detect monocyte infiltration and predict tumor growth. Ferumoxytol is used clinically, so this method has high potential for clinical translation

4863	Computer 117	Late-delayed perfusion decrease following radiochemotherapy in glioblastoma patients
		Jan Petr[1,2], Henri JMM Mutsaerts[2,3,4], Ivan Platzek[5], Vera C Keil[6], Frank Hofheinz[1], Iris Asllani[2], Annekatrin Seidlitz[7,8,9,10], Marketa Petrova[5], Esther GC Troost[7,8,9,10,11,12], Mechthild Krause[7,8,9,10,11,12], and Jörg van den Hoff[1,13]
		[1]PET Center, Institute of Radiopharmaceutical Cancer Research, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany, [2]Rochester Institute of Technology, Rochester, NY, United States, [3]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [4]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands, [5]Department of Radiology, University Hospital Carl Gustav Carus, Dresden, Germany, [6]University Hospital Bonn, Bonn, Germany, [7]Department of Radiation Oncology, University Hospital Carl Gustav Carus, Dresden, Germany, [8]OncoRay – National Center for Radiation Research in Oncology, Dresden, Germany, [9]German Cancer Consortium (DKTK), Dresden, Germany, [10]German Cancer Research Center (DKFZ), Heidelberg, Germany, [11]Institute of Radiooncology, Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany, [12]NCT – National Center for Tumor Disease, Dresden, Germany, [13]Department of Nuclear Medicine, University Hospital Carl Gustav Carus, Dresden, Germany
		Temozolomide-based radiochemotherapy (RCT) is a treatment standard for glioblastoma patients. However, RCT is associated with risks of neurocognitive decline. Perfusion is a possible early marker of tissue damage and has been shown to correlate with cognitive changes in many diseases. Perfusion decrease at 3 to 6 months after RT was recently reported in glioblastoma patients. However, it remains unclear whether the decrease is reversible and thus possibly a precursor of the late-delayed cognitive changes. In this study, we have measured perfusion changes up to 18 months following RCT. No further progress of perfusion deficits was found indicating that the early perfusion decrease is predictive of late perfusion decrease and might thus be connected with cognitive decline.

4864	Computer 118	THE CHALLENGE OF TRACTOGRAPHY APPLIED TO CRANIAL NERVES: OUR EXPERIENCE ON DESIGN OF REGIONS OF INTEREST
		Timothée Jacquesson[1,2,3], François Cotton[1,4], Justine Bosc[1], Moncef Berhouma[1,2], Emmanuel Jouanneau[2], Arnaud Attye[5], and Carole Frindel[1]

		[1]CREATIS UMR 5220, U1206, University of Lyon, Lyon, France, [2]Skull Base Multi-disciplinary Unit, Hospices Civils de Lyon, Lyon, France, [3]Department of Anatomy, University of Lyon, Lyon, France, [4]Department of Radiology, Hospices Civils de Lyon, Lyon, France, [5]Department of Radiology, Grenoble University Hospital, Grenoble, France
		Recent studies have demonstrated diffusion tensor imaging tractography of cranial nerves (CNs). Spatial and angular resolution, however, is limited with this imaging technique. In this study, we reported our experience in CNs tractography detailing the influence of ROI design. We demonstrated that understanding in detail the key role of ROI design and its influence helps to provide coherent tracts. We expect this work to enable a more reliable CNs tractography and made it a useful tool for surgical planning of complex skull base tumors.

4865	Computer 119	23Na MRI at 7 Tesla for Early Response Assessment in Patients with Glioblastoma and Skull Base Meningioma
		Sebastian Regnery[1,2], Daniel Paech[3], Heiz-Peter Schlemmer[3], Mark E. Ladd[4], Armin M. Nagel[4,5], Stefan Rieken[1,2], Jürgen Debus[1,2], Sebastian Adeberg[1,2], and Nicolas G.R. Behl[4]
		[1]Department of Radiation Oncology, University Hospital of Heidelberg, Heidelberg, Germany, [2]Clinical Cooperation Unit Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [3]Division of Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]Division of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [5]Institute of Radiology, University Hospital Erlangen, Erlangen, Germany
		Radiotherapy is a cornerstone in the treatment of glioblastoma and skull base meningioma. Here, the first results of a prospective longitudinal study employing 23Na MRI for the response evaluation of glioblastoma and skull base meningioma patients during radiotherapy are presented. The study results show that radiation treatment of glioblastoma leads to considerable changes in sodium concentrations within the tumor and the surrounding edema that are dependent on treatment response.

4866	Computer 120	MRI Texture Analysis based on 3D tumor measurement in the identification and prognosis of Gliomas with IDH1 Mutations
		Liang Han[1], Yanwei Miao[1], Junyi Dong[1], Xiaoxin Li[1], Yangyingqiu Liu[1], Shiyun Tian[1], Mame Fatou KEITA[1], Weiwei Wang[1], Yan Guo[2], and Qingwei Song[1]
		[1]The First Affiliated Hospital of Dalian Medical University, Dalian, China, [2]Life science, GE Healthcare, Shenyang, China

		The 2016 World Health Organization Classification of Tumors of the Central NervousSystem(CNS) used molecular parameters in addition to histology to define manytumor entities, thus formulating a concept for how CNS tumor diagnosis should bestructured in the molecular era.IDH1 is an important molecular marker which has important clinical significance. The prognosis of gliomas with IDH1 mutation is better than those without one. In general,IDH1is detected by pathological biopsy. In this study, gliomas with or without IDH1 mutation was distinguished by using non-invasive MRI texture analysis based on 3D tumor measurement, and then the relationship between MRI texture parameters with survival rate was further assessed.

Electronic Poster

Myocardial Tissue Characterization

Exhibition Hall	Wednesday 14:45 - 15:45

4867	Computer 1	Single Acquisition Multiparametric MRI for Differentiation of Left Ventricular Scar Tissue Composition
		Zahra Hosseini[1,2], Junmin Liu[1], Nikolaos Tzemos[3], Raymond Yee[3], and Maria Drangova[1,4]
		[1]Robarts Research Institute, Western University, London, ON, Canada, [2]Graduate Program in Biomedical Engineering, Western University, London, ON, Canada, [3]Department of Medicine, Western University, London, ON, Canada, [4]Biomedical Engineering, Western University, London, ON, Canada
		Cardiac MRI plays a key role in identifying heart failure patients' response to cardiac resynchronization therapy. The identification of healthy myocardial regions for lead implantation is accomplished by means of late gadolinium enhancement MRI using exogenous contrast agents. Most MRI techniques that enable non-contrast cardiac tissue characterization are magnitude-based. MRI phase is an effective standalone source of information. However, most successful phase-based imaging is performed at lower field strength to alleviate field inhomogeneity-related artifacts. We present the application of a robust multiparametric magnitude- and phase-based myocardial mapping approach for scar tissue characterization at 3T.

4868	Computer 2	Temporal evaluation of acute myocardial ischemia/reperfusion injury in rats using 7.0T magnetic resonance imaging and APT102 therapeutic effect
		Ziqian Xu[1], Jie Zheng[2], and Fabao Gao[1]
		[1]West China Hospital, Sichuan University, Chengdu, China, [2]Washington University School of Medicine, St. Louis, MO, United States

		Intramyocardial hemorrhage(IMH) and microvascualr obstruction(MVO) were the serious injuries in the early myocardial infarction reperfusion period, which were independent predictors of larger infarct size, lower systolic function and the worse prognosis at follow-up. APT102 as a synthetic apyrase of the hunman nucleoside triphosphate diphosphohydrolase-3(CD39L3) can exhibit ADPase activity, prevent thrombotic reocclusion and decrease infarct size without an increased bleeding risk. The purpose of this study was to continuously detect myocardial ischemia/reperfusion injury and APT102 effect in rats by 7.0T MRI.

4869	Computer 3	Estimation of late gadolinium enhancement of myocardial infarction with phase sensitive inversion recovery balanced steady state free precession (PSIR-bSSFP)
		Takashige Yoshdia[1,2], Masami Yoneyama[3], Kohei Yuda[1], Takumi Koyano[1], Yuki Furukawa[1], Hiroe Kobayashi[4], Nobuo Kawauchi[5], and Haruo Saito[2]
		[1]Radiology, Tokyo Metropolitan Police Hospital, Tokyo, Japan, [2]Graduate school of Medicine, Division of Diagnostic Image Analysis, Tohoku University, Miyagi, Japan, [3]MR Clinical Science, Philips Japan, Tokyo, Japan, [4]Radiology, Kenkoin Clinic, Tokyo, Japan, [5]Diagnosis of radiology, Tokyo Metropolitan Police Hospital, Tokyo, Japan
		The late gallium enhancement (LGE) image showing an expression amount having a significant difference for improvement wall motion or not is estimated from contrast enhancement area in patients with cardiovascular disease. However, left ventricle blood (LVB) with contrast wash-out can have similar T1 value to scar, and a fabrication sub-endocardial scar is often deluded as LVB. The phase sensitive inversion recovery balanced steady state free precession (PSIR-bSSFP) is possible to obtain black blood and contrast enhancement image. Our study of PSIR-bSSFP was propose BB-LGE that feasible visualize of myocardial hyper-enhancement area with LV blood suppression.

4870	Computer 4	Improvement of radiofrequency lesion visualization using 3D T1-weighted compressed sensing imaging
		Pierre Bour[1,2,3,4], Valéry Ozenne[1,2,3], Marylène Delcey [1,2,3,5], Takeshi Kitamura[1,2,3,6], David Gonthier[1,2,3], Michaela Schmidt[7], Christoph Forman[7], Wadie Ben Hassen[5], Hubert Cochet [1,2,3,6], Pierre Jais[1,2,3,6], and Bruno Quesson [1,2,3]
		[1]IHU-LIRYC, PESSAC, France, [2]Univ. Bordeaux, Centre de recherche Cardio-Thoracique de Bordeaux, Bordeaux, France, [3]INSERM U1045, Bordeaux, France, [4]Image Guided Therapy, Pessac, France, [5]Siemens Healthcare, Saint-Denis, France, [6]Bordeaux University Hospital (CHU), Bordeaux, France, [7]Siemens Healthcare, Erlangen, Germany

		Visualization of acute radiofrequency lesions in the heart is a key point to assess the endpoint of catheter-based anti-arrhythmic therapy. Albeit 3D navigated T1-weighted sequences have proven there reliability to delineate lesion cores and edema, these sequences remain too lengthy/insufficiently spatially resolved to be used clinically. In this study we investigated the benefit of combining 3D T1-weighted acquisition with compressed sensing acceleration to reduce acquisition duration while maintaining sufficient spatial resolution to visualize the core of the lesion and surrounding edema. Methods are evaluated with/without gadolinium injection with different inversion times in vivo in the heart of swine.

4871	Computer 5	Accelerated free breathing 3D cardiac T1ρ mapping in humans using compressed sensing and improved k-space reordering
		Srikant Kamesh Iyer[1], Yuchi Han[2], Harold Litt[3], and Walter R.T. Witschey[3]
		[1]Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Medicine, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States
		Cardiac T1ρ MRI is a parametric mapping technique for imaging myocardial fibrosis and may benefit heart disease patients unable to receive contrast agents due to poor kidney function. The purpose of this work was to develop accelerated free-breathing T1ρ mapping MRI that achieves whole heart coverage with superior spatial resolution compared to 2D methods in a reasonable scan time using compressed sensing (CS). The overall hypothesis is that 3-fold accelerated free breathing 3D cardiac T1ρ MRI is feasible.

4872	Computer 6	3D Whole-Ventricle, Free-Breathing, Non-ECG, Myocardial T1 and ECV Mapping with CMR Multitasking
		Jaime Shaw[1,2], Anthony Christodoulou[1], Xiaoming Bi[3], and Debiao Li[1,2]
		[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Bioengineering, UCLA, Los Angeles, CA, United States, [3]Siemens Healthineers, Los Angeles, CA, United States
		Myocardial fibrosis is a common pathological feature in cardiovascular diseases and can be detected with T1 and extracellular volume fraction (ECV) mapping. 3D methods are desirable to fully characterize the entire left ventricle. Typical T1 mapping methods require long scan times with respiratory navigators or repeated breath-holds which lead to patient discomfort or noncompliance. In this study, we perform 3D T1 and ECV mapping with CMR Multitasking to achieve whole-ventricle coverage in a free-breathing, non-ECG scan, producing comparable ECV to a conventional breath-hold, ECG-gated technique.

4873	Computer 7	Free-breathing and ungated 3D-T1rho mapping of the heart using golden angle radial sampling and compressed sensing with low-rank constrained sparse reconstruction

		Rajiv G Menon[1], Marcelo V.W. Zibetti[1], Azadeh Sharafi[1], Li Feng[1], Leon Axel[1], and Ravinder R Regatte[1]
		[1]*New York University School of Medicine, New York, NY, United States*
		In this study, we present a technique for T1rho mapping of myocardium using a combination of T1rho preparation, radial sampling, and low rank-based compressed sensing (CS) reconstruction. We acquire free-breathing, ungated data using a 3D T1rho prepared radial acquisition scheme with different spin lock times (TSL). After retrospectively synchronizing the data to a window in diastole, a sparse 3D k-dataset is given as input to compressed sensing reconstruction that uses a low rank constraint. Mono-exponential modeling of the reconstructed data yields the T1rho maps. The CS reconstruction results in improved images and the mean T1rho values estimated in the myocardium are consistent with literature.

4874	Computer 8	Myocardial fibrosis evaluated by diffusion weighted imaging and and its relationship to three-dimensional global contractile function in patients with hypertrophic cardiomyopathy
		Rui Wu[1], Dong-Ao-Lei An[1], Bing-Hua Chen[1], Ruo-Yang Shi[1], Wei-Bo Chen[2], Tong-Tong Han[3], Lian-Ming Wu[1], and Jian-Rong Xu[1]
		[1]*Radiology, Ren Ji Hospital, School of Medicine，Shanghai Jiao Tong University, Shanghai, China,* [2]*Philips Healthcare，shanghai，China, Shanghai, China,* [3]*Clinical Application, Circle Cardiovascular Imaging, Calgary, Canada*
		The prognostic value of the apparent diffusion coefficient (ADC) for diffuse myocardial fibrosis and its relationship to the contractile function is still not investigated. A total of 45 HCM patients and 20 controls underwent a 3.0-T cardiac magnetic resonance imaging (CMRI), including cine, T1 mapping, and DWI. ADC values in the ECV ≥ 29.6% group were significantly increased compared to the ECV < 29.6% group. ADC values were linearly associated with 3D LV GCS, GLS, GCSR, GLSR and GRSR. Impairment of contractile function in HCM is predominantly associated with the contrast-free ADC value.

4875	Computer 9	Elevated NT-proBNP in a Community Cohort is Associated with Myocardial Fibrosis: the Multi-Ethnic Study of Atherosclerosis (MESA)
		Chia-Ying Liu[1], Susan R Heckbert[2], Shenghan Lai[3], Bharath Amable-Venkatesh[4], Mohammad R Ostovaneh[4], Robyn L McClelland[5], Joao A.C Lima[4], and David A Bluemke[6]
		[1]*Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States,* [2]*Department of Epidemiology, University of Washington, Seattle, WA, United States,* [3]*Department of Pathology, Johns Hopkins School of Medicine, Baltimore, MD, United States,* [4]*Department of Radiology, Johns Hopkins School of Medicine, Baltimore, MD, United States,* [5]*Department of Biostatistics, University of Washington, Seattle, WA, United States,* [6]*David Bluemke, University of Wisconsin, Madison, WI, United States*

		We evaluated the relationship between cardiac MRI measures of fibrosis and NT-proBNP levels in 1334 participants in the Multi-Ethnic Study of Atherosclerosis (MESA). Univariate and multivariable regression analyses adjusting for demographics, cardiovascular risk factors, and left ventricular (LV) mass were performed to examine the association of log NT-proBNP with MRI T1 mapping indices. In the fully adjusted model, each one standard deviation increment (0.44pg/mL) of log NT-proBNP was associated with 0.62% increment in ECV (P<0.001), 4.7ms increment in native T1 (P=0.001), and 0.01 increment in partition coefficient (P<0.001). Elevated NT-proBNP is related to subclinical fibrosis in a community-based setting.

4876	Computer 10	Myocardial Oxygenation Using T2* BOLD Cardiac MRI with Compressed SENSE: Association with Myocardial Fibrosis and Contraction in Hypertrophic Cardiomyopathy
		Michinobu Nagao[1], Kenji Fukushima[1], Eri Watanabe[2], Umiko Ishizaki[1], Yuka Matsuo[1], Akiko Sakai[2], Risako Nakao[2], Yasuhiro Goto[3], Masami Yoneyama[4], and Shuji Sakai[1]
		[1]Diagnostic Imaging & Nuclear Medicine, Tokyo Women's Medical University, Tokyo, Japan, [2]Cardiology, Tokyo Women's Medical University, Tokyo, Japan, [3]Radiological service, Tokyo Women's Medical University, Tokyo, Japan, [4]Philips Electronics Japan, Tokyo, Japan
		We developed a new method for myocardial oxygenation using oxygen-inhalation blood-oxygen-level-dependent (BOLD) T2* cardiac magnetic resonance imaging (T2*-CMR). Myocardial oxygenation (ΔR2*, ms-1) was defined as the difference in R2* between under room-air and oxygen inhalation. ΔR2* is increased in patients with hypertrophic cardiomyopathy who had large LGE areas and low strains, suggesting that impairment of myocardial oxygenation associates with myocardial fibrosis and systolic dysfunction. In addition, T2*-CMR with compressed SENSE enables to shorten scan time and less motion artifact. This contributes to make high precision of T2* and R2* maps.

4877	Computer 11	Clinical validation of the T1blood-based synthetic hematocrit used to calculate the ECV on 3T MRI in patients with type 2 diabetes mellitus and hypertrophic cardiomyopathy
		Xiaoyue Zhou[1], Yongning Shang[2,3], Xiaochun Zhang[2,3], and Jian Wang[2,3]
		[1]Siemens Healthcare Ltd., Shanghai, China, [2]Third Military Medical University, Chongqing, China, [3]Southwest Hospital, Chongqing, China
		Calculation of the extracellular volume fraction is based on a patient's hematocrit (Hct), which can be obtained via a clinical blood test or can be estimated synthetically according its linear relationship with the native T1 of the blood. However, the reliability of the synthetic Hct needs to be studied further. We therefore assessed the clinical validation of the synthetic Hct compared with the Hct derived from a blood test in patients with type 2 diabetes mellitus and hypertrophic cardiomyopathy.

4878	Computer 12	Free-Breathing Myocardial T1-Acquisition with Region-based Analysis is Feasible to Quantify Diffuse Myocardial Fibrosis Mao-Yuan Marine Su[1], Yu-Sen Huang[1], Yeun-Chung Chang[1], Shun-Chung Yang[1], Kui-Yuan Ho[2], Lian-Yu Lin[3], Cho-Kai Wu[3], and Wen-Yih Isaac Tseng[1,4] *[1]Dpt of Medical Imaging, National Taiwan University Hospital, Taipei, Taiwan, [2]Dpt of Medical Imaging, Cathay General Hospital, Taipei, Taiwan, [3]Dpt of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan, [4]Institute of Medical Device and Imaging, National Taiwan University, Taipei, Taiwan* This study investigated whether free-breathing T1-acquisition with the proposed region-based (RB) method is feasible to quantify ECV as an index of diffuse myocardial fibrosis. Thirty-eight patients with non-ischemic cardiomyopathy (NICM) and 20 healthy controls were examined using both breath-hold and free-breathing myocardial T1-acquisitions. ECV was measured from free-breathing images by the RB method, which was compared with the measurement on the standard pixel-wise T1-mapping. Intraclass correlation coefficient of the two methods was 0.915. Patients with NICM showed significantly higher ECV than controls for both methods. Our results suggest that free-breathing T1-acquisition with the RB method is feasible to quantify diffuse myocardial fibrosis, and is comparable to the measurement using the standard T1-mapping.

4879	Computer 13	Validation of Diffusion Tensor Imaging in Diseased Myocardium Irvin Teh[1,2], Darryl McClymont[2], Marie-Christine Zdora[3,4], Hannah J. Whittington[2], Katja Gehmlich[2], Christoph Rau[3,5,6], Craig A. Lygate[2], and Jürgen E. Schneider[1,2] *[1]Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, United Kingdom, [2]Division of Cardiovascular Medicine, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [3]Diamond Light Source, Didcot, United Kingdom, [4]Department of Physics and Astronomy, University College London, London, United Kingdom, [5]University of Manchester, Manchester, United Kingdom, [6]Feinberg School of Medicine, Northwestern University, Chicago, IL, United States* Diffusion tensor imaging (DTI) has been used in clinical research to identify microstructural changes in the heart following disease. However, the evidence supporting its use in the presence of abnormalities such as scar, hypertrophy and collagen infiltration is limited. Here, we investigate the application of DTI in fixed healthy, infarcted, hypertrophic and fibrotic mouse hearts, and validate these on a voxel-wise basis with high-resolution structure tensor synchrotron radiation imaging. Our findings show good agreement in helix angle estimation between the two imaging modalities across all hearts, and supports the clinical role of DTI in the presence of cardiac pathologies.

4880	Computer 14	Feasibility Study of Whole Heart T1 Mapping with SMS in A Single Breath Hold Wenbo Sun[1], Meng Ye[2], Yuan Zheng[3], Lele Zhao[2], Nan Liu[2], Yanqun Teng[2], Lan Lan[1], Jian Xu[3], and Haibo Xu[1]

		[1]Department of Radiology, Zhongnan Hospital of Wuhan University, Wuhan, China, [2]United Imaging Healthcare, Shanghai, China, [3]UIH America Inc., Houston, TX, United States
		A novel single breath hold (BH) whole-heart T1 mapping technique with simultaneous multi-slice (SMS) imaging with improved spatial coverage and faster acquisition speed is proposed and evaluated, the initial results show that the proposed whole heart T1 mapping approach has similar results compared to conventional approaches.

4881	Computer 15	Spin Echo Based Cardiac Diffusion Tensor Imaging of the Unfixed, Ex-vivo Porcine Heart at 7T and 3T
		David Lohr[1], Maxim Terekhov[1], Andreas Max Weng[2], Anja Schröder[3], Heike Walles[3], and Laura Maria Schreiber[1]
		[1]Chair of Cellular and Molecular Imaging, Comprehensive Heart Failure Center (CHFC), University Hospital, Wuerzburg, Germany, [2]Institute of Diagnostic and Interventional Radiology, University Hospital, Wuerzburg, Germany, [3]Translational Center Regenerative Therapies (TLC-RT), Fraunhofer Institute for Silicate Research (ISC), Wuerzburg, Germany
		7T, 3D, whole heart, high resolution, diffusion tensor data sets with 1.3mm isotropic voxels, unachievable in human in-vivo scans, were acquired for 8 ex-vivo pig hearts using a Stejskal-Tanner sequence with varying parallel imaging factors. ADC, FA, helix angle and secondary eigenvector angle values were analyzed and compared to a reference set of 26 ex-vivo hearts measured with the same protocol at 3T. Purpose of this study was quality assessment in DTI of the ex-vivo porcine heart at 7T. The proof of principle data acquired allows future optimization of acquisition approaches and helps translating the method to an in-vivo application.

4882	Computer 16	A myocardial strain phantom for cardiovascular magnetic resonance
		Andrew Scott[1,2], Priyanka Sukumaran[1,3], Pedro Ferreira[1,2], Jennifer Keegan[1,2], Sonia Nielles-Vallespin[1,4], Dudley Pennell[1,2], and David Firmin[1,2]
		[1]Cardiovascular Magnetic Resonance Unit, Royal Brompton and Harefield Foundation NHS Trust, London, United Kingdom, [2]National Heart and Lung Institute, Imperial College London, London, United Kingdom, [3]Physics, Imperial College London, London, United Kingdom, [4]National Heart Lung and Blood Institute, National Institutes for Health, Bethesda, MD, United States
		We have developed a mechanical phantom which replicates myocardial strain in blocks of jelly and sections of myocardial tissue. Initial results show the effects of strain during the diffusion time in diffusion tensor cardiovascular magnetic resonance using STEAM and the use of the phantom evaluating the DENSE strain measurement technique.

4883	Computer 17	Native T1 Mapping for Characterization of Acute and Chronic Myocardial Infarction in Swine: Comparison with Contrast-enhanced MRI Xi Liu[1], Zhi-gang Yang[1], and Ying-kun Guo[2] *[1]Department of Radiology, West China Hospital, Sichuan University, Chengdu, China, [2]Department of Radiology, West China Second University Hospital, Sichuan University, Chengdu, China* Native T1 mapping is a novel technique that permits quantification of the T1 relaxation time of myocardial tissue without requiring exogenous contrast agents, it could be used as a reliable alternative to LGE in patients with severe renal insufficiency. The present study was conducted to determine and verify the clinical feasibility of native T1 mapping of AMI and CMI as a replacement for LGE and for the discrimination of AMI from CMI in Bama mini-pigs. In our study, native T1 mapping can accurately determine acute and chronic infarct areas as well as conventional LGE imaging, however, it cannot distinguish acute from chronic myocardial infarction.

4884	Computer 18	Second-order motion-compensated in-vivo cardiac diffusion tensor imaging in diastole – impact of ventricular flow, strain and trigger delay. Robbert J.H. van Gorkum[1], Constantin von Deuster[1], Christian T. Stoeck[1], and Sebastian Kozerke[1] *[1]Institute for Biomedical Engineering, University and ETH Zürich, Zürich, Switzerland* Motion-compensated spin-echo cardiac diffusion tensor imaging (cDTI) sequences suffer from signal loss if the motion pattern has higher-order motion terms than the motion compensation model of the encoding gradients. Particularly cardiac strain, ventricular flow and atrial contraction render diffusion imaging in diastole challenging. It is shown that a suitable trigger delay in the diastolic phase can be identified by taking into account ventricular flow, strain and diffusion-weighted data at several time points in diastole. This knowledge aids towards the development of spin-echo-based cDTI sequences to study dynamic myofiber changes between systole and diastole.

4885	Computer 19	Prognostic value of cardiac T1 mapping in Pulmonary Arterial Hypertension Laura Saunders[1], Chris Johns[1], Neil Stewart[2], Charlotte Oram[1], David Capener[1], David Kiely[1], Martin Graves[3], Jim Wild[1], and Andy Swift[1] *[1]University of Sheffield, Sheffield, United Kingdom, [2]Hokkaido University, Sapporo, Japan, [3]University of Cambridge, Cambridge, United Kingdom*

		Native T1 mapping of the myocardium was performed in 223 patients with pulmonary arterial hypertension. Patients with higher right ventricular (RV) insertion point T1 were less likely to survive than patients with lower inter-ventricular insertion point T1, however when assessed in a multivariate Cox regression with other MRI markers of cardiac size and function, inter-ventricular insertion point T1 was not an independent predictor of mortality.

4886	Computer 20	Contrast steady state myocardial scar imaging in a chronic porcine infarct model
		John Whitaker[1], Radhouene Neji[1,2], Rahul Mukherjee[1], James Harrison[1], Steven Williams[1], Henry Chubb[1], Louisa O'Neill[1], Justo Julia[1], John Silberbauer[1], Matthew Wright[1], Sébastien Roujol[1], Tevfik Ismail[1], Mark O'Neill[1], and Reza Razavi[1]
		[1]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Siemen's Healthcare, Erlangen, Germany
		Contrast steady state (CSS) may be achieved using continuous contrast infusion following bolus. This technique was used to acquire high resolution late gadolinium enhanced (LGE) scar imaging of 8 pigs with chronic myocardial infarction. CSS imaging allowed extended acquisition to facilitate high-resolution 3D LGE imaging with improved signal-to-noise, contrast-to-noise and overall image quality. CSS may also be used in experimental studies, when total gadolinium bolus is not restricted, to directly compare imaging sequences acquired using consistent contrast distributions.

4887	Computer 21	An off-resonance correction for in-vivo spiral STEAM diffusion tensor cardiovascular magnetic resonance
		Margarita Gorodezky[1,2], Andrew Scott[1,2], Pedro F Ferreira[1,2], Sonia Nielles-Vallespin[1,2,3], Dudley J Pennell[1,2], and David N Firmin[1,2]
		[1]Cardiovascular Magnetic Resonance Unit, Royal Brompton Hospital, London, United Kingdom, [2]National Heart and Lung Institute, Imperial College, London, United Kingdom, [3]National Heart, Lung and Blood Institute, National Institutes of Health, Bethesda, MD, United States
		Spiral diffusion tensor cardiovascular magnetic resonance demonstrates promising results, but as with all spiral techniques is susceptible to off-resonance artefacts. The majority of off-resonance corrections rely on acquiring a separate field map based on phase differences between acquisitions with different echo times. However, bulk motion is encoded in image phase using STEAM and the motion and off-resonance induced phases are indistinguishable. Here we use a dual spiral approach in each stimulated echo to separate the motion- and off-resonance-induced phase and use this information to correct DT-CMR data.

4888	Computer 22	Assessment of Myocardial Fibrosis in Uremic Cardiomyopathy using Cardiac MR Native T1 Mapping: A Comparison with Coronary Artery Calcium Score

		Shengjia Gu[1] and Wenjie Yang[1]
		[1]Radiology, Ruijin Hospital, Shanghai, China
		Congestive heart failure is the leading cause of death in patients with end-stage renal disease. The process of this type of dysfunction is termed uremic cardiomyopathy. Extensive myocardial fibrosis, which leads the process, has also been shown to be a stronger predictor of death. Recently, anti-fibrosis has risen as a hot target in the treatment of uremic cardiomyopathy. Therefore, its urgent to find a more accurate and non-invasive method in order to meet the demand of clinic.In this study, we use the native T1 mapping to assess the level of myocardial fibrosis in ESRD patients，comparing with the Coronary Artery Calcium Score, in order to evaluate its accuracy in diagnosis uremic cardiomyopathy.

4889	Computer 23	Expanding SMS cardiac imaging with deep slice interpolation
		Eric Gibbons[1], Akshay Chaudhari[2], and Edward DiBella[1]
		[1]Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States, [2]Radiology, Stanford University, Stanford, CA, United States
		Cardiac SMS imaging acquires multiple slices at the same time as a single slice. SMS provides increased slice coverage without a loss in temporal resolution, which is important in myocardial perfusion imaging. However, a single SMS acquisition is able to acquire three slices at a time, which is insufficient for whole heart coverage. This work expands SMS coverage by using new deep learning interpolation techniques to generate missing slices in the "gaps" between acquired slices in SMS imaging.

4890	Computer 24	Contrast-free 3D whole-heart magnetization transfer imaging for simultaneous myocardial scar and cardiac vein visualization
		Karina Lopez[1], Radhouene Neji[1,2], Rahul Mukherjee[1], Imran Rashid[1], Reza Razavi[1], Claudia Prieto[1], Sebastien Roujol[1], and Rene Botnar[1]
		[1]School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Frimley, United Kingdom
		A novel 3D contrast-free and motion corrected sequence for simultaneous assessment of chronic myocardial scar and coronary veins is proposed, using magnetization transfer ratio (MTR) to target the increase in collagen content associated with fibrosis. Two gradient echo datasets are sequentially acquired to obtain MTR: a reference and an off-resonance MT-weighted image. Bloch simulations and in-vivo data demonstrated that the proposed acquisition is superior to bSSFP MT-weighted sequences, yielding more consistent MTR values throughout the myocardium. Scans in patients with chronic scar confirmed the ability of MTR to localize scar, in addition to cardiac vein visualization from the MT-weighted image.

Electronic Poster

Motion & Beyond

Exhibition Hall	Wednesday 14:45 - 15:45

4891	Computer 25	A comparison of motion compensated spin echo (M2SE) and stimulated echo acquisition mode (STEAM) diffusion tensor cardiovascular magnetic resonance in the in vivo assessment of hypertrophic cardiomyopathy.
		Zohya Khalique[1], Andrew Scott[1], Pedro Ferreira[1], Sonia Nielles-Vallespin[2], David Firmin[1], and Dudley Pennell[1]
		[1]CMR Unit, Royal Brompton Hospital, London, United Kingdom, [2]National Institutes of Health, Bethesda, MD, United States
		Diffusion tensor cardiovascular magnetic resonance (DT-CMR) interrogates myocardial microstructure, using parameters such as mean diffusivity (MD), fractional anisotropy (FA) and secondary eigenvector angulation (E2A), an index of sheetlet orientation. We compared motion compensated spin echo (M2SE) and stimulated echo acquisition mode (STEAM) and their ability to distinguish hypertrophied fibrosed myocardium (LVH+Gd+) in hypertrophic cardiomyopathy. M2SE discriminated areas of LVH+Gd+ best through FA and MD, whilst STEAM was more sensitive to changes in E2A mobility. FA derived from both M2SE and STEAM correlated significantly with extracellular volume.

4892	Computer 26	Analysis of cardiac motion induced error for in-vivo cardiac DTI in different heart phases - a comparison of second-order motion compensated SE versus STEAM
		Christian T Stoeck[1], Constantin von Deuster[1], Robbert J H van Gorkum[1], and Sebastian Kozerke[1]
		[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland
		Being a single R-R interval imaging technique, second order motion compensated spin echo (M2-SE) cardiac DTI is appealing for clinical application but its implementation has so far been limited to systolic imaging. In this study we investigate signal dephasing in in-vivo cDTI at different time points within the cardiac cycle. The motion induced dephasing found for both sequences lies well within the previously reported limits for repeated measurements, when imaged in mid-to-end systole and diastole. STEAM based approaches result in consistent signal preservation across the cardia cycle, while M2-SE the exhibits a minimum in signal dephasing at around 50%-75% systole.

4893	Computer 27	3D Radial Free-breathing Variable Flip Angle Whole Heart Myocardial T1 Mapping
		Orhan Unal[1] and Steve Kecskemeti[2]
		[1]Departments of Medical Physics and Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States
		A number of quantitative T1 mapping techniques have been developed for assessing myocardial pathologies. Inversion recovery (IR) techniques such as MOLLI are widely used due to higher precision and better reproducibility but tend to underestimate T1 values. The aim of this study was to evaluate the potential of new, free-breathing, variable flip angle (VFA), 3D radial and 3D hybrid-radial-Cartesian IR techniques accelerated using radial k-space undersampling for myocardial T1 quantification. Our initial results show promise and suggest that the proposed 3D T1 mapping techniques are not sensitive to B1 variations.

4894	Computer 28	Reconstructing real-time exercise stress cine images with multiple sets of sensitivity maps
		Chong Chen[1], Yingmin Liu[1], Orlando Simonetti[1], and Rizwan Ahmad[1]
		[1]The Ohio State University, Columbus, OH, United States
		Motivated by the changing sensitivity maps due to exaggerated chest wall motion in real-time stress cardiac MRI (CMR), we utilize ESPIRiT-based multiple sets of sensitivity maps in a SENSE-based reconstruction method to reduce image artifact. The proposed method was tested on twelve volunteers and compared with the images reconstructed using a temporally invariant single set of sensitivity maps as well as a temporally varying single set of sensitivity maps. It was demonstrated that using multiple sets of sensitivity maps leads to significant reduction in image artifact.

4895	Computer 29	Accelerated, 3D Cine MRI with Stack of Stars k-space Sampling and Self-Navigation of Respiratory Motion for Aortic Valve Visualization.
		Nivedita Naresh[1], Hassan Haji-Valizadeh[2], Bradley D. Allen[1], Matthew J. Barrett[1], Daniel C. Lee[3], Jeremy D. Collins[1], James C. Carr[1], and Daniel Kim[1]
		[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Biomedical Engineering, Northwestern University, Chicago, IL, United States, [3]Cardiology, Northwestern University, Chicago, IL, United States

		Aortic valve disease is the most common form of valvular heart disease in the western world and accurate aortic valve visualization is very important for this reason. Accurate imaging of the aortic valve is very critical in grading and diagnosing the severity of the disease. 3D imaging may enable better visualization of the aortic valve as compared to the standard 2D techniques due to both the ability to acquire high resolution volumetric coverage and to visualize in other imaging planes. This study describes the development and evaluation of an accelerated, 3D cine MRI pulse sequence using a combination of stack-of-star k-space sampling and XDGRASP reconstruction.

4896	Computer 30	Influence of respiration-induced B0 variations in CSF flow quantification
		Kristina Peters[1], René Bastkowski[1], Kilian Weiss[1,2], David Maintz[1], and Daniel Giese[1]
		[1]Institute of Diagnostic and Interventional Radiology, University Hospital Cologne, Cologne, Germany, [2]Philips GmbH Healthcare, Hamburg, Germany
		Susceptibility changes and resulting B_0 changes during the respiratory cycle lead to phase variations in cerebrospinal fluid phase-contrast flow measurements and might be erroneously misinterpreted as physiological flow changes. These B_0 changes were analysed by acquiring flow compensated and flow encoded real-time, single-shot EPI images. The respiration-induced phase variations in phase-contrast images were found to depend on the magnetic field strength, the delay between the flow compensated and flow encoded images and the depth and frequency of respiration. Thus, respiration-induced B_0 variations need to be corrected prior to analysing true respiration-dependent cerebrospinal fluid flow measured by real-time phase-contrast MRI.

4897	Computer 31	Self-gated respiratory-resolved 5D Flow MRI using the 3D spiral phyllotaxis trajectory
		Monica Sigovan[1], Gastao Cruz[2], Torben Schneider[3], Juan Felipe Perez-Juste Abascal[1], Cyril Mory[1], Guruprasad Krishnamoorty[4], Rene Botnar[2], Philippe Douek[1,5], Claudia Prieto[2], and Loic Boussel[1,5]
		[1]CNRS, University of Lyon, CREATIS Laboratory, Lyon, France, [2]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [3]Philips Healthcare, Guildford, United Kingdom, [4]MR Clinical Science, Philips Healthcare, Best, Netherlands, [5]Department of Interventional Radiology and Cardio-vascular and Thoracic Diagnostic Imaging, Hospices Civils de Lyon, Lyon, France
		Clinical diagnosis based on thoracic blood flow using three-dimensional cardiac-resolved (4D) phase contrast PC-MRI is limited by long acquisition times, due to the need of respiratory gating. In addition, gating does not provide potentially important physiological information, the variation of flow within the respiratory cycle. To address these challenges we developed a 5D (4D respiratory-resolved) PC-MRI sequence combining 3D radial k-space sampling, respiratory self-gating, and compressed sensing reconstruction. Our preliminary results demonstrate respiratory related changes in blood flow in healthy subjects. The proposed method may potentially refine diagnosis in congenital heart disease by assessing the respiratory related blood flow variations.

4898	Computer 32	Dynamic Auto-calibrated Multiband CAIPIRINHA: proof of principle and application to cardiac tissue phase mapping
		Giulio Ferrazzi[1], Jean Pierre Bassenge[1], Clarissa Wink[1], Johannes Mayer[1], Anthony N. Price[2], Steen Moeller[3], Pierre-François Van de Moortele[3], Alexander Ruh[4], Michael Markl[4,5], and Sebastian Schmitter[1,3]
		[1]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, [2]Centre for the Developing Brain, Department of Perinatal Imaging & Health, Division of Imaging Sciences & Biomedical Engineering, King´s College London, London, United Kingdom, [3]Department of Radiology, Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [4]Department of Radiology, Feinberg School of Medicine, Northwestern University, Chicago, IL, United States, [5]Department of Biomedical Engineering, McCormick School of Engineering, Northwestern University, Chicago, IL, United States
		In conventional multiband CAIPIRINHA, an additional reference scan is acquired to allow the separation of the simultaneously excited slices. In this study, an acquisition-reconstruction method that makes use of the multiband data itself to calculate this reference scan is presented. The immediate implication is that the full multiband acceleration can be exploited. In addition, since the reference data has the same resolution and phase structure to multiband (i.e. it is the same data), improved slice separation is achieved. The method was implemented starting from a 2D CINE phase-contrast MR sequence, and it was used to assess velocities in the myocardium in two subjects scanned at 3T.

4899	Computer 33	Real life application of compressed sensing cardiac MRI for biventricular response to exercise.
		Aaron Lin[1,2], Norman Morris[3,4], Helen Seale[5], Andrew Trotter[1], Benjamin Schmitt[6], and Wendy Strugnell[1,2]
		[1]Richard Slaughter Centre of Excellence in Cardiovascular MRI, The Prince Charles Hospital, Brisbane, Australia, [2]Menzies Health Institute, Griffith University, Gold Coast, Australia, [3]School of Allied Health Sciences and Menzies Health Institute, Griffith University, Gold Coast, Australia, [4]Allied Health Research Collaborative, The Prince Charles Hospital, Brisbane, Australia, [5]Physiotherapy Department, The Prince Charles Hospital, Brisbane, Australia, [6]Siemens Healthineers, Sydney, Australia
		Accurate assessment of left and right ventricular function using cardiac MRI plays an important role in the management of cardiac diseases. Combined with exercise stress testing, unveiling of cardiac diseases in the latent phase permits early initiation of appropriate therapy. Using compressed sensing cardiac MRI, we demonstrated dynamic quantitative biventricular functional assessment is safe and highly feasible for clinical utility.

4900	Computer 34	One Minute Free Breathing 3D Cardiac Cine MRI Using Data Clustering for Respiratory Self-Gating with Subject-Adaptive Gating Efficiency

		Jing Liu[1], Peng Lai[2], Yan Wang[3], Zhaoying Wen[3], and Karen Ordovas[3]
		[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Global MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [3]University of California San Francisco, San Francisco, CA, United States
		Conventional 2D cine MRI for cardiac functional measurements requires a series of breath-holds, which is usually difficult for children or sick patients and often results in non-diagnostic images. We aim to develop a fast and reliable free-breathing 3D imaging technique, which also allows subject-specific respiratory motion compensation.

4901	Computer 35	3D myocardial t1 mapping using a 2D fat image navigator for respiratory motion correction
		Giovanna Nordio[1], Torben Schneider[2], Gastao Cruz[1], Teresa Correia[1], Claudia Prieto[1], Rene Botnar[1], and Markus Henningsson[1]
		[1]School of Biomedical Engineering and Imaging Science, King's College London, London, United Kingdom, [2]Philips Healthcare, London, United Kingdom
		In this study, we propose a 3D whole-heart saturation-recovery T1-mapping technique combined with a 2D fat image navigator (fat-iNAV) for respiratory motion compensation. Respiratory motion of the heart is estimated from the 2D fat-iNAVs and used to correct the T1-weighted images prior to the fitting. The delineation of the myocardium is considerably improved after motion correction, while gating permits to further improve image quality and precision ($p<0.05$) of the T1 maps. Future work will focus on validating the proposed technique on patients with cardiovascular disease.

4902	Computer 36	Motion Correction for 3D+time Cardiac MRI Perfusion Images
		Apoorva Shirish Pedgaonkar[1], Ye Tian[2], Jason Mendes[2], Ganesh Adluru[2], and Edward DiBella[2]
		[1]Electrical and Computer Engineering, University of Utah, Salt lake City, UT, United States, [2]UCAIR, University of Utah, Salt Lake city, UT, United States
		A motion correction technique for 3D dynamic cardiac perfusion MRI using rigid and non-rigid image registrations to improve quantification of cardiac perfusion is presented. This method is unique because it employs a 3D image registration which not only resolves in plane motion but also resolves the out of plane motion for all slices in a 3D volume. This method also ensures smooth registration between all time frames of the data giving a more accurate analysis of the flow values.

4903	Computer 37	Propagation of Metaplastic Adipose Tissue Throughout the Scar of Hemorrhagic Myocardial Infarct is an Iron-Dependent Process: Cardiac MRI Study with Histological Insights
		Ivan Cokic[1], Guan Wang[1], Xingmin Guan[1], Hsin-Jung Yang[1], Richard LQ Tang[1], Diego Hernando[2], Scott B Reeder[2], and Rohan Dharmakumar[1]
		[1]Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]University of Wisconsin, Madison, WI, United States
		Lipomatous metaplasia (LM) of myocardial infarctions (MI) is typically observed in the peripheral zone of chronic MI and has been linked to major adverse clinical outcomes. To date, the mechanisms driving LM of MI remain unknown. A common feature of many disease processes associated with pathological fat accumulation is the iron-induced foam cell formation. Growing body of evidence now shows that iron deposits within hemorrhagic MI drive the prolonged recruitment of phagocytes into the infarcted territory. Herein, we investigated the spatial distribution and temporal accumulation of fatty infiltration in hemorrhagic MIs.

4904	Computer 38	Simultaneous T1 and T2 Mapping of the Carotid Artery with T2 and Inversion Recovery Prepared 3D Radial Imaging
		Haikun Qi[1], Jie Sun[2], Huiyu Qiao[1], Rui Guo[1], Xihai Zhao[1], Niranjan Balu[2], Zechen Zhou[3], Chun Yuan[1,2], and Huijun Chen[1]
		[1]Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [2]Department of Radiology, University of Washington, Seattle, WA, United States, [3]Philips Research China, Shanghai, China
		Multi-contrast MRI has been widely used for comprehensive characterization of atherosclerotic plaque. However, the qualitative nature and long scan time have limited its clinical application. In this study, a 3D high spatial resolution time-efficient technique, iGOAL-SNAP, is proposed, which generates different T1 and T2 contrasts in a single scan of 8min, enabling simultaneous T1 and T2 mapping. In addition, a rapid B1 correction method is presented in the fitting process. The accuracy and feasibility of iGOAL-SNAP was demonstrated using phantoms and in vivo studies.

4905	Computer 39	Cardiac and Respiratory Self-Gated Motion-Corrected Free-Breathing Spiral Cine Imaging.
		Ruixi Zhou[1], Yang Yang[2], Roshin Mathew[3], and Michael Salerno[4]
		[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Medicine, Cardiovascular Division, University of Virginia, Charlottesville, VA, United States, [3]Medicine, Cardiovascular Medicine, University of Virginia, Charlottesville, VA, United States, [4]Medicine, Radiology and Medical Imaging, University of Virginia, Charlottesville, VA, United States

		We developed a free-breathing continuous-acquisition respiratory and cardiac self-gated spiral cine pulse sequence. Data was acquired using a single spiral interleaf rotated by the golden-angle in time. The cardiac self-gating signal was extracted using principal component analysis on a gridded 8x8 central region of k-space for each spiral, and the respiratory motion is derived from rigid registration for each heartbeat. Images were reconstructed with motion compensated SPIRiT using 16 seconds (2000 spirals) or 8 seconds of data. Free-breathing self-gated spiral cine imaging demonstrated high image quality providing whole heart coverage with clinical spatial and temporal resolution in under 3 minutes.

4906	Computer 40	Navigator-less manifold recovery of cardiac data using iterative SToRM
		Yasir Q Mohsin[1], Sunrita Poddar[2], Bijoy Thattayilath[3], Deidra Ansah[3], and Mathews Jacob[4]
		[1]Electrical and computer Engineering, University of Iowa, Iowa City, IA, United States, [2]Electrical and COmputer Engineering, University of Iowa, Iowa City, IA, United States, [3]Cardiology, University of Iowa, Iowa City, IA, United States, [4]Electrical and computer Engineering, University of Iowa, Iow City, IA, United States
		Self-gated acquisitions, which rely on navigator acquisitions, can offer shortened scan time and can enable cardiac imaging of patients who cannot hold their breath; they are emerging as promising alternatives to breath-held protocols. A challenge with such schemes is the inefficiencies associated with the navigator acquisition, as well as the need for complex and heuristic processing of the navigator signals to accurately determine the cardiac and respiratory phases. The focus of this work is to introduce a navigator-less acquisition and reconstruction strategy, built upon our recent work termed as SToRM, which exploits the manifold structure of images. The proposed framework eliminates the need for navigators in SToRM, in addition to enabling spatially localized manifold modeling, where the manifold structure can vary depending on the spatial structure.

4907	Computer 41	Initial Validation of Free-Breathing Navigator Gated Cardiac Quantitative Susceptibility Mapping via Comparison with Right Heart Catheterization Measurements
		Yan Wen[1,2], Thanh Nguyen[2], Pascal Spincemaille[2], Zhe Liu[1,2], Javid Alakbarli[3], Jiwon Kim[4], Evelyn M. Horn[4], Meridith P. Pollie[4], Jonathan W. Weinsaft[4], and Yi Wang[1,2]
		[1]Meinig School of Biomedical Engineering, Cornell University, New York, NY, United States, [2]Radiology, Weill Cornell Medicine, New York, NY, United States, [3]Medicine, NewYork-Presbyterian, New York, NY, United States, [4]Medicine, Weill Cornell Medicine, New York, NY, United States
		Our previous work has shown the feasibility of measuring differential RV-to-LV oxygen saturation with cardiac quantitative susceptibility mapping (QSM) in healthy volunteers; in this work, we present our initial validation of cardiac QSM in patients by comparing the QSM-based measurements with gold standard right heart catheter measurements.

4908	Computer 42	Reduced Specific Energy Deposition with Diagnostic Image Quality in Pediatric Population using CArdioREspiratory Synchronized (CARESync) Balanced Steady-State Free Precession Cine Imaging Amol S. Pednekar[1], Siddharth Jadhav[1], Ivone Rodriguez[1], Connor Ho[1], Cory Noel[2], and Prakash Masand[1] *[1]Radiology, Texas Children's Hospital, Houston, TX, United States, [2]Cardiology, Texas Children's Hospital, Houston, TX, United States* Cine-bSSFP cardiac imaging in sedated pediatric population faces two-fold challenges: 1) respiratory motion; and 2) cardiocirculatory impairment associated compromised thermoregulatory response. Prospective 63 sedated patients' study shows that CAdioREspiratory Synchronized sequence, with prospective arrhythmia rejection and retrospective cardiac gating, reduced specific absorbed energy per slice in fixed (18.96±5.16 J/kg) by 49.36% and adaptive (24.13±9.55 J/kg) by 39.24% modes, than equivalent 4NSA sequence while maintaining spatial, temporal, and contrast resolutions possible with breath-holds, providing consistently good image quality with 21.13% increased scan time (26.38±8.15 s) per slice. Adaptive mode reduced scan time by 18% than fixed mode for favorable cardiorespiratory rates.

4909	Computer 43	MRI-based retrospective gating for PET reconstruction in rats: implementation and proof of principle study Willy Gsell[1], Uwe Himmelreich[1], Arno Nauerth[2], Cesar Molinos[3], Carlos Correcher[3], Antonio J Gonzalez[4], Sven Junge[2], Thorsten Greeb[2], Ramiro Polo[3], Bryan Holvoet[5], Christophe M Deroose[5], and Michael Heidenreich[2] *[1]Biomedical MRI, KU Leuven, Leuven, Belgium, [2]Preclinical Imaging PCI, Bruker Biospin MRI, GmbH, Ettlingen, Germany, [3]Preclinical Imaging NMI, Bruker Biospin MRI, GmbH, Valencia, Spain, [4]Institute for Instrumentation in Molecular Imaging, i3M-CSIC, Valencia, Spain, [5]Nuclear Medicine and Molecular Imaging, KU Leuven, Leuven, Belgium* We hereby report the implementation and the preliminary results of an MRI-based retrospective gating strategy for reconstructing simultaneously acquired PET data in rats (SPECMRI). Ejection fraction extracted from MRI, SPECMRI and ECG-gated PET were all within the same range (70.0 ± 3.5%, 72.5 ± 5.4% and 70.5 ±6% for MRI, ECG-gated and SPECMRI respectively). This new technique enables to ease the animal handling (no need for ECG electrodes) and provide true synchronization of PET and MRI data.

4910	Computer 44	Assessment of right ventricular functional recovery after acute myocardial infarction by cardiac magnetic resonance Yue Gao[1], Zhigang Yang[1], Min Ma[1], Kaiyue Diao[1], Qin Zhao[1], and Yong He[1]

		[1]west china hospital, sichuan university, chengdu, China
		In order to clarify the assess the right ventricular (RV) function changes and recovery and the relationship with different culprit vessel for myocardial infarction (MI) patients on cardiac magnetic resonance (CMR). We prospectively recruited forty-nine MI patients and 20 healthy control, all them underwent CMR to analysis right ventricular (RV) function and global strain. Our results showed that, the RV function was related to whether the culprit vessel was RCA or not, and even RCA was obstructed the RV global strain can significantly recovery at chronic phase.

4911	Computer 45	Simultaneous multislice spiral cine DENSE MRI
		Changyu Sun[1], Yang Yang[2], Xiaoying Cai [1], Sophia Cui[1], Daniel Auger[1], Michael Salerno[1,2,3], and Frederick H. Epstein[1,3]
		[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Medicine, University of Virginia, Charlottesville, VA, United States, [3]Radiology, University of Virginia, Charlottesville, VA, United States
		Spiral cine DENSE is an established method for imaging myocardial strain, however a relatively long acquisition time is a limitation. We developed a simultaneous multislice (SMS) method to accelerate spiral cine DENSE imaging. For SMS excitation we employed CAIPIRINHA phase modulation of the multiple slices. For the SMS reconstruction, we implemented a modified iterative conjugate gradient sensitivity encoding (CG-SENSE) method. Simulations and experiments in phantoms show that a 10-15% error occurs when imaging two slices simultaneously. Two-slice volunteer SMS images showed close agreement with separately-acquired single-slice images. SMS with CG-SENSE may be an effective means to accelerate spiral cine DENSE.

4912	Computer 46	Effects of sex and age on CMR-derived left ventricular wall thickness and peak systolic wall stress in normal subjects
		Xiaodan Zhao[1], Angela S Koh[1,2], Soo Kng Teo[3], Sen Lin[2], Shuang Leng[1], Ris Low[1], Yi Su[3], Ru San Tan[1,2], and Liang Zhong[1]
		*[1]National Heart Centre Singapore, Singapore, Singapore, [2]Duke-NUS Medical School Singapore, Singapore, Singapore, [3]Institute of High Performance Computing, A*STAR, Singapore, Singapore, Singapore*

		To investigate the left ventricular (LV) wall thickness, LV wall stress and their association with age and sex in a cohort of 210 healthy subjects (age: 19 to 87 years), endocardial and epicardial contour meshes from stacks of 2D short axis images were imported into our in-house software (CardioWerkz) for further analysis of 3D regional wall thickness and peak systolic wall stress (PSWS). Results indicated that mean LV wall thickness was smaller in females than males, and more positively correlated with age in female than male. Moreover, no significant difference for mean PSWS between females and males.

4913	Computer 47	Model-Based Lag Free Processing of Pilot Tone Navigator Data Enables Prospective Cardiac Triggering
		Mario Bacher[1], Peter Speier[1], Jan Bollenbeck[1], Matthias Fenchel[2], and Matthias Stuber[3]
		[1]Siemens Healthcare, Erlangen, Germany, [2]Siemens Medical Solutions USA, New York, NY, United States, [3]CHUV, Département de Radiologie Médicale, Lausanne, Switzerland
		Cardiac MRI acquisitions require accurate triggering, usually derived from ECG. The contactless, electromagnetic Pilot Tone navigator enables direct measurement of cardiac and respiratory motion, independently of the acquisition. Here we present an almost lag free pipeline to process the cardiac Pilot Tone signal and derive triggers from it.

4914	Computer 48	k-t2 ESPIRiT – Image reconstruction of respiratory motion resolved undersampled 4D Flow MRI data in a higher-dimensional subspace
		Jonas Walheim[1], Claudio Santelli[1], and Sebastian Kozerke[1]
		[1]ETH Zurich, Zurich, Switzerland
		An image reconstruction algorithm termed k-t2 ESPIRiT is proposed, which constrains respiratory motion-resolved MRI to a high-dimensional subspace spanned by receiver-coil channels, cardiac phases, and respiratory motion states. Respiratory motion resolved 4D flow MRI data is reconstructed and compared to k-t ESPIRiT reconstruction of end-expiration and a standard parallel imaging protocol. Increased reconstruction accuracy compared to k-t ESPIRiT reveals that k-t2 ESPIRiT can effectively exploit redundancies between respiratory motion states to improve scan efficiency.

Electronic Poster

Blood Brain Barrier & CSF Flow

Exhibition Hall	Wednesday 14:45 - 15:45

4915	Computer 49	Pulsatility and velocity in cerebral penetrating arteries in patients with carotid occlusive disease with 7T phase contrast: preliminary results Tine Arts[1], Laurien Onkenhout[2], Jeroen Siero[1], Jaco Zwanenburg[1], and Geert Jan Biessels[2] *[1]Radiology, UMC Utrecht, Utrecht, Netherlands, [2]Neurology, UMC Utrecht, Utrecht, Netherlands* The direct contribution of hemodynamics to the development and progression of vascular cognitive impairment (VCI) is relatively unexplored due to technical challenges concerning the assessment of hemodynamic properties of small vessels. This ongoing study explores changes of hemodynamics by measuring the velocity and pulsatility of perforating arteries in patients with internal carotid artery disease and healthy controls. The preliminary results indicate that high resolution velocity and pulsatility measurements in patients are challenging, particularly due to motion related artefacts. Thus, future research will evaluate user independent analysis to reduce the influence of artifacts and assess test-retest agreement by repeated scanning.

4916	Computer 50	INVESTIGATION OF CEREBRAL BLOOD FLOW PULSATILITY IN AGING PROCESS USING PHASE CONTRAST MAGNETIC RESONANCE IMAGING Armelle LOKOSSOU[1], Bader CHAARANI[1], Souraya ELSANKARI[1], Catherine GONDRY-JOUET[2], and Olivier BALEDENT[1] *[1]Department of Medical Image Precessing, Amiens University Hospital, BioFlowImage Laboratory/Chimère, University of Picardie Jules Verne, Amiens, France, [2]Department of Radiology, Amiens University Hospital, Amiens, France* No study already evaluated how arterial blood flow is transferred from extracranial to intracranial level and how venous outflow is transferred from intracranial sinuses to jugular veins. Healthy young and elderly volunteers were enrolled and underwent phase contrast magnetic resonance imaging to investigate intracranial and extracranial arterial and venous flows. In both groups, we found a significant decrease of arterial and venous flows pulsatilities inside the cranium. However, the intracranial and extracranial cerebral blood flow pulsatilities increased significantly with age.

4917	Computer 51	Quantification of total cerebral blood flow measurements using phase contrast magnetic resonance imaging: Comparison and validation at 1.5T and 3T Yen-Chih Huang[1], Chun-Ming Chen[1], and Shin-Lei Peng[2] *[1]Department of Radiology, China Medical University Hospital, Taichung, Taiwan, [2]Department of Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan*

		The effect of field strengths of the total cerebral blood flow (TCBF) quantification using non-gated phase contrast magnetic resonance imaging (PC-MRI) was evaluated in this study. Our results show that, non-gated PC-MRI for TCBF quantification at 3T provided better inter-scan reproducibility when compared to that at 1.5T. Nevertheless, non-gated PC-MRI for TCBF measurements can be performed equally well at 1.5T and 3T. Findings of this study may facilitate data interpretation and comparison of TCBF between different field strengths.

4918	Computer 52	4D CSF Flow Measurement in Cervical Spine at 3T
		Ruponti Nath[1], MJ Negahdar[1], Robert Bert[2], and Amir Amini[3]
		[1]ECE, University of Louisville, Louisville, KY, United States, [2]Department of Radiology, University of Louisville, Louisville, KY, United States, [3]Electrical and Computer Enginnering, University of Louisville, Louisville, KY, United States
		Quantitative and Qualitative analysis of CSF flow was done on a Siemens Skyra 3T Scanner. Four normal Volunteers data shows highly accurate flow waveform, average distance travelled by particle along spinal axis and clear axial and coronal flow visualization between C3-C6 in the cervical spine. Particle tracking was performed in each axial slices. Distance travelled by particles along spinal axis was measured in all volunteers. The average distance travelled in all slices during systole in the head to foot direction varied from 0.1mm to 0.38 mm and during diastole varied from 0.14mm to 0.28 mm in the opposite directions.

4919	Computer 53	Pseudo spiral sampling and Compressed Sensing reconstruction provides high acceleration of intracranial 4D flow MRI at 7T
		Lukas M. Gottwald[1], Johannes Töger[2], Eva S. Peper[1], Karin Markenroth Bloch[3], Qinwei Zhang[1], Bram F. Coolen[4], Gustav J. Strijkers[4], Pim van Ooij[1], and Aart J. Nederveen[1]
		[1]Department of Radiology and Nuclear Medicine, Academic Medical Center, Amsterdam, Netherlands, [2]Department of Diagnostic Radiology, Skane University Hospital, Lund, Sweden, [3]Lund University Bioimaging Center, Lund University, Lund, Sweden, [4]Department of Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Netherlands
		Long scan times limit the application of 4D flow in clinical practice. Even at 7T, considerable scan times are needed for modest spatiotemporal resolutions. This work demonstrates the advantage of Compressed Sensing acceleration of 4D flow MRI at 7T with a novel undersampling technique. Healthy subjects (n=5) were scanned using standard SENSE and a proposed undersampling technique with Compressed Sensing reconstruction. Flow analysis showed minor differences, and image quality improved for Compressed Sensing reconstructions with maintained resolution and reduced scan time. The method enables further increases of acceleration and spatiotemporal resolution, adding more physiological details beyond current resolution limitations.

4920	Computer 54	Influence of Signal Magnitude on Intracranial Flow Quantification using 4D flow MRI Leonardo A Rivera-Rivera[1], Tilman Schubert[2], Patrick A Turski[1,3], Oliver Wieben[1,3], and Kevin M Johnson[1,3] *[1]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Radiology, Basel University Hospital, Basel, Switzerland, [3]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States* Physiological parameters derived from quantitative flow MRI can potentially improve characterization of a large spectrum of vascular diseases if routinely used in a clinical setting. However, current barriers limit the use of quantitative flow MRI in a clinical setting, partially due to a lack of calibration tests, and concerns regarding accuracy and reproducibility. In this study we investigate the potential induced bias of flow measurements in a cranial 4D flow MRI acquisition due to signal magnitude heterogeneity, and the implications for comparing protocols with differing flip angle or contrast agent usage.

4921	Computer 55	Blood Brain Barrier Water Permeability in Non-Enhancing Multiple Sclerosis Lesion with Intrinsic Diffusivity Encoding of Arterial Labeled Spins (IDEALS) Kenneth T Wengler[1], Jason Ha[2], Patricia Coyle[3], Mark Schweitzer[4], Tim Q Duong[4], and Xiang He[4] *[1]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [2]Biology, Stony Brook University, Stony Brook, NY, United States, [3]Neurology, Stony Brook University Hospital, Stony Brook, NY, United States, [4]Radiology, Stony Brook University Hospital, Stony Brook, NY, United States* Persistent endothelial abnormalities and blood-brain barrier (BBB) disruption may play an important role in MS lesion formation and progression. In MS, BBB dysfunction occurs not only in active lesions with contrast-enhancement, but also in inactive (chronic) lesions and normal appearing white matter. In this study a novel method to map whole-brain BBB water permeability (IDEALS) was used to measure in non-enhancing MS lesions of 11 relapse-remitting MS patients. Although the permeability for MRI contrast in non-enhancing MS lesions is several orders of magnitude lower than that of enhancing MS lesions, our study demonstrated a robust reduction of lesion water permeability.

4922	Computer 56	Epidermal Growth Factor's lowers Blood Brain Barrier leakiness in an Alzheimer's disease mouse model as detected using Diffusion Weighted Arterial Spin Labeling MR Imaging Frederick C Damen[1], Riya Thomas[2], Rong-Wen Tain[1], Weiguo Li[3], Leon Tai[2], and Kejia Cai[1] *[1]Radiology, University of Illinois at Chicago Medical Center, Chicago, IL, United States, [2]Anatomy and Cell Biology, University of Illinois at Chicago Medical Center, Chicago, IL, United States, [3]Research Resources Center, University of Illinois at Chicago Medical Center, Chicago, IL, United States*

		Blood-brain barrier (BBB) dysfunction is reemerging as a critical component of Alzheimer's disease (AD). Higher BBB leakiness is one of the mechanistic pathways through which AD risk factors induce cognitive decline. We have previously demonstrated that epidermal growth factor (EGF) prevents BBB leakiness in a model of two important AD risk factors: APOE4 and female sex (female E4FAD mice). The goal of this study was to use Diffusion Weighted Arterial Spin Labeling MRI to determine whether post-symptomatic EGF treatment, (during 8-10 months) can reduce BBB leakiness in EGF treated mice compared to vehicle controls.

4923	Computer 57	Imaging Blood Brain Barrier Disruption in Multiple Sclerosis using GlucoCEST MRI
		Xiang Xu[1,2], Pavan Bhargava[3], Linda Knutsson[1,4], Martin Pomper[1], Peter Calabresi[3], and Peter C.M. van Zijl[1,2]
		[1]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States, [2]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Research Institute, Baltimore, MD, United States, [3]Department of Neurology, Johns Hopkins University, Baltimore, MD, United States, [4]Department of Medical Radiation Physics, Lund University, Lund, Sweden
		It has been demonstrated that glucose can be used as a contrast agent for chemical exchange saturation transfer (glucoCEST) and enhanced relaxation (T2 or T1ρ). In the present work we show the possibility of detecting blood brain barrier (BBB) disruption in multiple sclerosis (MS) using glucoCEST MRI at 7T and 3T. At both field strengths, glucoCEST enhancement was observed in some MS lesions that were not enhanced by Gd T1w images. Our results show that glucose may be more permeable than Gd to minor BBB disruptions, suggesting that glucose transport may also be more sensitive to MS disease activities.

4924	Computer 58	High Resolution UTE-MRAs for Longitudinal Visualization of Revascularization and Blood-Brain Barrier Disruption on a Rat Transient Middle Cerebral Artery Occlusion Model
		MungSoo Kang[1] and HyungJoon Cho[1]
		[1]Department of Biomedical Engineering, Ulsan National Institute of Science and Technology, Ulsan, Republic of Korea
		Longitudinal study of revascularization and BBB disruption after ischemic stroke provides prognostic and therapeutic information. In this work, high resolution UTE-MRAs with superparamagnetic iron oxide nanoparticles (SPION) were performed on a rat tMCAO model to visualize revascularization and BBB disruption longitudinally. UTE-MRAs before and after SPION injection clearly visualized arterial vessels and all vessels, respectively. Thickened and twisted vessels at the rat brain surface of ipsilateral hemisphere were highly resolved (59 μm^3 isotropic).

4925	Computer 59	Glycine is an early 'biomarker' of blood brain barrier breakdown in Gliomas
		Vivek Tiwari[1], Zhongxu An[1], Yiming Wang[1], Michael Levy[2], Marco Pinho[1,3], Elizabeth A. Maher[4,5,6], Edward Pan[2,4,5], Toral Patel[2,4], Bruce E. Mickey[2,5,7], and Changho Choi[1,3,5]
		[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [2]Department of Neurological Surgery, UT Southwestern Medical Center, Dallas, TX, United States, [3]Department of Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [4]Department of Neurology and Neurotherapeutics, UT Southwestern Medical Center, Dallas, TX, United States, [5]Harold C. Simmons Cancer Center, UT Southwestern Medical Center, Dallas, TX, United States, [6]Department of Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States, [7]Annette Strauss Center for Neuro-Oncology, UT Southwestern Medical Center, Dallas, TX, United States
		Cancer cells may use altered metabolic pathways with respect to their normal counterparts; this metabolic switch is necessary to support their rapid proliferation in oxygen- and nutrient-poor conditions. A few of the metabolites are up-regulated while some others are down-regulated or unaltered. High grade malignant tumors present with enhancement on T1-weighted (T1w) image. Enhancement on post-contrast T1w images is an indicative of breakdown of blood brain barrier (BBB). The increased number of tumor cells may stress the vessels and, thus BBB tend to rupture. A non-invasive bio-marker that can predict the disruption of BBB will be of great clinical significance for assessing the tumor aggressiveness. Here, we show elevated Gly can be a potential bio-marker for predicting the tumor’s potential to present with ruptured BBB.

4926	Computer 60	Increased vascular permeability in the lenticulostriate arteries results in increased hemosiderin deposition in the basal ganglia in aging and cognitive impairment
		Axel Montagne[1], Giuseppe Barisano[2], Meng Law[1,2,3], Farshid Sepherband[3], Arthur Toga[3], and Berislav Zlokovic[1]
		[1]Zilkha Neurogenetics Institute, University of Southern California, Los Angeles, CA, United States, [2]Radiology, University of Southern California, Los Angeles, CA, United States, [3]Stevens Institute of Neuroimaging and Informatics, University of Southern California, Los Angeles, CA, United States
		The intramural periarterial drainage pathway is critical for the elimination of metabolic waste products from the brain. In a number of neurological diseases such as Alzheimer’s Disease, blood-brain barrier damage and increased vascular permeability may play an important role in the pathogenesis. Leakiness of the blood-brain barrier allows fibrin(ogen), hemosiderin and metabolic wastes to exudate and deposit around the vessels in the basal ganglia. In order to test this hypothesis, we evaluated the relationship between blood-brain barrier permeability measured as ktrans and hemosiderin deposition in 76 subjects scanned at 3T MRI.

4927	Computer 61	Exercise selectively increases cerebral blood flow in the postcentral gyrus in patients with Huntington’s disease

		Jessica Steventon[1], Hannah Furby[2,3], Richard Wise[3], and Kevin Murphy[1]
		[1]School of Physics and Astronomy, Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff University, Cardiff, United Kingdom, [2]Department of Neurodegenerative Disease, University College London, London, United Kingdom, [3]School of Psychology, Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff University, Cardiff, United Kingdom
		The therapeutic potential of exercise - a potent trigger for both neurogenesis and vascular plasticity - is currently a hot research topic in neurodegenerative diseases. Here we tested whether a single 20-minute bout of aerobic exercise was sufficient to induce changes in cerebral blood flow (CBF) in people with Huntington's disease (HD). We find a transient and selective increase in CBF in the postcentral gyrus in HD participants following exercise, a region with reduced intrinsic functional connectivity in HD patients, with no change in healthy controls. The CBF change was unrelated to clinical and genetic markers of disease.

4928	Computer 62	Impact of focused ultrasound on cerebral blood flow
		Vasile Stupar[1,2], Anthony Delalande[3], Nora Collomb[1,2], Claire Rome[1,2], and Emmanuel L. Barbier[1,2]
		[1]Grenoble Institut des Neurosciences, INSERM U 1216, Grenoble, France, [2]Université Grenoble Alpes, Grenoble, France, [3]CNRS UPR4301-CBM, Orleans, France
		One major application of FUS is the opening of the blood brain barrier (BBB) to target the brain cells with drugs such as in glioma. While the impact of FUS on brain disease is under intense evaluation, its impact of normal brain physiology has received less attention. In this study, we evaluate the impact of BBB opening using FUS on cerebral blood flow (CBF), assessed by pseudo-continuous arterial spin labeling (ASL). Following 0.6MPa FUS at 1.2Mhz, a small change in ADC was observed, suggesting a small vasogenic edema. In addition, there was a 50%CBF reduction in a large vascular territory.

4929	Computer 63	Age-related shift of cerebral venous outflow pathway detected by BOLD signal-based blood flow tracking
		Toshihiko Aso[1,2], Shinnichi Urayama[2], Tsukasa Ueno[1], Naoya Oishi[2], Yukako Nakagami[1], Toshiya Murai[1], and Hidenao Fukuyama[3]
		[1]Department of Psychiatry, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan, [3]Center for the Promotion of Interdisciplinary Education and Research, Kyoto University, Kyoto, Japan

		A novel blood tracking technique based on BOLD MRI signal was applied to two age groups of healthy subjects (n=81) to investigate age-related alterations in cerebral circulation. By mapping the phase of low-frequency component and between-subject regression analysis on this "BOLD lag map", linear extension of venous drainage times with age was found in the deep venous system draining the periventricular region. Interestingly, age-related shortening of washout time was observed in the superficial system involving the major sinuses. This dissociation of deep and superficial venous systems may reflect focal inefficiency in the deep system as part of normal aging processes.

4930	Computer 64	Cerebral Blood Flow, Intracranial Volumes and Cognitive Status in Type-2 Diabetes Mellitus
		Leanne Hunt[1], Dinesh Selvarajah[1], Solomon Tesfaye[2], and Iain D Wilkinson[1]
		[1]Academic Units of Radiology & Diabetes, University of Sheffield, Sheffield, United Kingdom, [2]Diabetes, Sheffield Teaching Hospitals, Sheffield, United Kingdom
		This study quantitates regional brain volumes and arterial cerebral perfusion characteristics (ASL) in patients with Type-2 Diabetes Mellitus (T2DM) who have Mild Cognitive Impairment, in patients with T2DM who have normal cognitive status and in non-diabetic healthy volunteers. Mean group differences were identified in both grey matter volume and cerebral blood flow in regions that include the medial temporal lobes. These findings may further our understanding of the mechanisms that lead to an increased risk of the development of cognitive impairment associated with diabetes.

4931	Computer 65	Aortic flow and cerebral hemodynamics in age-related brain volume loss
		Ann Ragin[1], Can Wu[1], Guixiang Ma[2], Sameer A. Ansari[1], Michael Markl[1], and Susanne Schnell[1]
		[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Department of Computer Science, University of Illinois at Chicago, Chicago, IL, United States
		Concurrent cardiac and neurovascular (4D flow) MR imaging were used to quantify cardiac and cerebral hemodynamics in 30 healthy adults to determine the relationship to brain volumetric measures of regions considered vulnerable in aging. Cardiac index (p=0.001); ascending aorta (p=0.003) total cerebral blood flow (p=0.001) and flow for left internal carotid (p<0.001), basilar (p=0.04), and right anterior cerebral (p=0.03) arteries were significantly lower in midlife compared to younger adults. Lower cardiac index, total cerebral blood flow and left internal carotid flow were correlated with reduced gray matter, superior frontal cortical thinning and volume loss in putamen.

4932	Computer 66	Altered cerebral blood flow before and after 4-weeks of neurostimulation in patients with episodic migraine

		Lars Michels[1], Jessica Aschmann[2], Franz Riederer[1], Andreas Gantenbein[1,3], Roger Luechinger[4], Spyros Kolllias[1], and Peter Sandor[3]
		[1]University Hospital Zurich, Zurich, Switzerland, [2]Unversity of Zurich, Zurich, Switzerland, [3]Rehaclinic Bad Zurzach, Zurzach, Switzerland, [4]Swiss Federal Institute of Technology and the University of Zurich, Zurich, Switzerland
		Cerebral blood flow is altered in migraineurs but it is unknown if this can be changed by repetitive neurostimulation, leading to less migraine attacks. In a double blind and sham-controlled study, we used arterial spin labeling MRI and transcranial direct current stimulation (tDCS) to address this question. Four weeks of real tDCS diminished initial hyperperfusion in patients with episodic migraine in pain processing brain regions ($p < 0.001$). In addition, less migraine attacks occurred after real tDCS compared to baseline ($p < 0.05$). Our results indicate a regulating effect of tDCS on cerebral blood flow and clinical outcome in migraineurs.

4933	Computer 67	Quantifying brain oxygen extraction fraction: correlation between a global venous susceptibility method and calibrated fMRI mapping method.
		Hannah L Chandler[1], Michael Germuska[1], Thomas W Okell[2], Ana E Rodriguez-Soto[3], Erin K Englund[3], Rachael C Stickland[1], Catherine Foster[1], Jessica Steventon [4], Fabrizio Fasano[5], Kevin Murphy[6], Valentina Tomassini[4], Felix W Wehrli[3], and Richard G Wise[1]
		[1]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]Nuffield Department of Clinical Neurosciences, Oxford University, Oxford, United Kingdom, [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [4]School of Medicine, Cardiff University, Cardiff, United Kingdom, [5]Siemens Healthcare Ltd, Camberley, United Kingdom, [6]School of Physics and Astronomy, Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom
		Measuring oxygen extraction fraction (OEF) may prove a useful clinical tool for assessing brain oxygen consumption. Dual-calibrated fMRI is used to map voxel-wise OEF across grey-matter and requires respiratory challenge (hypercapnia and hyperoxia). However, this method presents challenges to clinical implementation. Conversely, OxFlow provides a global estimate of OEF, has a shorter acquisition time and does not require respiratory challenge. Here we examine the relationship between both approaches for measuring OEF, revealing a significant association between methods. While further investigation is required, OxFlow may offer additional clinical utility for measuring cerebral oxygen consumption.

4934	Computer 68	MR susceptometry based superior sagittal sinus venous oxygen saturation: effects of carbon dioxide based cerebral vascular reserve and anesthesia in Moyamoya patients
		Chou-Ming Cheng[1,2], Tzu-Chen Yeh[3,4], Jen-Chuen Hsieh[2,4], and Hsiao-Wen Chung[1]

		[1]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan, [2]Department of Medical Research, Taipei Veterans General Hospital, Taipei, Taiwan, [3]Department of Radiology, Taipei Veterans General Hospital, Taipei, Taiwan, [4]Institute of Brain Science, National Yang-Ming University, Taipei, Taiwan
		Venous oxygen saturation (SvO_2) is measured on Moyamoya patients with previous proposed automatic methods based on MR susceptometry from the phase information obtained with multi-echo gradient-echo imaging. According to anesthesia condition and carbon dioxide based cerebral vascular reserve (CO_2-CVR) using blood oxygen level dependence (BOLD) technique, 21 Moyamoya patients are classified into four groups. Results from them suggested that global SvO_2 value may indicate global pathophysiological change supported by reduced SvO_2 without obviously impaired CO_2-CVR and elevated SvO_2 under anesthesia.

4935	Computer 69	Assessment of Intravenous Immunoglobulin treatment on BBB function following inflammation
		Oliviero L. Gobbo[1,2], Aislinn Mc Phillips[1], Tara Hamilton[2], Jerrard Hayes[2], and Gavin Davey[2]
		[1]School of Pharmacy and Pharmaceutical Sciences, Trinity College Dublin, Dublin, Ireland, [2]School of Biochemistry and Immunology, Trinity College Dublin, Dublin, Ireland
		The blood brain barrier (BBB) is a complex structure that separates brain interstitial fluid from blood. BBB dysfunction is a key feature of Central Nervous System diseases. This in vivo study examines the effects of Intravenous Immunoglobulin (IVIg), regularly used to treat immune and inflammatory diseases, on BBB function following LPS-induced BBB disruption. The change in permeability of the BBB was evaluated by MRI, using gadolinium. Our results suggest that LPS breach the integrity of the BBB with regional specificity and can be reversed by IVIg administration.

4936	Computer 70	Permeability of the blood-brain barrier predicts no evidence of disease activity at two years after natalizumab or fingolimod treatment in relapsing-remitting multiple sclerosis
		Stig P Cramer[1], Helle J Simonsen[1], Ulrich Lindberg[1], Aravinthan Varatharaj[2], Ian Galea[2], Jette Frederiksen[3], and Henrik BW Larsson[1]
		[1]Department of Clinical Physiology, Nuclear Medicine and PET, Rigshospitalet, Glostrup Hospital, Glostrup, Denmark, [2]Clinical Neurosciences, Clinical and Experimental Sciences, Faculty of Medicine, University of Southampton, United Kingdom, Southampton, United Kingdom, [3]Department of Neurology, Rigshospitalet, Glostrup Hospital, Glostrup, Denmark

		Dynamic contrast-enhanced MRI enables measurements of the permeability of the blood-brain barrier (BBB), possibly a marker of disease activity in multiple sclerosis (MS). In order to investigate if permeability predicts early suboptimal treatment response, defined as loss of no evidence of disease activity (NEDA) status after two years, we included 35 relapsing-remitting MS patients initiating either fingolimod or natalizumab, drugs with a common effect of decreasing lymphocyte influx into the CNS. We find that permeability measured after six months of treatment was a good predictor loss of NEDA status at two years and a surrogate marker of the state of health of the blood-brain barrier.

4937	Computer 71	Imaging correlates of the Blood Brain Barrier disruption in HIV associated neuro cognitive disorder and therapeutic implications
		Joga Chaganti[1] and Bruce James Brew[2]
		[1]Radiology, St Vincent's Hospital, Sydney, Australia, [2]Neurology, St Vincents Hospital, Sydney, Australia
		. Neurocognitive impairment in HIV infection, known as HIV associated neurocognitive disorder (HAND), in the context of suppressive combination antiretroviral therapy still occurs. We hypothesized that ongoing chronic systemic inflammation, a feature of HIV disease despite viral suppression, causes blood brain barrier (BBB) disruption thereby allowing entry of neurotoxic cytokines/chemokines or HIV itself (in very low levels because of suppression) thereby causing HAND or at least worsening it. To test this hypothesis, we have used dynamic contrast enhancement derived metrics (K-trans) to measure the capillary permeability as, a direct indicator for possible BBB disruption and correlated it with neuro inflammatory markers in the cerebrospinal fluid (CSF) MR spectroscopy derived metabolites as well as with clinical indices of neurocognition (neuropsychological scores).

Electronic Poster

Traumatic Brain Injury

Exhibition Hall	Wednesday 14:45 - 15:45

4938	Computer 73	Effects of Track Length on White Matter Alterations in Mild Traumatic Brain Injury
		Sourajit Mitra Mustafi[1], Jaroslaw Harezlak[2], Joaquin Goni[3], Laura A Flashman[4], Thomas W McAllister[5], and Yu-Chien Wu[1]
		[1]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States, [2]Department of Epidemiology and Biostatistics, Indiana University, School of Public Health, Bloomington, IN, United States, [3]College of Engineering, Purdue University, West Lafayette, IN, United States, [4]Department of Psychiatry, Dartmouth-Hitchcock Medical Center and Geisel School of Medicine, Hanover, NH, United States, [5]Department of Psychiatry, Indiana University School of Medicine, Indianapolis, IN, United States

		In the present study, we performed streamline tractography to characterize effects of track length on white-matter microstructural alterations after mild traumatic brain injury. Streamline length and counts were studied in involved white-matter fiber tracts that were found to have decreased axonal density at some points along the tracts using voxel-based analyses. The results suggested that long fibers in the brains of individuals who sustained mild traumatic brain injury are more vulnerable to the injury.

4939	Computer 74	Regional fractional anisotropy and processing speed in diffuse traumatic brain injury: An exploratory analysis using a linear regression panel model
		Sindhuja T Govindarajan[1], David J Ouellette[1], Junghoon Kim[2], and Tim Q Duong[3]
		[1]Stony Brook University, Stony Brook, NY, United States, [2]Department of Molecular, Cellular, and Biomedical Sciences, The City College of New York School of Medicine, New York, NY, United States, [3]Stony Brook University School of Medicine, Stony Brook, NY, United States
		Recently, Ware and colleagues[1] showed that FA-derived damage assessment in WM regions can accurately classify subjects with processing speed impairment in moderate to severe diffuse TBI at 3 months post-injury. Using a subset of the same cohort who completed follow-up DTI scans at 6 and 12 months post-injury, the goals of this study were 1) to investigate if regional FA remains associated with processing speed in a dataset including all time points and 2) to conduct an exploratory analysis to identify a subset of regions that can best explain such association. Four regions were identified that explained most variance in processing speed.

4940	Computer 75	Within-Subject Characterization of Sports Concussion with Serial Diffusion MRI and Spherical Mean Technique
		Matthew Budde[1], L. Tugan Muftuler[1], Andrew Nencka[2], Kevin Koch[2], Yang Wang[2], Timothy Meier[1], and Michael McCrea[1]
		[1]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States
		Diffusion tensor imaging is a promising biomarker of mild Traumatic Brain Injury and concussion, but it has not been refined sufficiently for diagnosis in individual subjects. In this study, we demonstrate that spherical mean technique (SMT) diffusion MRI can detect post-concussion changes in single subjects over the acute recovery period.

4941	Computer 76	Characterizing acute, subacute and chronic changes in the brain following sport-related concussion using Diffusion Kurtosis Tensor Imaging
		L. Tugan Muftuler[1,2], Timothy B. Meier[1], Daniel V. Olson[3], and Michael A. McCrea[1,4]

		[1]*Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States,* [2]*Center for Imaging Research, Medical College of Wisconsin, Milwaukee, WI, United States,* [3]*Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States,* [4]*Neurology, Medical College of Wisconsin, Milwaukee, WI, United States*
		The aim of this study was to characterize acute, subacute and chronic changes in the brain following sport-related concussion in a group of young athletes. Diffusion kurtosis tensor parameters were compared between concussed athletes and controls. The concussed group demonstrated widespread increase in axial kurtosis compared to the controls at the acute time point, which gradually diminished over the course of 14 days. Conversely, alterations in radial kurtosis were mostly in the frontal white and gray matter and occipital gray matter regions. These findings may have important implications for the clinical management of sport-related concussions.

4942	Computer 77	Evaluating Microstructural Integrity of Cortical and Deep Gray Matter over a Season of High School Football Using Diffusion Kurtosis Imaging and Quantitative Susceptibility Mapping
		Nan-Jie Gong[1,2], Samuel Kuzminski[3], Michael Clark[4], Melissa Fraser[4], Mark Sundman[5], Kevin Guskiewicz[4], Jeffrey R Petrella[2], and Chunlei Liu[1,2]
		[1]*University of California Berkeley, Berkeley, CA, United States,* [2]*Duke University School of Medicine, Durham, NC, United States,* [3]*University of Oklahoma, Norman, OK, United States,* [4]*University of North Carolina at Chapel Hill School of Medicine, Chapel Hill, NC, United States,* [5]*University of Arizona, Tucson, AZ, United States*
		Over the course of a single high school football season, QSM showed no evidence of microhemorrhage or iron-related changes; however, we observed significant microstructural alterations, as reflected by DKI metrics, in cortical and deep gray matter over the course of a single high school football season. These microstructural changes correlated with the frequency of head impacts, suggesting that DKI imaging of cortical and deep gray matter may yield valuable biomarkers for tracking subclinical traumatic brain injury in contact-sport athletes.

4943	Computer 78	Exploring the effects of concussion history on quantitative estimation of temporal delays and cerebrovascular reactivity: A novel approach combining hypercapnia and hyperoxia in collegiate football players
		ALLEN A. CHAMPAGNE[1], NICOLE S. COVERDALE[1], ALEX A. BHOGAL[2], and DOUGLAS J. COOK[1,3]
		[1]*Centre for Neuroscience studies at Queen's University, Kingston, ON, Canada,* [2]*Department of Radiology at the University Medical Center Utrecht, Utrecht, Netherlands,* [3]*Department of Surgery at Queen's University, Kingston, ON, Canada*

		Recent evidence suggests that concussion history may be associated with long-term structural and functional changes in the brain. However, little is known about the effects of head injury on vascular reactivity. In this study, we combined hypercapnic and hyperoxic respiratory manipulations to explore the effects of concussion history on hemodynamic latencies and tissue cerebrovascular reactivity (CVR) in football players. We found that, although tissue CVR was not different between the groups (P>0.05), time delays to hypercapnia were shorter in subjects with a history of concussion (P<0.05), which may suggest some compensatory mechanism in the vasculature that persists beyond clinical recovery.

4944	Computer 79	Investigating tissue oxygenation in acute Traumatic Brain Injury using Arterial Spin Labelling and quantitative-BOLD
		Alan J Stone[1], Tim P Lawrence[1,2], Thomas W Okell[1], Natalie L Voets[1,2], and Nicholas P Blockley[1]
		[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Department of Neurosurgery, John Radcliffe Hospital, Oxford University Hospitals NHS Foundation Trust, Oxford, United Kingdom
		Following a traumatic brain injury, oxygen metabolism may be disrupted by changes in oxygen supply and demand. This study aims to investigate global changes in oxygen metabolism in the hours immediately following the initial insult to the brain. Pseudo-continuous ASL (PCASL) and streamlined-qBOLD (sqBOLD) are used to measure blood flow and oxygenation in the acute stages of TBI (<24 hours post-injury). When compared with an age matched control group, blood oxygenation appears to increase during injury (decreased OEF (p=0.03)) at this acute time-point.

4945	Computer 80	DTI Connectome Analysis in Moderate TBI: Parcellation Improves Detection of Relevant Injury and the Monitoring of Therapeutic Response
		TALAIGNAIR N VENKATRAMAN[1], RYAN PEARMAN[2], HAICHEN WANG[3], CHRIS PETTY[2], ALLEN W SONG[2], DANIEL T LASKOWITZ[3], and CHRISTOPHER D LASCOLA[2]
		[1]DUKE UNIVERSITY MEDICAL CENTER, DURHAM, NC, United States, [2]RADIOLOGY, DUKE UNIVERSITY MEDICAL CENTER, DURHAM, NC, United States, [3]NEUROLOGY, DUKE UNIVERSITY MEDICAL CENTER, DURHAM, NC, United States
		Conventional DTI readouts such as fractional anisotropy (FA), axial diffusion (RD) and radial diffusion (RD) show distinct alterations following closed head injury but do not correlate well with measured functional and cognitive outcomes. 3D DTI with parcellated connectome analysis reveals neural fiber networks between brain regions that are most vulnerable to closed head (acceleration-deceleration) injury and also most relevant to measurable functional deficits. In this study, fiber tract number between hippocampus and cortex is the most sensitive marker of both motor and memory deficits and therapeutic improvement following administration of a novel neuroprotective therapeutic agent.

4946	Computer 81	Working Memory And White Matter Microstructure In Mild Traumatic Brain Injury Sohae Chung[1], Els Fieremans[1], Xiuyuan Wang[1], Charles J Morton[1], Dmitry S Novikov[1], Joseph F Rath[2], and Yvonne W Lui[1] *[1]Center for Advanced Imaging Innovation and Research (CAI2R) & Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States, [2]Department of Rehabilitation Medicine, NYU School of Medicine, New York, NY, United States* Working memory is a critical cognitive function implicated after mild traumatic brain injury (MTBI). Here, we investigate the association between white matter microstructure and working memory in normal controls (NC) and MTBI patients, using diffusion white matter tract integrity (WMTI) and WAIS-IV subtests, respectively. For the NC group, significant correlations were observed in axonal water fraction (AWF; higher axonal density/myelination) and mean kurtosis (MK; greater tissue complexity) with letter-number sequencing (LNS). However, such relationships were not present in the MTBI group.

4947	Computer 82	CNR comparison to identify the detectability rate and FA histogram analysis of FLAIR lesions in DTI metrics. Ramtilak Gattu[1], Randall R Benson[2], and Ewart M Haacke[3] *[1]Radiology, Wayne State University, Detroit, MI, United States, [2]Center for Neurological Studies, Dearborn, MI, United States, [3]Wayne State university, Detroit, MI, United States* There is a paucity of studies trying to investigate the sensitivity of DTI metrics like Fractional Anisotropy (FA), Apparent Diffusion Coefficient (ADC), Axial Diusivity and Radial Diffusivity in areas corresponding to the lesion sites detected in clinical MRI using FLAIR images. Aim of this study was to compare the utility of DTI with FLAIR by evaluating the contrast to noise ratio (CNR) in their detecting capacity of DAI lesions and to evaluate whether DTI is more accurate than FLAIR or vice versa.

4948	Computer 83	Using fMRI to assess cerebrovascular reactivity after acute concussion Nathan W Churchill[1], Michael Hutchison[2], Simon Graham[3], and Tom Schweizer[4] *[1]Neuroscience Research Program, St. Michael's Hospital, Toronto, ON, Canada, [2]University of Toronto, Toronto, ON, Canada, [3]Sunnybrook Hospital, Toronto, ON, Canada, [4]St. Michael's Hospital, Toronto, ON, Canada* Cerebrovascular reactivity (CVR) is an important biomarker of concussion, as brain activity and blood flow regulation are often impaired after brain injury. This study examines an fMRI breath hold paradigm as a probe of CVR in concussed athletes, showing significant variations with days post-injury.

4949	Computer 84	Functional correlates of microstructural damage in developmental traumatic brain injury: a multi-modal MRI study of neuroanatomy, cerebrovascular reactivity, and functional connectivity Maxime Parent[1], Ying Li[2], Basavaraju G. Sanganahalli[1], Vijayalakshmi Santhakumar[2], D.S. Fahmeed Hyder[1], and Sridhar Kannurpatti[3] *[1]Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [2]Pharmacology, Physiology and Neurosciences, Rutgers New Jersey Medical School, Newark, NJ, United States, [3]Radiology, Rutgers New Jersey Medical School, Newark, NJ, United States* The developing brain is particularly vulnerable to traumatic brain injury (TBI), with symptoms and co-morbidities lasting into adulthood. Animal models of developmental TBI are useful tools for investigating molecular pathways of TBI injuries and to assess novel therapeutics; however, validation of in vivo injury biomarkers in these models is important for the translational application of pre-clinical findings. Here, we demonstrate that the persistent dysfunctions of developmental TBI in an animal model can be measured at the level of microstructural damage (with diffusion MRI), functional interhemispheric connectivity (with resting-state fMRI) and systemic neurovascular coupling (with CO2 challenge fMRI).
4950	Computer 85	Military TBI Patients Demonstrate Increased Cerebral Venous Volume Using Quantitative Susceptibility Mapping Wei Liu[1,2], Gerard Riedy[1], Ping-Hong Yeh[1,2], Dominic E Nathan[1,2], Chihwa Song[1], Grant H Bonavia[1], and John Ollinger[1] *[1]National Intrepid Center of Excellence, Walter Reed National Military Medical Center, Bethesda, MD, United States, [2]The NorthTide Group, LLC, Sterling, VA, United States* Cerebral venous volume above the lateral ventricle was analyzed using quantitative susceptibility mapping in patients with severe (n = 7), moderate (n = 21) and mild (n = 27 for blast and n = 19 for nonblast) TBI. Severe and moderate TBI patients both demonstrated increased venous volume compared to control subjects without history of TBI. Blast injured mild TBI patients also showed increased venous volume compared to the control subjects. These results suggest that microvascular injury may present in TBI patients and blast related injury might have a more pronounced impact on the venous system.
4951	Computer 86	Transient neuronal dysfunction correlates with hypo-perfusion in patients with moderate post-traumatic brain injury Eva-Maria Ratai[1,2], Suk-tak Chan[2,3], Maria Gabriela Figueiro Longo[4], Michael Wenke[1], Termara Parker[1], Jonathan Welt[2,5], Joyce van Loon[4], Emad Ahmadi[1], Anastasia Yendiki[2,3], Jacqueline Namati[2,5], Isabel Chico-Calero[2,5], Blair Parry[6], Can Ozan Tan[2,7], Jarone Lee[2,8], Michael Lev[2,9], Michael Hamblin[2,5], Benjamin Vakoc[2,5], and Rajiv Gupta[1,2]

[1]Department of Radiology / Neuroradiology Division, Massachusetts General Hospital/ A.A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Department of Radiology, Massachusetts General Hospital/ A.A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [4]Department of Radiology, Massachusetts General Hospital, Boston, MA, United States, [5]Wellman Center for Photomedicine, Department of Dermatology, Massachusetts General Hospital, Boston, MA, United States, [6]Department of Emergency Medicine, Massachusetts General Hospital, Boston, MA, United States, [7]Department of Physical Medicine & Rehabilitation, Spaulding Rehabilitation, Charlestown, MA, United States, [8]Department of Emergency Medicine and Department of Surgery, Massachusetts General Hospital, Boston, MA, United States, [9]Emergency Radiology and Emergency Neuroradiology, Massachusetts General Hospital, Boston, MA, United States

We present a DOD funded study to assess the effects of low-level light therapy (LLLT) on metabolites measured by MRS and cerebral perfusion measured by ASL using a double-blind, placebo controlled study where patients with moderate TBI were randomized between LLLT and sham treatment. We report CBF and metabolic changes pertaining to neuronal injury and neuroinflammation for the entire cohort (i.e., both treated and control arms), before the blind is broken. Our findings suggest that transient neuronal dysfunction in the posterior cingulate cortex and neuroinflammation in the thalamus correlated with hypo-perfusion during the subacute phase of moderate TBI.

4952 | Computer 87

Eye motion artifacts in T2-weighted images, identified by deep neural networks, correlate with concussion

Andrew S. Nencka[1], John D. Bukowy[2], Robin A. Karr[1], Andrew P. Klein[1], Kevin M. Koch[1], Peter LaViolette[1], Sean D. McGarry[1], Timothy B. Meier[3], Brad J. Swearingen[3], and Michael McCrea[3]

[1]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Physiology, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States

Oculomotor deficits occur with traumatic brain injury, and eye motion yields artifacts in the phase encoding directions of common MRI acquisitions. Here we quantify motion artifacts in regions of interest of T2-weighted MRI head images in concussed and healthy high school and collegiate athletes. Regions of interest over eyes, and inner ear structures as a control, were automatically generated using a convolutional neural network. Acute and sub-acute injury was found to yield significantly increased motion artifact compared to controls in ROIs covering eyes. No differences in motion artifacts covering inner ear structures were found. These results indicate that anatomical MRI following traumatic brain injury may offer increased diagnostic or prognostic information through artifact resulting from eye motion associated with injury.

4953 | Computer 88

Alteration of Resting-state Functional Networks is Associated with Post Concussion Symptoms in Mild Traumatic Brain Injury

		Nai-Chi Chen[1], Chia-Feng Lu[1,2,3], Li-Chun Hsieh[1,4,5], Sho-Jen Cheng[1,5], Yu-Chieh Jill Kao[1,4], Ho-Fang Huang[1,6], and Cheng-Yu Chen[1,4,5]
		[1]Research Center of Translational Imaging, College of Medicine, Taipei Medical University, Taipei, Taiwan, [2]Department of Anatomy and Cell Biology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [3]Department of Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan, [4]Department of Radiology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [5]Department of Medical Imaging, Taipei Medical University Hospital, Taipei, Taiwan, [6]Department of Medical Research, Taipei Medical University Hospital, Taipei, Taiwan
		A subgroup of patients with mild traumatic brain injury (mTBI) suffer from a series of post-concussion symptoms, such as headache, dizziness, and cognitive deficits. These patients also present altered neural connectivity compared to healthy controls (HC). In our study, we examined resting-state functional connectivity in 30 mTBI patients and 35 HC using independent component analysis. We found that patients showed lower functional connectivity in several resting-state networks, and the left frontoparietal network was associated with the level of dizziness in patients. We concluded that the alterations of resting-state neural networks may support post-concussion symptoms after mTBI.

4954	Computer 89	Low-frequency Fluctuations of Resting-state fMRI BOLD Signal after Experimental Mild Traumatic Brain Injury
		Yu-Chieh Jill Kao[1,2], Chia-Feng Lu[1,3], Ping-Huei Tsai[1,2], Fei-Ting Hsu[1,2], Bao-Yu Hsieh[4], and Cheng-Yu Chen[1,2]
		[1]Research Center of Translational Image, Teipei Medical University, Taipei, Taiwan, [2]Department of Radiology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [3]Department of Anatomy and Cell Biology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [4]Department of Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan
		Regional amplitude of rsfMRI BOLD signal after mTBI was quantified using amplitude of low-frequency fluctuation (ALFF). The significant increase of ALFF around the impact regions at 24 h and renormalized at 50 days after mTBI may suggest the dynamics of neuronal activity and neurovascular response induced by the injury.

4955	Computer 90	Altered Functional Connectivity and Network Topology in Active Profession Fighters
		Karthik R Sreenivasan[1], Zhengshi Yang[1], Virendra Mishra[1], Sarah Banks[1], Dietmar Cordes[1,2], and Charles Bernick[1]
		[1]Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States, [2]University of Colorado Boulder, Boulder, CO, United States

		Studies have shown that both active and retired athletes with repeated head trauma are more likely to suffer from cognitive decline and loss of executive and attention functions when compared to age-matched healthy controls. Our results show decreased functional connectivity in the active fighter group when compared to controls between regions known to be implicated in traumatic brain injury. Furthermore, we found a shift towards a less efficient network topology with altered integration and segregation in active professional fighters.

4956	Computer 91	GlucoCEST weighted MRI detects metabolic abnormalities following experimental TBI on 7T and 9.4T
		Tsang-Wei Tu[1,2], Jaclyn Witko[2], and Joseph Frank[2]
		[1]Howard University, Washington, DC, United States, [2]National Institutes of Health, Bethesda, MD, United States
		Delayed glucose hypometabolism has been reported in traumatic brain injury (TBI) patients from weeks to years posing a high risk for neurodegenerative diseases. This study shows the feasibility of glucoCEST weighted MRI (GWI) to detect metabolic abnormalities following TBI on 7T and 9.4T. The GWI results were compared to 2DG autoradiography and immunohistochemitry indicating that the injured brain needed immediate energy to restore nervous function and then entered a hypometabolism state in week 2. GWI affords the sensitivity to detect cerebral metabolic states following TBI and has potential to identify the treatment window to increase neuronal survival.

4957	Computer 92	Transient disappearance of traumatic microbleeds on susceptibility weighted imaging in rats
		Arnold Tóth[1], Bálint Soma Környei[2], Zoltán Berente[3], Endre Czeiter[2], Krisztina Amrein[4], Péter Bogner[1], Tamás Dóczi[2], András Büki[4], and Attila Schwarcz[4]
		[1]Department of Radiology, University of Pécs, Pécs, Hungary, [2]Department of Neurosurgery, University of Pécs, Pécs, Hungary, [3]Department of Biochemistry an Medical Chemistry, University of Pécs, Pécs, Hungary, [4]University of Pécs, Pécs, Hungary
		Traumatic microbleeds (TMBs) are regarded as markers of traumatic brain injury (TBI) related diffuse axonal injury (DAI). According to several recently published observations, TMBs depicted by susceptibility weighted imaging (SWI), seems to show temporal changes. This study aims to explore the temporal features of TMBs in a rat model.

4958	Computer 93	Gray matter volume changes following Cranial Nerve Non-invasive NeuroModulation in patients with traumatic brain injuries
		Jiancheng Hou[1], Arman Kulkarni[2], Neelima Tellapragada[1], Veena Nair[1], Mitch Tyler[2,3], Yuri Danilov[3], Kurt Kaczmarek[3], Beth Meyerand[2], and Vivek Prabhakaran[1]

		[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [3]Department of Kinesiology, University of Wisconsin-Madison, Madison, WI, United States
		The main conventional approach for treating traumatic brain injury related gait and balance deficits has been through physical therapy, but few approaches have focused on brain based rehabilitation efforts that create direct neuroplastic changes. There remains a need for such an approach. Therefore, the goal of this study was: 1) to apply Cranial Nerve Non-Invasive NeuroModulation (CN-NINM) via the tongue in combination with multiple symptom-specific physical therapy exercises in patients with mild to moderate TBI, and 2) to investigate and quantify gray matter volume changes prior to and after intervention as well as their correlation with behavior.

4959	Computer 94	Novel Processing of Magnetic Resonance Spectroscopy Enables Biomarker Discovery for PTSD and mTB
		John M. Irvine[1], Laura Mariano[1], Ben Rowland[2], Huijun Liao [2], Kristin Heaton[3], and Alexander P Lin[2]
		[1]Draper, Cambridge, MA, United States, [2]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [3]US Army Institute of Environmental Medicine, Natick, MA, United States
		The objective of this study was to determine the neurochemical biomarkers for mild traumatic brain injury (mTBI) and posttraumatic stress disorder (PTSD) among members of the military. A sample of 100 participants were assigned to each cohort (mTBI only, PTSD only, mTBI and PTSD, military control, and civilian control). Analysis of metabolite concentrations in the mTBI and PTSD cohorts showed significant metabolite difference across 3 voxels in the brain (posterior cingulate gyrus (PCG), anterior cingulate cortex (ACC), and posterior white matter (PWM)), indicating that magnetic resonance spectroscopy provides objective biomarkers for distinguishing these conditions.

4960	Computer 95	Assessment of metabolic changes in traumatic brain injury using hyperpolarized [1-13C]pyruvate: a longitudinal study
		Edward Hackett[1], Laura Ingle[2], Brenda Bartnik-Olson[3], and Jae Mo Park[1]
		[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Neurology and Neurotherapeutics, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Radiology, Loma Linda University, Loma Linda, CA, United States

		In this study, we longitudinally assessed acute metabolic changes during 2-120hrs post traumatic brain injury in a controlled-cortical impact rat model using hyperpolarized [1-^{13}C]pyruvate. We observed mildly increased pyruvate conversion to lactate and significantly reduced bicarbonate production in the injured site at 24hrs after impact. Conversely, lactate was reduced when measured at 48hrs-post injury. Bicarbonate production in the lesion remained low with significantly increased bicarbonate production in the contralateral normal-appearing brain

4961	Computer 96	Hippocampal-Cerebellar metabolic investigation in TBI rats: NMR spectroscopy study
		Subash Khushu[1], Kavita Singh[1], Richa Trivedi[1], Sonia Gandhi[1], and Poonam Rana[1]
		[1]NMR Research Centre, Institute of Nuclear Medicine & Allied Sciences(INMAS), DELHI, India
		Cerebellar atrophy and dysfunction has been reported in clinical TBI. hippocampal-cerebellar cognitive collaborations and its manifestation in TBI is being reported. This study investigated TBI mediated metabolic irregularities in CB and HP in animal model of TBI. These results indicated that CB and HP are metabolically different regions. The models generated from the changes due to trauma could accurately discriminate CB and HP and injury severity. We speculate that reduced NAA and Cho levels may be due to substantial focal neuronal loss after weight drop TBI. Edema and excitotoxity following injury leads to altered levels of osmolytes and Glu/Gln.

Electronic Poster

Neuroimaging: Animal Studies

Exhibition Hall	Wednesday 14:45 - 15:45

4962	Computer 97	ASL-based fMRI phenotyping of high-anxiety Fischer rat strain reveals two unexpected sub-traits or -states: caveat for rodent studies
		Andreas Bruns[1], Thomas Mueggler[1], Markus von Kienlin[1], and Basil Künnecke[1]
		[1]Roche Pharma Research & Early Development, Neuroscience Discovery & Translational Area, Roche Innovation Center Basel, F. Hoffmann-La Roche Ltd, Basel, Switzerland

		Fischer rats serve as a rodent model of high trait anxiety in neuroscience and drug discovery. Using ASL-based fMRI, we characterized Fischer rats with respect to their regional brain activity patterns and with reference to the standard Sprague-Dawley rat strain. Fischer rats clearly differed from Sprague-Dawley rats, but also split into two distinct subpopulations, with one showing a more deviant pattern than the other. Although it has remained elusive whether this is a trait or a state phenomenon, our data suggest that neuronal networks related to anxiety and/or depression are implicated.

4963	Computer 98	In utero monitoring of early embryonic mouse brain development and injury progression with localized diffusion MRI
		Dan Wu[1], Jun Lei[2], Yan Zhu[2], Michael McLane[2], and Irina Burd[2]
		[1]Radiology, Johns Hopkins University school of Medicine, Baltimore, MD, United States, [2]Gynecology and Obstetrics, Johns Hopkins University school of Medicine, Baltimore, MD, United States
		In utero diffusion MRI (dMRI) of the embryonic mouse brain is challenging due to maternal and fetal motions and limited resolution. We have previously developed a localized imaging technique and achieved fast dMRI of the live embryos. Here we explored the capacity of this technique to image embryonic mouse brains from mid-to-late gestation stages during development. Furthermore, we monitored the progression of embryonic brain injury in a mouse model of intrauterine inflammation. Our results suggested in utero dMRI is an indicator of fetal outcome after inflammatory injury, and the embryonic brain injury correlates with placental injury in this animal model.

4964	Computer 99	Longitudinal voxel-based morphometry in juvenile zebra finch brains reveals volume changes linked to distinct stages of the critical period for song learning
		Julie Hamaide[1], Kristína Lukáčová[1,2], Geert De Groof[1], Johan Van Audekerke[1], Marleen Verhoye[1], and Annemie Van der Linden[1]
		[1]Bio-Imaging Lab, University of Antwerp, Wilrijk, Belgium, [2]Department of Physiology and Ethology, Institute of Animal Biochemistry and Genetics, Slovak Academy of Sciences, Bratislava, Slovakia
		We present an *in vivo* longitudinal MRI study that traces relative volume changes in the brain of juvenile male zebra finches from 20 to 200 days post hatching. In parallel, we also characterized song behavior to explore whether improvements in song performance can be linked to regional volume changes in the developing bird brain.

4965	Computer 100	Towards the Macaque Connectome: 24-Channel 3T Multi-Array Coil, MR Sequences, and HCP-style Preprocessing

		Joonas Autio[1], Takayuki Ose[1], Masahiro Ohno[1], Yoshihiko Kawabata[2], Yuta Urushibata[3], Kantaro Nishigori[1], Masataka Yamaguchi[1], Yuki Hori[1], Atsushi Yoshida[1], Katsutoshi Murata[3], Matthew Glasser[4,5], and Takuya Hayashi[1]
		[1]Center for Life Science Technologies, RIKEN, Kobe, Japan, [2]Takashima Seisakusho Co., Ltd, Tokyo, Japan, [3]Siemens Healthcare Japan, Tokyo, Japan, [4]Department of Neuroscience, Washington University, St. Louis, MO, United States, [5]St. Luke's hospital, St. Louis, MO, United States
		Macaque monkeys are an important neuroscientific model for understanding cortical organization of primates, yet non-human primate MRI applications have lagged behind those developed for humans. To address this issue, we developed a 24-channel receive coil for macaque brain imaging and adapted the Human Connectome Project (HCP)'s image acquisition protocols matched to monkey's neuroanatomical resolution. By adapting HCP's preprocessing methods for the macaque, we demonstrate that the resulting HCP-style monkey MRI data show great promise for multi-modal analyses of cortical architecture and connectivity, which have previously only been possible in humans.

4966	Computer 101	Orbitofrontal-limbic structural development maturation in non-human primates: a longitudinal study
		Akiko Uematsu[1,2,3], Junichi Hata[1,3,4], Yuji Komaki[3], Fumiko Seki[1,3,4], Chihoko Yamada[3], Norio Okahara[3], Yoko Kurotaki[3], Erika Sasaki[1,3,4], and Hideyuki Okano[1,4]
		[1]Keio University School of Medicine, Tokyo, Japan, [2]RIKEN BSI Laboratory for Marmoset Neural Architecture, Saitama, Japan, [3]Central Institute for Experimental Animals, Kawasaki, Japan, [4]RIKEN BSI, Saitama, Japan
		We investigated typical orbitofront-limbic structural development of a non-human primate model, common marmoset, using longitudinal MRI data. Overall, robust volumetric growth was observed during infancy. This rapid brain volumetric growth was associated with the largest decrease in diffusivities of diffusion tensor imaging. That suggest that the volume increment result from an increase in the number and size of cells, dendrites, and spines in the regions. In addition, our result suggested familial factors contributed the development of the orbitofrontal-limbic brain regions. Overall, this study provides further data on the factors and timing important for typical brain development.

4967	Computer 102	Assignment of Two More Fucose-α-(1-2)-Galactose Glycans in the Human Brain Linked in Animal Models to Learning and Memory
		Nathan Tosh[1,2], Scott Quadrelli[1,3], Graham Galloway[1], and Carolyn Mountford[1]
		[1]Translational Research Institute, Brisbane, Australia, [2]Faculty of Health, Queensland University of Technology, Brisbane, Australia, [3]University of Newcastle, Newcastle, Australia

		Two-dimensional COSY scans at 3T using a 64 channel head and neck coil have enabled the inspection of fucose-α-(1-2)-galactose glycans that resonate in the region of F1=0.9-1.7ppm; F2= 4.1-4.5ppm. With accurate shimming and water suppression, two new peaks were identified (Fuc VI at 4.44-1.37 ppm and Fuc VII at 4.29-1.36 ppm). These cross-peaks were consistently visualised across 86 participants.

4968	Computer 103	Tomoelastography of the mouse brain by multifrequency single-shot MR elastography
		Gergely Bertalan[1], Jing Guo[1], Heiko Tzschätzsch[1], Charlotte Klein[2], Jürgen Braun[3], and Ingolf Sack[1]
		[1]Department of Radiology, Charité - University Medicine Berlin, Berlin, Germany, [2]Department of Neurology, Charité - University Medicine Berlin, Berlin, Germany, [3]Department of Medical Informatics, Charité - University Medicine Berlin, Berlin, Germany
		The overall aim of this study was to introduce in-vivo multifrequency single-shot MR elastography (MRE) for full-field-of-view stiffness mapping of mouse brain and to compare in-vivo stiffness of neural tissues featuring different white-to-gray matter ratios. Tomoelastography retrieves mouse brain stiffness with greater detail. The measured order of shear vave speed values indicates that white matter in the mouse brain is softer than gray matter within the examined frequency range from 900 to 1400 Hz.

4969	Computer 104	Synaptic Basis for Remodeling in the Mouse Somatosensory System Characterized by fMRI
		Emily Petrus[1], Galit Saar[1], Zhiwei Ma[1], Steve Dodd[1], and Alan Koretsky[1]
		[1]Laboratory of Functional and Molecular Imaging, National Institutes of Health, NINDS, Bethesda, MD, United States
		Functional MRI (fMRI) is an effective tool to analyze brain activity, with research and clinical implications. Here we describe changes in fMRI stimulus evoked BOLD responses after unilateral whisker denervation in adult mice. These effects were mediated by specific synaptic remodeling in the whisker somatosensory system. Our results indicate that fMRI can detect circuit level changes in vivo, which can then be characterized at the synaptic level in vitro.

4970	Computer 105	Transient hyperhydration modulates the brain fluid distribution of spontaneous hypertension rats: A T2 relaxometry study
		Kun-I Chao[1], Xia-Yu Lyu[1], Pei-Lun Yu[1], Sheng-Min Huang[1], Shin-Lei Peng[2], Kung-Chu Ho[3], Ping-Huei Tsai[4], and Fu-Nien Wang[1]

[1]Department of Biomedical Engineering and Environmental Science, National Tsing Hua University, Hsinchu, Taiwan, [2]Department of Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan, [3]Nuclear Medicine, Chang Gung Memorial Hospital, Taoyuan, Taiwan, [4]Department of Radiology, Taipei Medical University Hospital, Taipei, Taiwan

After 2% of body weight fluid infusion, the homeostasis of fluid distribution was temporally modulated in spontaneously hypertensive rats, which is an animal model of neurodegenerative disease. After fluid infusion, shortened T2 showed in hippocampus and ventricles, and prolonged T2 was in corpus callosum and amygdala. The analysis of T2 distribution with rNNLS showed that a component with T2 around 100-200ms was increased in both T2-altered regions. We attributed this component as a restricted interstitial fluid, which could be correlated to the function of glymphatic system. Therefore, our experiment may shed a light on functional imaging of glymphatic system.

4971 | Computer 106

Comparison of white matter tracts between macaque and human brain

Qinlin Yu[1,2,3,4], Fang Fang[3,4], and Hao Huang[1,2]

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White matter as the substrate of connectivity plays a critical role in brain evolution. However, the comprehensive tract-level comparison in morphology and microstructure between all common macaque and human white matter tracts has not been delineated. We aimed to qualitatively and quantitatively compare the tract-level microstructure and 3D pathways of corresponding white matter tracts between macaque and human brain using DTI measurements and tractography. Macaque white matter tract skeleton was obtained and comparison was conducted in five categorized tract groups. The differences are most prominent in association tracts with more extensive pathways and higher microstructural integrity in human brain association tracts.

4972 | Computer 107

Lactate, the new hope against brain damages in neonatal hypoxia-ischemia

Hélène Roumes[1], Ursule Dumont[1], Leslie Mazuel[1], Stéphane Sanchez[1], Jordy Blanc[1], Véronique Bouchaud[1], Jean-François Chateil[1], and Anne-Karine Bouzier-Sore[1]

[1]Centre de Résonance Magnétique des Systèmes Biologiques - UMR 5536 - CNRS, BORDEAUX, France

		Hypoxia-ischemia remains a major perinatal mortality and chronic disability cause in newborns. Hypothermia is the only clinically therapeutic approach but new therapy must be developed. Our aim was to study the neuroprotective role of lactate in rat neonatal hypoxic-ischemic model and to determine the best pattern to counteract brain damages. Interestingly, lactate was much more neuroprotective when administered after hypoxia (curative) than before (preventive). Single versus 48h injection of lactate were compared. Lactate shows significant and important neuroprotection (ADC, FA, immunohistochemistry, behavioral studies).

4973	Computer 108	Mapping neurotransmitter variations upon water deprivation in rats using overlap-resolved CEST
		Frederico Severo[1] and Noam Shemesh[1]
		[1]Champalimaud Centre for the Unknown, Lisbon, Portugal
		Thirst regulation involves several brain regions and Glutamatergic/GABAergic mechanisms. Imaging those noninvasively could make a big impact on understanding brain circuitry in-vivo. A recently proposed method termed overlap-resolved CEST (orCEST) was suggested for mapping both Glutamate and GABA in the brain with increased specificity. Here, orCEST is used to investigate changes in these neurotransmitters in the rat brain in vivo upon water deprivation. Decreases in GABA and Glutamate in hypothalamic preoptic areas and corpus callosum, respectively, were observed in the Water Deprived group. This bodes well for future applications of orCEST for studying neurotransmission in-vivo.

4974	Computer 109	In Vivo Mapping and Quantification Approaches in Epileptic Seizure Rat Models Using Creatine Chemical Exchange Saturation Transfer (CrCEST) Imaging
		Dong-Hoon Lee[1], Do-Wan Lee[2], Jae-Im Kwon[3], Chul-Woong Woo[3], Sang-Tae Kim[3], Jin Seong Lee[4], Choong Gon Choi[4], Kyung Won Kim[4], Jeong Kon Kim[4], and Dong-Cheol Woo[5,6]
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		CrCEST imaging is a novel imaging technique to provide in vivo image contrasts related with the changes of energy metabolism by creatine level changes. In this abstract, we attempted to evaluate signal changes in hippocampus at epileptic seizure rat models based on the quantified CrCEST signals. We also analyzed the correlations between CrCEST signals and PCr and PCr+Cr concentrations assessed by ^{1}H-MRS spectra. Our results clearly showed that the CrCEST imaging can be a useful approach to evaluate the energy metabolism in hippocampus at epileptic seizure model, and to provide the quantitative results that related with creatine level changes.

4975	Computer 110	Chemical Exchange Saturation Transfer Imaging of Glutamate (GluCEST) in a Rat Model of Epilepsy using Proton Magnetic Resonance Spectroscopy (1H-MRS) at 7T
		Do-Wan Lee[1], Jae-Im Kwon[2], Dong-Hoon Lee[3], Chul-Woong Woo[2], Sang-Tae Kim[2], Jin Seong Lee[4], Choong Gon Choi[4], Kyung Won Kim[4], Jeong Kon Kim[4], and Dong-Cheol Woo[5,6]
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		Chemical exchange saturation transfer imaging of glutamate (GluCEST) is a novel magnetic resonance imaging (MRI) method for measuring brain glutamate (Glu) in humans and animals. *In vivo* quantification of neurotransmitter signals can provide insight into functional roles of brain structures and knowledge about biochemical compounds. This study, based on quantified GluCEST contrast values and ^{1}H-MR spectral concentrations, assessed signal changes in control rats and rats with kainic acid-induced epileptic seizures, and showed that in vivo GluCEST and ^{1}H-MR spectral data can provide valuable information for interpreting changes in signals and concentrations of specific cerebral metabolites in kainic acid-induced rats.

4976	Computer 111	Correlations between brain metabolites and tau protein accumulation assessed by H-MRS and tau PET in Alzheimer's disease model mice
		Yuhei Takado[1], Hiroyuki Takuwa[1], Urushihata Takuya[1], Manami Takahashi[1], Maiko Ono[1], Jun Maeda[1], Masafumi Shimojo[1], Nobuhiro Nitta[2], Sayaka Shibata[2], Ichio Aoki[2], Naruhiko Sahara[1], Tetsuya Suhara[1], and Makoto Higuchi[1]
		[1]Department of Functional Brain Imaging Research, National Institutes for Quantum and Radiological Science and Technology, Chiba, Japan, [2]Department of Molecular Imaging and Theranostics, National Institutes for Quantum and Radiological Science and Technology, Chiba, Japan

		Amyloid beta protein and tau proteins are two major hallmarks of the pathology of Alzheimer's disease. To elucidate the relationship between brain metabolites and tau protein, we performed H-MRS and tau PET imaging of tauopathy mouse model (rTg4510). Five rTg4510 mice and five wild-type mice were scanned at the age of 4 and 6 months by H-MRS and tau PET. We demonstrated that the amount of tau had negative correlations with the amount of taurine, tNAA, and glutamate, indicating that tau might reduce those metabolites selectively and caused neural impairment.

4977	Computer 112	Longitudinal evaluation of lesion pathology in a novel murine model for Multiple Sclerosis
		Caroline Guglielmetti[1,2], Christian Cordano[3], Ari Green[3], and Myriam Chaumeil[1,2]
		[1]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Department of Physical Therapy and Rehabilitation Science, University of California San Francisco, San Francisco, CA, United States, [3]Department of Neurology, University of California San Francisco, San Francisco, CA, United States
		We used conventional MRI to longitudinally assess lesion pathology in a combined cuprizone and experimental autoimmune encephalomyelitis (CPZ/EAE) model. The novelty of this model lies in the recruitment of cells from the innate and adaptive immune system into brain lesions. We used T_2-weighted imaging to monitor white matter lesions. Interestingly, we showed a transient change in T_2 contrast at the onset of clinical symptoms in the CPZ/EAE group. Using gadolinium-enhanced MRI, we showed transient opening of the blood-brain-barrier prior and/or following clinical symptoms. Altogether, these findings are of relevance to understand the dynamics of lesion formation in a novel MS model.

4978	Computer 113	Anti-angiogenic treatment alters stiffness of glioblastoma in an orthotopic mouse model
		Katharina Schregel[1,2,3], Michal Oskar Nowicki[4], Miklos Palotai[2,3], Navid Nazari[5], Rachel Zane[4], Ralph Sinkus[6], Sean Lawler[3,4], and Samuel Patz[2,3]
		[1]Institute of Neuroradiology, University Medical Center Goettingen, Goettingen, Germany, [2]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [3]Harvard Medical School, Boston, MA, United States, [4]Department of Neurosurgery, Brigham and Women's Hospital, Boston, MA, United States, [5]Department of Biomedical Engineering, Boston University, Boston, MA, United States, [6]Department of Radiological Imaging, Imaging Sciences & Biomedical Engineering Division, King's College London, London, United Kingdom

		Glioblastoma (GBM) is the most common malignant brain tumor. As it is highly vascularized, anti-angiogenic treatment strategies have been tested. Such treatment hinders radiological tumor monitoring. Here, we probed the potential of magnetic resonance elastography (MRE) to evaluate GBM treated with anti-angiogenic therapy. GBM was orthotopically implanted in 10 nude mice, of which 5 were treated with B20 anti-VEGF antibody. MRI and MRE were performed repeatedly and brains were harvested for histology afterwards. Anti-angiogenic treatment slowed tumor growth, affected contrast-enhancement and slowed down tumor softening. The phase angle Y expressing the solid/liquid ratio appeared to indicate tumor progression.

4979	Computer 114	Fronto-striatal connectivity alterations in a prenatal ethanol exposure rat model: a resting-state functional MRI study
		Shiyu Tang[1], Su Xu[1], Jaylyn Waddell[2], Marie Hanscom[2], Wenjun Zhu[1], Rao Gullapalli[1], and Sandra Mooney[2]
		[1]Department of Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States, [2]Department of Pediatrics, University of Maryland School of Medicine, Baltimore, MD, United States
		People with Fetal Alcohol Spectrum Disorders (FASDs) may present deficits in executive functions. The fronto-striatal circuit is a critical component of the fronto-basal ganglia pathway that plays an important role in executive processes. We used resting-state functional MRI to assess the effects of prenatal alcohol exposure on the functional interaction within the fronto-striatal circuit in a rat FASD model. Male alcohol-exposed rats, but not females, showed reduced fronto-striatal connectivity. Further exploratory analysis revealed a reduction in cortico-striatal connectivity in female alcohol-exposed rats, suggesting that prenatal alcohol exposure has sex dependent effects on executive and sensory processing functions.

4980	Computer 115	Longitudinal assessment of TAT-PHP treatment effect in improving brain function recovery from cardiac arrest resuscitation with endogenous perfusion using ASL and metabolic CEST MRI
		Rong-Wen Tain[1,2,3], Chunpei Lee[4], Alessandro Scotti[2,3,5], Weiguo Li[6,7], Xiangdong Zhu[4], Terry L. Vanden Hoek[4], Jing Li[4], and Kejia Cai[2,3,5]
		[1]Campus Center for Neuroimaging, University of California, Irvine, CA, United States, [2]Radiology, College of Medicine, University of Illinois, Chicago, IL, United States, [3]3T Research Program, Center for MR Research, College of Medicine, University of Illinois, Chicago, IL, United States, [4]Emergency Medicine, College of Medicine, University of Illinois, Chicago, IL, United States, [5]Bioengineering, College of Engineering, University of Illinois, Chicago, IL, United States, [6]Research Resource Center, University of Illinois, Chicago, IL, United States, [7]Radiology, Northwestern University, Chicago, IL, United States

		Sudden cardiac arrest is a leading cause of death in the US. A recently developed peptide-based (TAT-PHP) therapy has been shown to improve survival rate and heart metabolism in animal studies. There is a great need to evaluate the effect of the treatment in the brain as the brain is the most susceptible organ following cardiac arrest. We here demonstrated that the recovery of brain perfusion and metabolism is improved in mice with TAT-PHP treatment vs. controls with endogenous perfusion arterial spin labeling MRI and metabolic MRI based on chemical exchange saturation transfer.

4981	Computer 116	Longitudinal evaluation of iron load with quantitative suceptibility mapping (QSM) in a primate model of Parkinson's disease
		Mathieu David Santin[1,2], Maxime Verdier[1,2], Romain Valabregue[1,2], Elodie Laffrat[2], Lydia Yahia Cherif[1,2], Alexandra Petiet[1,2], Stéphane Lehéricy[1,2], and Stéphane Hunot[2]
		[1]CENIR, ICM, Paris, France, [2]Inserm U 1127, CNRS UMR 7225, Sorbonne Universités, UPMC Univ Paris 06 UMR S 1127, Institut du Cerveau et de la Moelle épinière, ICM, Paris, France
		In this study, we performed a longitudinal follow-up of iron load in a primate model of Parkinson's disease using both QSM and R2* mapping. ROI definition was automatically performed using an in-house template computed from all acquired data. Statistical analyses revealed that QSM is more sensitive to model-induced variation in iron-rich regions compared to R2* mapping.

4982	Computer 117	Optical Coherent Tomography (OCT) Detected Axonal Loss but Failed to Identify Acute Axonal Injury: A Diffusion Study
		Tsen-Hsuan (Abby) Lin[1], Ying-Bo Shui[2], Ying Liu[2], Hsin-Chieh Yang[1], Michael Wallendorf[3], Carla J Siegfriedand[2], and Sheng-Kwei Song[1,4,5]
		[1]Radiology, Washington University School of Medicine, St Louis, MO, United States, [2]Ophthalmology & Visual Sciences, Washington University School of Medicine, St Louis, MO, United States, [3]Biostatistics, Washington University School of Medicine, St Louis, MO, United States, [4]Hope Center for Neurological Disorders, Washington University School of Medicine, St Louis, MO, United States, [5]Biomedical Engineering, Washington Univerisyt is St. Louis, St Louis, MO, United States
		Optical coherence tomography (OCT) is widely used to noninvasively assess retinal nerve fiber layer (RNFL) thickness to assess optic nerve damage. However, the impact of coexisting pathology on OCT-detected RNFL thickness remains unclear. We have previously developed a diffusion basis spectrum imaging (DBSI) to directly assess coexisting pathologies in mouse models of optic nerve crush (ONC) and optic neuritis. In the current study, we assessed retinal pathology and coexisting pathologies in optic nerve of ONC mice longitudinally, with OCT and DBSI, respectively. Our goal is to determine the relationship between OCT-detected RNFL change and DBSI-derived optic nerve pathologies.

4983	Computer 118	Diffusion Basis Spectrum Imaging (DBSI): Successful in vivo Use to Assess Axonal Protection in Mouse Optic Neuritis treated with Fingolimod Tsen-Hsuan (Abby) Lin[1], Rui-Meng Yang[1,2], Jie Zhan [1,3], Chunyu Song[4], Peng Sun[1], Michael Wallendorf[5], Anne H Cross[6,7], and Sheng-Kwei Song[1,4,7] *[1]Radiology, Washington University School of Medicine, St Louis, MO, United States, [2]Radiology, Guangzhou Medical University, Guangzhou, China, [3]Radiology, The First Affiliated Hospital of Nanchang University, Nanchang, China, [4]Biomedical Engineering, Washington Univerisyt is St. Louis, St Louis, MO, United States, [5]Biostatistics, Washington University School of Medicine, St Louis, MO, United States, [6]Neurology, Washington University School of Medicine, St Louis, MO, United States, [7]Hope Center for Neurological Disorders, Washington University School of Medicine, St Louis, MO, United States* We previously introduced diffusion basis spectrum imaging (DBSI) to noninvasively assess coexisting pathologies in central nervous system (CNS) tissues.Previously, we showed in multiple sclerosis (MS) spinal cord specimens and mice with experimental autoimmune encephalomyelitis (EAE), the main animal model of MS, that DBSI reflected coexisting white matter pathologies in CNS. Fingolimod, a disease-modifying treatment approved for relapsing MS, is thought to preserve axons. In the current study, we employed longitudinal DBSI to noninvasively assess fingolimod treatment efficacy in EAE mouse optic nerve, followed by histological validation.

4984	Computer 119	Protein Aggregation in Mouse Brain with Alzheimer's Disease Revealed by Saturation Transfer MRI Lin Chen[1,2,3], Zhiliang Wei[2,3], Kannie Chan[2,3,4], Shuhui Cai[1], Guanshu Liu[2,3], Hanzhang Lu[2,3], Philip C. Wong[5], Peter C.M. van Zijl[2,3], Tong Li[5], and Jiadi Xu[2,3] *[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Research Institute, Baltimore, MD, United States, [3]Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States, [4]Department of Mechanical and Biomedical Engineering, City University of Hong Kong, Hong Kong, China, [5]Department of Pathology, Johns Hopkins University, Baltimore, MD, United States* This study aims to detect the aggregated proteins involved in Alzheimer's Disease (AD) using chemical exchange saturation transfer (CEST) as a potential strategy for early diagnosis of the disease. A radial ultra-short echo time (UTE) image acquisition scheme was applied to map CEST signals with sufficient sensitivity and robustness to motion. Studies on cross-linked bovine serum albumin (BSA) and an AD transgenic model (mutant APP/PS1 mouse) demonstrated that the saturation transfer (ST) signal at -3.6 ppm, which is a combination of relayed nuclear Overhauser enhancement (rNOE)-CEST and a small portion of magnetization transfer contrast (MTC), can be used a potential biomarker for monitoring changes in brains of a mouse model of AD.

4985	Computer 120	Atlas-based and voxel-based symptom mapping to explore anatomical substrates of functional recovery after stroke in the mouse

Stefan Paul Koch[1,2], Felix Knab[1], Ulrike Grittner[1], René Bernard[1], Susanne Mueller[1,2], Marco Foddis[1], Janet Lips[1], Philipp Euskirchen[1], Norman Zerbe[3], Peter Hufnagl[3], André Rex[1], Ulrich Dirnagl[1], Tracy Deanne Farr[4], Christoph Harms[1], and Philipp Boehm-Sturm[1,2]

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Post-stroke functional recovery remains a poorly understood process. We aimed to identify anatomical regions that statistically explain a deficit in the staircase test after stroke in the mouse using two animal models (MCAO, photothrombosis). MATLAB toolboxes are presented for co-registration of MRI and histology data to the Allen brain atlas and implementation of atlas region-wise or voxel-wise mapping of behavioral deficits. Automatic techniques are shown for validation of MRI results on stained tissue sections.

Electronic Poster

Quantitative Susceptibility Mapping

Exhibition Hall	Wednesday 16:15 - 17:15

4986 Computer 1

True Phase Quantitative Susceptibility Mapping Using Continuous Single Point Imaging: A Feasibility Study

Hyungseok Jang[1], Xing Lu[1], Eric Y Chang[1,2], and Jiang Du[1]

[1]Radiology, University of California San Diego, San Diego, CA, United States, [2]Radiology Service, VA San Diego Healthcare System, San Diego, CA, United States

Quantitative susceptibility mapping (QSM) has recently been in the limelight as a novel contrast mechanism to provide quantification of apparent magnetic susceptibility based on phase information in MR images. In this study, we explore feasibility of single point imaging (SPI) for QSM. SPI, also known as constant time encoding or pure phase encoding, provides true phase information not affected by phase evolution during readout, which is beneficial for accurate QSM. We propose a new and efficient SPI acquisition scheme for QSM, termed Continuous SPI, where SPI images are continuously obtained with extremely high temporal resolution in a single scan.

4987 Computer 2

Quantitative MRI and laser ablation-inductively coupled plasma-mass spectrometry imaging of iron in post-mortem frontal cortex of Alzheimer patients

		Marjolein Bulk[1,2], Walid M. Abdelmoula[1], Wim Wiarda[3], Itamar Ronen[1], Jouke Dijkstra[1], and Louise van der Weerd[1]
		[1]Radiology, LUMC, Leiden, Netherlands, [2]Percuros BV, Leiden, Netherlands, [3]Netherlands Forensic Institute, The Hague, Netherlands
		Previous imaging studies reported iron-induced T2* or phase contrast changes in the cortex of post-mortem brain tissue of patients with Alzheimer's disease (AD), but comparison with a gold standard is lacking. This study used laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) as a gold standard for iron in post-mortem brain tissue of controls and AD patients and investigated the correlation between LA-ICP-MS, quantitative MRI (R2*, phase, and QSM) and histology. R2* and QSM showed the highest correlation with iron content; the correlation of phase with iron was weaker, probably due to its high orientation dependence.

4988	Computer 3	Fat Correction of MRI Phase Images for Accurate Susceptibility Mapping in the Head and Neck
		Anita Karsa[1], Shonit Punwani[2], and Karin Shmueli[1]
		[1]Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]Centre for Medical Imaging, University College London, London, United Kingdom
		Susceptibility Mapping (QSM) is increasingly applied in parts of the body where fatty tissue is present. QSM uses the phase of the complex MRI signal which contains both susceptibility-, and chemical-shift-induced components. For accurate QSM, the latter need to be suppressed. Here we compared a range of different fat-correction strategies for QSM in head-and-neck images. Techniques providing reliable fat-fraction maps also gave similar susceptibility values in fatty fascia. However, some of these methods were not robust to the choice of echo times. In-phase imaging was found to be the best candidate for robust fat-correction in QSM of the head-and-neck.

4989	Computer 4	Bone Marrow Susceptibility as a Marker of Bone Mineral Density in Spondyloarthritis
		Anita Karsa[1], Timothy J.P. Bray[2,3], Alan Bainbridge[4], Shonit Punwani[2], Margaret A. Hall-Craggs[2], and Karin Shmueli[1]
		[1]Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]Centre for Medical Imaging, University College London, London, United Kingdom, [3]Arthritis Research UK Centre for Adolescent Rheumatology, University College London, London, United Kingdom, [4]Department of Medical Physics, University College London Hospitals, London, United Kingdom

		New bone formation (causing spinal fusion) and bone loss are both key features of spondyloarthritis, and contribute to significant morbidity and disability. However, these processes are difficult to monitor using conventional MRI, which provides minimal information about bone mineral density (BMD). Here, we show that bone marrow susceptibility can be used as a marker of BMD, using data from a fat-water-bone phantom and from subjects with spondyloarthritis. Susceptibility values are significantly increased in areas of fat metaplasia compared to normal marrow, suggesting that this lesion represents a form of local bone loss, which could be monitored using susceptibility mapping.

4990	Computer 5	Whole Brain Background Field Removal using Spherical Mean Value Filtering and Local Polynomial Approximation for Quantitative Susceptibility Mapping
		Toru Shirai[1], Ryota Sato[1], Takenori Murase[2], Yoshitaka Bito[2], and Hisaaki Ochi[1]
		[1]Research and Development Group, Hitachi, Ltd., Tokyo, Japan, [2]Healthcare Business Unit, Hitachi, Ltd., Tokyo, Japan
		We propose a novel background-field removal method to recover a local field of a brain edge. The proposed method consists of two steps. First, the background field of the brain edge is calculated from the total field by using local polynomial approximation. Second, the local field of the whole brain is calculated by regularization that enables sophisticated harmonic artifacts reduction for phase data (RESHARP) processing with the constraint term of the background field of the brain edge. The results from a human brain experiment showed that the method is useful for calculating the local field and susceptibility maps of the whole brain.

4991	Computer 6	High resolution frequency difference mapping using ASPIRE phase combination
		Korbinian Eckstein[1], Siegfried Trattnig[1], and Simon Daniel Robinson[1]
		[1]High Field Magnetic Resonance Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria
		Frequency difference mapping (FDM) is a promising new method for investigating tissue microstructure. To date, images have been of quite low resolution and noise because of the need to use monopolar readout and two difference operations. We propose an improved approach – ASPIRE-FDM – which is based on a recently developed coil combination method which removes both phase offsets and phase gradients in readout direction in more efficient bipolar acquisitions. The resulting maps have drastically reduced noise and make feasible a four-fold reduction in voxel volume compared to prior work.

4992	Computer 7	An assessment of the ‘Prescan-Normalize Adaptive Combine’ approach to combining phase images from multi-channel coils at 3T

		Korbinian Eckstein[1], Siegfried Trattnig[1], and Simon Daniel Robinson[1]
		[1]High Field Magnetic Resonance Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria
		The combination of data acquired with array coils often leads to phase artifacts. The recently-introduced method ‘Prescan-Normalize Adaptive Combine’ (PN-AC) is assessed in terms of non-ΔB_0-related contributions and reproducibility with different head positions and compared with a robust multi-echo phase combination approach (called ASPIRE) which yields only ΔB_0-related phase. PN-AC was found to generate low noise phase images but introduce non-ΔB_0-related contributions to the combined phase. It was robust to motion between the prescan and the main acquisition other than the introduction of arbitrary background phase.

4993	Computer 8	Multi-channel phase combination for quantitative susceptibility mapping at 7T using Phase-Offsets Estimation from Multi-echoes (POEM) method
		Hongfu Sun[1], Jon O. Cleary[2], Rebecca Glarin[2], Scott Kolbe[2], Bradford A. Moffat[2], Roger J. Ordidge[2], and G. Bruce Pike[1]
		[1]University of Calgary, Calgary, AB, Canada, [2]University of Melbourne, Melbourne, Australia
		A Phase-Offsets Estimation from Multi-echoes (POEM) method is proposed to combined the phase-arrayed coil at 7T for quantitative susceptibility mapping (QSM). The method demonstrates equivalent or better results than adding a conventional reference scan for both single-orientation and multi-orientation QSM.

4994	Computer 9	Extracting more: Multi-echo MP2RAGE at 7T enables simultaneous T1w, quantitative T1, T2* and susceptibility mapping from a single acquisition
		Hongfu Sun[1], Jon O. Cleary[2], Rebecca Glarin[2], Yuhan Ma[3], Kieran O'Brien[4], Scott Kolbe[2], Bradford A. Moffat[2], Roger J. Ordidge[2], and G. Bruce Pike[1]
		[1]University of Calgary, Calgary, AB, Canada, [2]University of Melbourne, Melbourne, Australia, [3]McGill University, Montreal, QC, Canada, [4]Siemens Healthcare Pty Ltd, Brisbane, Australia
		We demonstrate the feasibility of extracting simultaneous T1w, quantitative T1, T2* and susceptibility mapping from a single Multi-echo MP2RAGE scan of 10min at 7T. After optimizing the multi-channel phase combination, QSM from the Multi-echo MP2RAGE is comparable to that from a standard GRE sequence, with the benefits of additional parametric maps.

4995	Computer 10	Shading Artifact Suppression using Relaxation Map and Machine Learning-based Region Detection for Quantitative Susceptibility Mapping Taichiro Shiodera[1], Takashi Watanabe[1], Tomoyuki Takeguchi[1], Naotaka Sakashita[2], Masao Yui[2], and Samir D. Sharma[3] *[1]Toshiba Corporation, Kawasaki, Japan, [2]Toshiba Medical Systems Corporation, Otawara, Japan, [3]Toshiba Medical Research Institute, Mayfield Village, OH, United States* We propose a dipole inversion method for improving quantitative susceptibility mapping. In conventional methods, shading artifacts often occur near the longitudinal fissure (LF) region of the estimated susceptibility map. Here, we propose an algorithm for LF region detection and regularized inversion, to reduce the shading artifacts. The LF region is automatically detected using information from the T2* map as well as training datasets via machine learning. The proposed method eliminates shading artifacts near the LF region in the susceptibility maps, while also showing negligible change in regions that do not suffer from shading artifacts, such as the basal ganglia.

4996	Computer 11	Considerations in Quantitative Susceptibility Mapping using Echo Planar Imaging Beata Bachrata[1,2], Korbinian Eckstein[1], Siegfried Trattning[1,2], and Simon Daniel Robinson[1] *[1]High Field MR Centre, Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [2]Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria* Phase images from EPI and GE acquisitions differ due to the divergent acquisition schemes and reconstruction steps. The effect of these is investigated both in measured phase and estimated susceptibility values. We show that non-ΔB_0-related phase is present in phased array data combined with the Virtual Receiver Coil and Roemer approaches and that this influences estimated susceptibilities. For EPI, data can be combined using a multi-echo “ASPIRE” GE prescan, leading to minimal non-ΔB_0-related phase. There was large variability of in-vivo EPI fieldmaps due to physiological noise and non-linearities in phase evolution in both GE and EPI data.

4997	Computer 12	Accelerating 3D whole brain quantitative susceptibility mapping acquisition using compressed sensing Nian Wang[1], Gary Cofer[1], Yi Qi[1], and G. Allan Johnson[1] *[1]Center for In Vivo Microscopy, Department of Radiology, Duke University, Durham, NC, United States*

		To evaluate the feasibility of compressed sensing (CS) for accelerating quantitative susceptibility mapping (QSM) acquisition at a high spatial resolution in mouse brains (22.5 μm^3, isotropic). This preliminary study shows that CS can be applied to significantly reduce the acquisition time of GRE MRI of mice brains at 9.4 T without losing apparent accuracy in quantitative susceptibility values.

4998	Computer 13	Simultaneous Analyses and Reconstruction of Quantitative Susceptibility Mapping and Voxel-based Morphometry Using Magnetization-prepared Spoiled Turbo Multiple Gradient Echo
		Hirohito Kan[1], Nobuyuki Arai[1], Satoshi Tsubokura[1], Masato Yamada[1], Yuta Nishiwaki[1], Kyosuke Mizuno[1], Harumasa Kasai[1], Yasujiro Hirose[1], and Yuta Shibamoto[1]
		[1]Department of Radiology, Nagoya City University Hospital, Nagoya, Japan
		Quantitative susceptibility mapping (QSM) and voxel-based morphometry (VBM) analyses are helpful in detecting an abnormal iron overload and the regional change of volume in the gray and white matters, respectively. This abstract presents a novel method for simultaneous analyses of QSM and VBM using magnetization-prepared spoiled turbo multiple gradient echo sequence with inversion pulse for QSM sequence which provides 3D T1-weighted structural images for VBM and multi-echo phase images for QSM on single scan.

4999	Computer 14	A multi-scale approach to quantitative susceptibility mapping (MSDI)
		Julio Acosta-Cabronero[1], Carlos Milovic[2,3], Cristian Tejos[2], and Martina F Callaghan[1]
		[1]Wellcome Centre for Human Neuroimaging, UCL Insitute of Neurology, University College London, London, United Kingdom, [2]Department of Electrical Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile, [3]Biomedical Imaging Center, Pontificia Universidad Catolica de Chile, Santiago, Chile
		We propose a new QSM algorithm, namely multi-scale dipole inversion (MSDI), which builds on the nonlinear MEDI (nMEDI) framework incorporating two additional features: (i) improved error control through dynamic phase-reliability compensation across harmonic scales and (ii) scale-specific use of the morphological prior. MSDI is the first algorithm to rank in the top-10 for all performance metrics evaluated in the 2016 QSM Reconstruction Challenge. It also demonstrates lower variance than nMEDI in a reproducibility test.

5000	Computer 15	Quantitative susceptibility mapping Accelerated Reconstruction Technique (QUART): A novel Split Bregman based approach for rapid reconstruction of quantitative susceptibility maps
		Srikant Kamesh Iyer[1], Brianna F. Moon[2], and Walter R.T. Witschey[1]

		[1]Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States, [2]Bioengineering, University of Pennsylvania, Philadelphia, PA, United States
		This abstract presents a novel Split Bregman (SB) based approach to enable rapid minimization of the quantitative susceptibility reconstruction formulation that includes a weighted least squares fidelity constraint and a total variation (TV) penalty. The purpose of this approach is to develop a rapid minimization technique that does not need complex matrix factorization or computation of matrix preconditioners to accelerate convergence. Rapid minimization is achieved by the application of two variable substitutions, one to the weighted fidelity constraint and the other to the total variation term. Minimization of the cost functional is achieved by the novel combination of FISTA based iterative re-weighting and soft thresholding.

5001	Computer 16	Reducing Streaking Artifacts in Quantitative Susceptibility Mapping via Deep Learning
		Jie Liu[1], Yida Wang[1], Yang Song[1], Haibin Xie[1], Jianqi Li[1], and Guang Yang[1]
		[1]Shanghai Key Laboratory of Magnetic Resonance, East China Normal University, Shanghai, China
		In this study, we proposed a new approach to reduce streaking artifacts in quantitative susceptibility mapping via deep learning. It combined two convolutional neural networks to reduce streaking artifacts from classic threshold-based k-space division (TKD) . The proposed method achieved impressive performance both visually and statistically.

5002	Computer 17	Susceptibility-Weighted Imaging on a Compact 3T Scanner with High-Performance Gradients
		Yunhong Shu[1], Shengzhen Tao[1], MyungHo In[1], Joshua D Trzasko[1], Erin Gray[1], John Huston III[1], and Matt A Bernstein[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		Susceptibility-weighted imaging (SWI) uses a 3D multi-echo gradient-echo sequence with unipolar gradient lobes to acquire all echoes, with fly-back gradients inserted in-between. These fly-back gradients reduce acquisition efficiency and increase echo spacing. We demonstrated that the high gradient performance available on a compact 3T system can reduce the echo spacing in the multi-echo readout by reducing the pulse-width of the fly-back gradient, which consequently allows a greater number of echoes to be sampled. The increased number of echoes translates into reduced noise and improved small vessel conspicuity in SWI acquired on the compact 3T compared to the conventional whole-body system.

5003	Computer 18	Quantitative Susceptibility Mapping of Articular Cartilage in Patients with Osteoarthritis

		Hongjiang Wei[1], Huimin Lin[2], Yuyao Zhang[1], Weibo Chen[3], Fuhua Yan[2], and Chunlei Liu[1]
		[1]University of California, Berkeley, Berkeley, CA, United States, [2]Department of Radiology, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Philips Healthcare, Shanghai, Shanghai, China
		Osteoarthritis (OA) is a multifactorial degenerative joint disease and is the most common form of arthritis which characterized by degenerative changes in the cartilage, menisci, ligaments and bone. The purpose of this study is to evaluate the magnetic susceptibility changes in knee diseases, such as patients with bone marrow lesions and cartilage loss. Clear susceptibility contrast was observed between bone marrow lesions and surroundings. The multilayer pattern of the damaged cartilage was lost compared with that of healthy subjects. QSM may provide a new way to improve the characterization of tissue microstructure in the knee joint related to osteoarthritis.

5004	Computer 19	GRE Phase Contrast of the Brain at Ultra-Short TE in Patients with Multiple Sclerosis
		Hongjiang Wei[1], Peng Cao[2], Roland Henry[2], Peder Larson[2], and Chunlei Liu[1]
		[1]EECS, University of California, Berkeley, Berkeley, CA, United States, [2]Radiology and Biomedical Imaging, UCSF School of Medicine, San Francisco, CA, United States
		The purpose of this study was to determine whether gradient-echo proton images of the brain exhibit any phase contrast at UTE and whether this contrast can be used to improve the characterization of tissue microstructure in the brain. Our data demonstrated that UTE images of the brain can attain strong phase contrast even at a TE of 226ms by using off-resonance RF pulses for selective saturation. UTE phase in an MS patient shows a strong contrast with surrounding white matters.

5005	Computer 20	Imaging Human Brain Cortical Substructure with Quantitative Susceptibility Mapping at 7 T
		Hongjiang Wei[1], Berkin Bilgic[2], Kawin Setsompop[2], Boris Keil[2], David Feinberg [3,4], and Chunlei Liu[1,3]
		[1]EECS, University of California, Berkeley, Berkeley, CA, United States, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [3]Helen Wills Institute for Neuroscience, University of California, Berkeley, Berkeley, CA, United States, [4]Advanced MRI Technologies, Sebastopol, CA, United States
		High-field MRI combined with high-density motor-cortex coil and a novel QSM algorithm allows in vivo brain cortex imaging with high contrast-to-noise ratio and spatial resolution (0.15x0.15x0.65 mm^3). Our work revealed up to six apparent myelin/iron layers in human cortex in vivo determined by the underlying magnetic susceptibility and complex vasculature in the cortical areas. Cortical susceptibility imaging provides high-resolution quantitative measurements of cortical cytoarchitecture and vasculature.

5006	Computer 21	In vivo quantitative susceptibility mapping detection of β-amyloid targeted by curcumin-conjugated magnetic nanoparticles Celia M. Dong[1,2], Mengye Lyu[1,2], Anthea To[1,2], and Ed X. Wu[1,2] *[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China* At present, there is a lack of reliable in vivo diagnostic methods to visualize and quantify the Alzheimer's disease (AD) pathologies. β-amyloid (Aβ) plaques are the hallmarks of AD brains. Recently, we have designed a novel curcumin-conjugated magnetic nanoparticles (Cur-MNPs) that target Aβ pathologies. Quantitative susceptibility mapping (QSM) offers the possibility of quantifying Cur-MNPs in vivo as a quantitative surrogate marker for Aβ pathologies. In this study, we optimized the QSM acquisition and processing procedure for mouse brains in vivo. Furthermore, we investigated the ability of QSM in detecting Cur-MNPs targeted Aβ pathologies in vivo in transgenic AD mouse models.

5007	Computer 22	Quantitative assessment of melanoma metastases at 7T: Susceptibility and T1 mapping Sina Straub[1], Frederik B. Laun[1,2], Martin T. Freitag[3], Heinz-Peter Schlemmer[3], Mark E. Ladd[1], and Till M. Schneider[3,4] *[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Radiology, University Hospital Erlangen, Erlangen, Germany, [3]Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]Neuroradiology, University of Heidelberg, Heidelberg, Germany* Susceptibility values and T1 values of melanoma metastases measured at 7T are shown. There is an ongoing discussion about whether melanin or hemorrhage dominate the contrast mechanisms observed in melanoma metastases. Susceptibility maps as well as T1 maps benefit from the high contrast and high resolution available at 7T, though we observed paramagnetic susceptibility in areas corresponding to vessels or hemorrhagic events, but no general relation between susceptibility values and T1 values of individual metastases

5008	Computer 23	Clinical Implementation of Quantitative Susceptibility Mapping: Experience Across Multiple Sites and Scanner Platforms. Pascal Spincemaille[1], Zhe Liu[1,2], Shun Zhang[1,3], Matteo Ippoliti[4], Marcus Makowski[4], Richard Watts[5], Ludovic de Rochefort[6], Vijay Venkatraman[7], Patricia Desmond[7], Brian Kopell[8,9,10,11], Patrice Péran[12], and Yi Wang[1,2]

		[1]Radiology, Weill Cornell Medical College, New York, NY, United States, [2]Meinig School of Biomedical Engineering, Cornell University, Ithaca, NY, United States, [3]Radiology, Tongji Hospital, Wuhan, China, [4]Radiology, Charité Universitätsmedizin Berlin, Berlin, Germany, [5]Radiology, Larner College of Medicine, The University of Vermont, Burlington, VT, United States, [6]Center for Magnetic Resonance in Biology and Medicine, Aix Marseille Université, Marseille, France, [7]Radiology, University of Melbourne, Melbourne, Australia, [8]Division of Movement Disorders, Department of Neurology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [9]Department of Neurosurgery, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [10]Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [11]Department of Neuroscience, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [12]Toulouse NeuroImaging Center, Université de Toulouse, Toulouse, France
		In recent years, quantitative susceptibility mapping (QSM) has undergone a series of technical improvements and found applications in an expanding array of diseases. To support this ongoing process of development and validation, it is important to automate the computationally intensive susceptibility reconstruction on the scanner after the acquisition of gradient echo data. In this work, an online QSM reconstruction system for a variety of scanner platforms with low cross-site ROI standard deviation is demonstrated.

5009	Computer 24	Multi-site reproducibility of quantitative susceptibility mapping at 1.5, 3 and 7T
		Kofi M Deh[1], Keigo Kawaji[2], Deb Horng[3], Marjolein Bulk[4], Louise Van Der Weerd[4], Pascal Spincemaille[5], Thanh Nguyen[6], and Yi Wang[6]
		[1]Radiology, Weill Cornell Medicine, New York, NY, United States, [2]University Of Chicago Medicine, Chicago, IL, United States, [3]Department of Medical Physics, University of Wisconsin–Madison, Madison, WI, United States, [4]Leiden University Medical Center, Leiden, Netherlands, [5]Radioogy, Weill Cornell Medicine, New York, NY, United States, [6]Weill Cornell Medicine, New York, NY, United States
		Quantitative susceptibility mapping (QSM) is increasingly being applied to quantitative research on disease conditions including intracerebral hemorrhage, liver iron overload and bone mineral quantification. These applications require knowledge of the reproducibility of QSM of sources with high susceptibility, which has not been previously reported. Here, we investigate the agreement between QSM maps generated from gradient-echo scans acquired at multiple sites using multiple platforms.

Electronic Poster

Physiological Techniques

Exhibition Hall	Wednesday 16:15 - 17:15

5010	Computer 25	Gadoxetate relaxivities increase significantly after hepatic uptake at clinical field strength impacting kinetic modelling for liver function analysis

		Gregor Jost[1], Gunnar Schuetz[1], and Hubertus Pietsch[1]
		[1]MR & CT Contrast Media Research, Bayer AG, Berlin, Germany
		Schuhmann-Giampieri1 reported r1 of gadoxetate to be significantly higher in liver tissue compared to blood at 0.47T. Gadoxetate relaxivities at 1.5T, 3T and 4.7T have since then been reported for water and plasma2, but not hepatocytes. We here present r1 values for gadoxetate in hepatocytes at 1.5T and 3T to complement existing data. r1 values of gadoxetate after uptake into hepatocytes are about 2x higher compared to blood. There is no relevant field strength dependency over a wide range (0.47T - 3T). This has implications on kinetic modelling of dynamic gadoxetate enhanced MRI data for determination of liver transporter activity.

5011	Computer 26	Exploring the Origin of Asymmetries in the Balanced SSFP Profile at 9.4 Tesla: Microstructure Anisotropy or Chemical Exchange?
		Rahel Heule[1], Moritz Zaiss[1], Philipp Ehses[2], and Klaus Scheffler[1,3]
		[1]High Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]German Center for Neurodegenerative Diseases, Bonn, Germany, [3]Department of Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany
		The balanced steady-state free precession (bSSFP) profile is known to carry information about the tissue-dependent frequency content in a voxel. There has been strong evidence that the observed asymmetries in the bSSFP profile of white matter depend on the tract orientation with the largest asymmetries occurring in tracts perpendicular to B_0. Recently, it was demonstrated that the bSSFP sequence can be used for chemical exchange detection based on profile asymmetries arising in isotropic probes of two exchanging pools. In this work, we explore the question whether exchanging species might contribute to the bSSFP profile asymmetry observed in white matter.

5012	Computer 27	Towards Quantification of Manganese Deposition in the Human Brain in the Presence of Iron: A Calibration Study
		Chien-Lin Yeh[1,2] and Ulrike Dydak[1,2]
		[1]School of Health Sciences, Purdue University, West lafayette, IN, United States, [2]Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States

		Welders are exposed to high levels of manganese (Mn) and iron (Fe). Since Mn is neurotoxic, being able to quantify brain Mn deposition by MRI is of high interest. This phantom calibration study is a first step towards understanding the combined effect of Mn and Fe on R1. Our results show that the presence of serum in the solution requires a Mn-Fe interaction term to improve the fit, likely due to the competing binding to the protein. The presence of Fe reduces the R1 effect of pure Mn, which would lead to an underestimation of brain Mn if Fe was neglected.

5013	Computer 28	Comparison of B0 versus B0 and B1 field inhomogeneity correction for glycosaminoglycan chemical exchange saturation transfer imaging
		Anja Müller-Lutz[1], Alexandra Ljimani[1], Julia Stabinska[1], Hans-Jörg Wittsack[1], and Christoph Schleich[1]
		[1]Department of Diagnostic and Interventional Radiology, University Dusseldorf, Medical Faculty, Dusseldorf, Germany
		Glycosaminoglycan CEST (gagCEST) has been shown to be a useful tool for assessing changes in glycosaminoglycan concentrations in cartilage. However, accurate B0 referencing is necessary for observing reliable gagCEST. Here we investigate whether the quality of in vivo gagCEST images can be further improved by correction of both B0 and B1 inhomogeneity by using a novel water shift and B1 (WASABI) mapping method. We present results from 20 healthy volunteers acquired at 3T. A comparison with the outcome of WASSR B0 mapping shows that the application of the WASABI maps to inhomogeneity artefact correction is advantageous to gagCEST imaging.

5014	Computer 29	Dephasing and diffusion in blood vessel networks: an exact solution of the Bloch-Torrey-equation
		Lukas R. Buschle[1], Felix T. Kurz[1,2], Heinz-Peter Schlemmer[1], and Christian H. Ziener[1,2]
		[1]E010 Radiology, German Cancer Research Center, Heidelberg, Germany, [2]Neuroradiology, University Hospital Heidelberg, Heidelberg, Germany
		The relaxation in blood vessel networks depends on susceptibility and diffusion effects around vessels. In 1994, Yablonskiy and Haacke developed a geometrical model of vessels and analyzed the gradient echo signal for negligible diffusion. Many approximative methods were developed generalizing this model in the limits of small and large diffusion effects. Important methods like vessel size or architectural imaging are based on these works. Here, we provide an exact solution of the Bloch-Torrey-equation in the model of Yablonskiy and Haacke for arbitrary diffusion effects that allows a validation of previously developed methods.

5015	Computer 30	An improved blood pool MRI agent with dinuclear structure: characterization and in vivo bio-distribution

		Alberto Fringuello Mingo[1], Francesca La Cava[2], Luigi Miragoli[1], Enzo Terreno[2], Enrico Cappelletti[1], Luciano Lattuada[1], Sonia Colombo Serra[1], Luisa Poggi[1], and Fabio Tedoldi[1]
		[1]Bracco Imaging Spa, Colleretto Giacosa, Italy, [2]Università degli Studi di Torino, Torino, Italy
		A novel dinuclear gadolinium(III) chelate containing two moieties of DTPA, covalently conjugated to deoxycholic acid is presented. The product was synthesized and characterized in vitro (analysis of relaxometric properties in different media) and in vivo (blood pharmacokinetic and MRI bio-distribution). The complex showed a much higher relaxivity than Gd-DTPA and other dinuclear complexes proposed in literature. Moreover, it displayed a strong interaction with human serum albumin in three binding sites. This property translates in a long blood elimination half time (130min in rats) making the product an optimal blood-pool agent.

5016	Computer 31	Comparison of cardiac output calculated from low dose Ultra-fast DCE MRI to the values measured from cardiac MRI
		Shiyang Wang[1], Yue Zhang[1], Xiaobing Fan[1], Dianning He[1], Milica Medved[1], Tatjana Antic[2], Ambereen Yousuf[1], Gregory Karczmar[1], and Aytekin Oto[1]
		[1]Radiology, University of Chicago, Chicago, IL, United States, [2]Pathology, University of Chicago, Chicago, IL, United States
		Accurately measuring arterial input function (AIF) is essential for quantitative dynamic contrast enhanced (DCE) MRI. The indicator dilution principle was used to verify the accuracy of AIF measured at iliac arties following injection of low dose (0.015 mmol/kg) gadolinium contrast media. The cardiac output from cardiac MRI (CO_{CMRI}) were compared with the cardiac output from Ultra-fast DCE-MRI (CO_{DCE}). Results demonstrated that the CO_{DCE} were consistent with the ‘gold standard’ CO_{CMRI}. This demonstrates that the low dose ultra-fast DCE-MRI can be used to accurately measure the AIF.

5017	Computer 32	Principal Process Analysis of dynamic GlucoCEST MRI data
		Stefano Casagranda[1], Marco Pizzolato[2], Francisco Torrealdea[3], Xavier Golay[4], and Timothé Boutelier[1]
		[1]Olea Medical, La Ciotat, France, [2]EPFL, Lausanne, Switzerland, [3]Centre for Medical Imaging, UCL, London, United Kingdom, [4]Institute of Neurology, UCL, London, United Kingdom
		GlucoCEST is an MRI contrast enhancement technique sensitive to the concentration of sugar in the tissue. Because of a difference in metabolism, it is thought that tumors consume more sugar than normal tissue. However, glucose metabolism is complex and depends on many processes, which are all important to understand the origin of the measured signal. To achieve this goal we apply here a process analysis method to a deterministic system describing the metabolism of glucose in the tissue.

5018	Computer 33	NOE contributions to the z-spectrum of human blood Andrew John Carradus[1], Simon Shah[1], Olivier Mougin[1], Hans Hoogduin[2], and Penny Gowland[1] *[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands* This study investigates the properties of relayed NOE effects in the blood by fitting z-spectra acquired using continuous wave saturation to the analytical solutions of the Bloch-McConnel equations. We systematically model for an increasing number of NOE peaks based on previous reports, and find that adding in two NOE peaks at -3.5ppm and -1.7ppm significantly improves the fit, but adding further peaks does not. Furthermore, we fit for the exchange rates and T_2s of these pools, and find that the peak at -3.5ppm has exchange rate=21.5Hz and T_2=0.9ms and the peak at -1.7 ppm has exchange rate=8.6Hz and T_2=3ms.

5019	Computer 34	Non-rigid atlas registration for improved quantitative assessment of rat brain regions with limited inherent anatomical contrast Matthew Tarasek[1], Jeannette Roberts[2], Deirdre Cassidy [3], Desmond Yeo[1], Randall Carter[2], and Brian Bales[2] *[1]MRI, GE Global Research, Niskayuna, NY, United States, [2]Life Sciences, GE Global Research, Niskayuna, NY, United States, [3]Life Sciences, GE Healthcare UK, United Kingdom, United Kingdom* We present a method for 3D non-rigid, feature-based atlas registration to images that contain limited inherent anatomical MR contrast. This method can be used to standardize ROI identification and may be applied to any multi-functional imaging technique to provide increased quantitative registration accuracy. Here quantitative T1 measurements were used to test the accuracy and reproducibility of the method. Overall, data analysis performed with atlas registration provides a 2-fold reduction in standard deviation and 4-fold increase in reproducibility versus data analysis performed without registration.

5020	Computer 35	Phenols as Diamagnetic T2-exchange Magnetic Resonance Imaging Contrast Agents Jia Zhang[1], Yuguo Li[1], Stephania Slania[2], Nirbhay Yadav[1,3], Jing Liu[1], Rongfu Wang[4], Jianhua Zhang[4], Martin Pomper[1], Peter van Zijl[1,3], Xing Yang[1,4], and Guanshu Liu[1,3] *[1]Department of Radiology and Radiological Science, Johns Hopkins University, School of Medicine, Baltimore, MD, United States, [2]Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States, [3]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [4]Department of Nuclear Medicine, Peking University First Hospital, Beijing, China*

		To further explore the ability of using diamagnetic compounds for generating MRI contrast, we chose phenol as a model compound and systematically characterized its T_2-exchange (T_{2ex}) ability. We designed a library of phenol-based compounds and determined the effects of chemical modification on their proton exchange rate (k_{ex}) and chemical shift ($\Delta\omega$) and consequently, their T_{2ex} contrast. A large $\Delta\omega$ is favorable for generating strong T_{2ex} contrast, while there is an optimal k_{ex} at each specific $\Delta\omega$. Finally, as an example of biomedical application, we demonstrated the label-free detection of tyrosinase activity using T_{2ex} MRI.

5021	Computer 36	Nanomicelles – A Blood Pool Contrast Agent for MRI
		Vassily Vorobiev[1], Lindsey Alexandra Crowe[2], Yohan van de Looij[3,4,5], Lothar Helm[6], Samuel Espy[1], Andrej Babič[1], Jean-Paul Vallée[2], and Eric Allémann[1]
		[1]School of Pharmaceutical Sciences, University of Geneva, Geneva, Switzerland, [2]Division of Radiology, Geneva University Hospitals, Geneva, Switzerland, [3]Institut Translationnel d'Imagerie Moléculaire, University of Geneva, Geneva, Switzerland, [4]Service Développement et Croissance, University of Geneva, Geneva, Switzerland, [5]Laboratoire d'Imagerie Fonctionnelle et Métabolique, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [6]Group of Inorganic and Bioinorganic Chemistry, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
		A blood pool MRI contrast agent for free breathing MR angiography is highly desirable in particular for pediatric cardiovascular exams in order to improve both image quality and patient comfort. Apnea in infants and be propofol induced, or via intubation, which is invasive and limits acquisition to short protocols. We present here initial in-vivo studies in mice of a newly developed nanomicelles gadolinium contrast agent. Persistent vascular enhancement is observed with no toxicity. Micelles also open the way to functionalization for theranostic applications.

5022	Computer 37	Investigating the nature of distinct regions in brain tissue affected by stroke with principal component analysis of multi-b valued diffusion data
		Ana-Maria Oros-Peusquens[1], Omid Nikoubashman[2], Martin Wiesmann[2], and N. Jon Shah[1]
		[1]Institute of Neuroscience and Medicine 4, Medical Imaging Physics, Research Centre Juelich, Juelich, Germany, [2]Department of Neurology, Faculty of Medicine, RWTH Aachen University, Aachen, Germany
		A data-driven, observer-independent segmentation of brain regions affected by stroke is proposed. It is based on PCA analysis of a multi b-value diffusion trace acquisition and offers fast, high-SNR visualisation of affected areas. Substructure of these areas is easily identified and can be automatically delineated using clustering algorithms.

5023	Computer 38	Reducing T2-related bias in mq-BOLD derived maps of Oxygen Extraction Fraction by 3D acquisition

Stephan Kaczmarz[1,2], Jens Goettler[1,2], Andreas Hock[3], Dimitrios Karampinos[4], Claus Zimmer[1], Fahmeed Hyder[2,5], and Christine Preibisch[1,6]

[1]*Department of Neuroradiology, Technical University of Munich, Munich, Germany,* [2]*Department of Radiology & Biomedical Imaging, Yale University, New Haven, CT, United States,* [3]*Philips Healthcare, Hamburg, Germany,* [4]*Departement of Radiology, Technical University of Munich, Munich, Germany,* [5]*School of Engineering & Applied Science, Yale University, New Haven, CT, United States,* [6]*Clinic for Neurology, Technical University of Munich, Munich, Germany*

Multi-parametric quantitative BOLD (mq-BOLD) measurements have been successfully applied in several studies to assess the vascular oxygenation, however, calculated relative Oxygen Extraction Fraction (rOEF) shows unphysiological systematic elevations. We suspect biased T_2-measurements to be the main source of error. Therefore, we present an optimized 3D-GraSE T_2-mapping sequence and its evaluation in four stages within phantoms, young healthy controls, elderly controls and internal carotid artery stenosis (ICAS) patients. We found significant T_2-decreases, fully consistent with reference-values, and thereby significantly decreased rOEF-values by ~25 % towards physiologically more realistic values. Additional clinical value was demonstrated by detecting focal rOEF-increases in an ICAS-patient.

5024 Computer 39

Comparison of Labeling Capacity for Protamine-sulphate-conjugated and FuGENE-labeled Progenitor Cardiac Stem Cells using Perfluorocarbon Nanoparticle Labels for In Vivo Murine Cardiac 19F MRI/MRS

Chris Constantinides[1], Akhilesh Rai[2], Mangala Srinivas[3], Lino Ferreira[4], and Carolyn Carr[1]

[1]*U. Oxford, Oxford, United Kingdom,* [2]*U. Coimbra (UC-BIOTECH), Cantanhede, Portugal,* [3]*Radboud University Medical Center, Nijmegen, Netherlands,* [4]*U. Coimbra, Coimbra, Portugal*

Despite prior work, a direct comparison of the labeling of progenitor cardiac stem cells (CPCs) using protamine-sulphate (PS)-conjugated or FuGENE-labeled perfluorocarbon nanoparticle labels (based on their respective cellular uptake mechanisms), and their capacity to achieve direct cardiac 19FMRI on the same animal species, is still lacking. We report herein improved in vivo cardiac 19FMRI performance for FuGENE-labeled compared to PS-labeled CPCs.

5025 Computer 40

High rotating frame relaxation MRI mapping for detecting ischemia in rats

Eleni Demetriou[1], Hanne Laakso[2], Timo Liimatainen[3], Silvia Mangia[2], Shalom Michaeli[2], and Xavier Golay[4]

[1]*Brain repair and rehabilitation, University College of London, London, United Kingdom,* [2]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States,* [3]*Diagnostic Imaging Canter, Kuopio University Hospital, Kuopio, Finland,* [4]*Brain Repair and Rehabilitation, University College of London, London, United Kingdom*

		The goal of this work is to evaluate novel MRI technique entitled Relaxation Along a Fictitious Field (RAFF) in the rotating frame of rank n (RAFFn, with n=4) in its ability to detect ischemia, specifically when tuning the sensitivity of RAFF4 to exchange processes of amide protons. Relaxation maps were thus measured in healthy and infarcted rats at 24h post stroke, and were compared with other conventionally used quantitative MRI modalities. RAFF4 robustly detected infarcted regions with enhanced contrast as compared to T1 relaxation and MTR asymmetry, thus offering a sensitive novel MRI marker for quantifying tissue abnormalities during ischemia.

5026	Computer 41	Direct D2O MRI for quantifying tissue permeability: application to Vitreous
		Shengwen Deng[1], Eric Muir[2], and Shiliang Huang[2]
		[1]Research Imaging Institute, University of Texas Health at San Antonio, San Antonio, TX, United States, [2]University of Texas Health at San Antonio, San Antonio, TX, United States
		D2O is a freely diffusible trace for calculating blood flow and give more accurate than limited diffused Gadolinium based contrast agents. A few publications from over twenty years ago used MRI or single-voxel NMR spectroscopy to assess D2O (or 17O water) for tissue perfusion. However, these studies never investigated the application of D2O MRI to altered permeability. Our current study explore the dynamic direct D2O MRI to map tissue permeability, and applied it to map the water exchange in rodent vitreous.

5027	Computer 42	Performance of ultrafast DCE-MRI for diagnosis of prostate cancer
		Aritrick Chatterjee[1], Dianning He[1,2], Xiaobing Fan[1], Shiyang Wang[1], Teodora Szasz[3], Ambereen Yousuf[1], Federico Pineda[1], Tatjana Antic[4], Melvy Mathew[1], Gregory S Karczmar[1], and Aytekin Oto[1]
		[1]Department of Radiology, University of Chicago, Chicago, IL, United States, [2]Sino-Dutch Biomedical and Information Engineering School, Northeastern University, Shenyang, China, [3]Research Computing Center, University of Chicago, Chicago, IL, United States, [4]Department of Pathology, University of Chicago, Chicago, IL, United States
		This study aimed to test high temporal resolution DCE- MRI for different zones of the prostate and evaluate its performance in the diagnosis of prostate cancer (PCa). High temporal resolution (~2.2s) was achieved by modestly decreasing spatial resolution, increasing sensitivity encoding and partial Fourier factors. Our results show that PCa had significantly faster signal enhancement and washout rates than normal tissue. DCE-MRI with higher temporal resolution may capture clinically useful information for PCa diagnosis that would be missed by low temporal resolution DCE-MRI. This new information could improve the performance of mpMRI in prostate cancer detection.

5028	Computer 43	Is the Parker arterial input function necessary to model the second pass for dynamic contrast enhanced MRI? - A simulation study Dianning He[1], Lisheng Xu[1], Wei Qian[1], and Xiaobing Fan[2] *[1]Sino-Dutch Biomedical and Information Engineering School, Northeastern University, Shenyang, China, [2]Radiology, The University of Chicago, Chicago, IL, United States* Accurately modeling arterial input function (AIF) is important for dynamic contrast enhanced (DCE) MRI. Simulations were performed comparing nine population AIF models to the Parker AIF. Effects of AIF second pass with and without adding noise onto extracted physiological parameters were evaluated with n=1,000 randomly generated physiological parameters (K^{trans} and v_e) used to calculate contrast agent concentration curves using the Tofts model and Parker AIF. Results demonstrated that the six-parameter linear function plus bi-exponential function AIF model was almost equivalent to Parker AIF. Effects of the second pass were small, unless noise with signal-to-noise ratio was <10 dB.

5029	Computer 44	Relaxivity of Ferumoxytol at 1.5T and 3.0T Gesine Knobloch[1], Timothy Colgan[1], Curtis Wiens[1], Xiaoke Wang[1,2], Tilman Schubert[1], Diego Hernando[3], and Scott Reeder[1,3,4,5,6] *[1]Department of Radiology, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [2]Department of Biomedical Engineering, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [3]Department of Medical Physics, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [4]Department of Biomedical Engineering, University of Wisconsin – School of Medicine and Public Health, Madison, WY, United States, [5]Department of Medicine, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States, [6]Department of Emergency Medicine, University of Wisconsin – School of Medicine and Public Health, Madison, WI, United States* Ferumoxytol (Feraheme, AMAG, Waltham, MA) is an iron supplement that has shown promise as an off-label alternative contrast agent for MRI. Optimization of imaging and dosing protocols requires accurate knowledge of the relaxation characteristics of ferumoxytol, which are currently not well understood. Therefore, the purpose of this work was to measure the r1, r2 and r2* relaxivity of ferumoxytol. Studies were performed at 1.5T and 3.0T over a range of concentrations, in saline, human plasma, and human blood, all at body temperature.

5030	Computer 45	R2-Star & DCE-Perfusion MRI based Novel Approach for Classification of Intra Tumoral Susceptibility Signal (ITSS) into Haemorrhage, Non-Leaky Vessels and Leaky Vessels in Glioblastoma Anup Singh[1,2], Rupsa Bhattacharjee[1,3], Prashant Budania[1], Pradeep Kumar Gupta[4], Rakesh Kumar Gupta[4], and Sunita Ahlawat[5]

		[1]*Centre for Biomedical Engineering, Indian Institute of Technology, Delhi, New Delhi, India,* [2]*Biomedical Engineering, AIIMS, New Delhi, Delhi, India,* [3]*Philips Health Systems, Philips India Limited, Gurgaon, India,* [4]*Department of Radiology and Imaging, Fortis Memorial Research Institute, Gurgaon, India,* [5]*SRL Diagnostics, Fortis Memorial Research Institute, Gurgaon, India*
		Susceptibility-weighted-imaging (SWI) demonstrates intra-tumoral-susceptibility-signal (ITSS) which could be a combination of haemorrhage and vasculature. True biological classification is necessary to understand the tumor-viability, aggressiveness and angiogenesis. This study develops a novel quantitative approach which combines SWI, R2-Star-relaxivity and DCE-MRI parameters for segmenting ITSS and its further classification into biological-behavior-based sub-categories. After analysis of 128 ITSS from 25 high-grade-glioblastoma patients, we found haemorrhages have higher R2-Star and lower rCBV values compared-to vessel ITSS. Leakage parameter Ve from tracer-kinetic analysis is found as differentiator between leaky and non-leaky-vessels. Proposed approach enables automatic-classification of ITSS into haemorrhage, non-leaky (passive) and leaky (aggressive) vessels.

5031	Computer 46	Formalin fixation significantly changes cell membrane permeability in cortical brain tissue
		Ruiliang Bai[1], Xihui Ju[1], and Peter J Basser[2]
		[1]*Interdisciplinary Institute of Neuroscience and Technology, Qiushi Academy For Advanced Studies, Zhejiang University, Hangzhou, China,* [2]*Section on Quantitative Imaging and Tissue Sciences, DIBGI, NICHD, National Institutes of Health, Bethesda, MD, United States*
		Ex vivo, formalin-fixed biological tissue sample are often used to validate MRI methods for *in vivo* applications. However, since fixation may alter the chemical and physical properties of tissue, including the cell membrane permeability, it is important to know how and whether fixation changes in water microdynamics and potentially affects MRI signals. In this work, we studied the transmembrane water exchange kinetics in live rat brain cortical tissue *in vitro*, and following formalin fixation. We found that the fixation process can significantly increase the transmembrane water exchange kinetics by increasing the cell membrane permeability to water.

5032	Computer 47	A compact solution for physiological parameters from ultrafast prostate DCE-MRI may reduce random and systematic errors
		Xiaobing Fan[1], Dianning He[2], Aritrick Chatterjee[1], Shiyang Wang[1], Milica Medved[1], Federico D Pineda[1], Ambereen Yousuf[1], Tatjana Antic[3], Aytekin Oto[1], and Gregory S Karczmar[1]
		[1]*Radiology, The University of Chicago, Chicago, IL, United States,* [2]*Sino-Dutch Biomedical and Information Engineering School, Northeastern University, Shenyang, China,* [3]*Pathology, The University of Chicago, Chicago, IL, United States*

		The Tofts pharmacokinetic model requires multiple calculations for analysis of dynamic contrast enhanced (DCE) MRI. This can result in error propagation that reduces the accuracy of pharmacokinetic measurements. Here, we present a new compact solution for estimating physiological parameters based on changes in signal intensity, without the Tofts model. Human prostate DCE-MRI data were analyzed to compare physiological parameters estimated from proposed compact solution with the Tofts model. The K^{trans} and v_e from the compact solution correlated strongly with values from the Tofts Model. Bland–Altman plots showed moderate to excellent agreement between the compact solution and the Tofts Model.

Electronic Poster

MSK: Cartilage

Exhibition Hall	Wednesday 16:15 - 17:15

5033	Computer 49	Automated evaluation of T2 relaxation time measurements in the knee cartilage at 3T
		Ales Neubert[1,2], Craig Engstrom[3], Ilaria Croci[3,4], Shekhar S. Chandra[2], Benjamin Schmitt[5], Stuart Crozier[2], and Jurgen Fripp[1]
		[1]The Australian E-Health Research Centre, CSIRO, Brisbane, Australia, [2]School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, Australia, [3]School of Human Movement and Nutrition Sciences, University of Queensland, Brisbane, Australia, [4]K.G. Jebsen Center of Exercise in Medicine, Department of Circulation and Medical Imaging, Faculty of Medicine, Norwegian University of Science and Technology, Trondheim, Norway, [5]Siemens Healthcare, Sydney, Australia
		A software framework for fully automated analysis in 3D of regional distribution of biochemical MRI values in knee cartilage sub-regions was proposed. The framework was compared to values extracted using manual segmentations and strong agreement with the automated measures was found. The framework was applied in a preliminary analysis to assess the reproducibility of T2 relaxation time measurements at 3T with promising results. The proposed automated framework can facilitate investigations and advance the search for biomarkers of pathophysiological processes preceding the development of osteoarthritis.

5034	Computer 50	Depth dependence of diffusion in articular cartilage of the knee visualized at 7T
		Sander Brinkhof[1], Qinwei Zhang[2], Martijn Froeling[1], Gustav J. Strijkers[3], Aart J. Nederveen[2], Keita Ito[4,5], and Dennis W.J. Klomp[1]
		[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Radiology, Academic Medical Center, Amsterdam, Netherlands, [3]Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands, [4]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands, [5]Orthopaedics, University Medical Center Utrecht, Utrecht, Netherlands

		The goal of this study was to apply high-resolution diffusion weighted imaging (DWI) at 7T to assess depth dependence of diffusion in the articular cartilage in the knee. Four healthy volunteers were scanned with a diffusion prepared TSE sequence. ADC maps were consequently used to assess the depth dependence of ADC throughout the articular cartilage. The ADC value was shown to significantly increase from the bone-cartilage interface to the superficial zone. This work shows that the significant depth dependence of the ADC in cartilage layers can be observed in vivo on 7T with diffusion weighed imaging.

5035	Computer 51	Measurement of Acute Changes in Articular Cartilage T2 Relaxation Times Immediately After Exercise
		Joanna Langner[1], Feliks Kogan[1], Bryan Haddock[2], and Garry Gold[1]
		[1]Radiology, Stanford University, Stanford, CA, United States, [2]Nuclear Medicine, Copenhagen University Hospital, Copenhagen, Denmark
		Increased joint loading is a known risk factor for progression of osteoarthritis (OA) of the knee. However, the acute effects of exercise and joint loading are still poorly understood. Quantitative MRI measures, such as T2 relaxation times, provide an opportunity to objectively study how exercise affects cartilage matrix organization and hydration. In this work, we evaluate the feasibility of measuring acute changes in T2 relaxation times immediately after exercise, in both knees simultaneously.

5036	Computer 52	T2-mapping of Femoral Cartilage 3-months Following ACL Reconstruction Surgery
		Marianne S. Black[1,2], Katherine A. Young[2], Akshay S. Chaudhari[2,3], Bragi Sveinsson[4], Feliks Kogan[2], Uchechukwuka Monu[2,5], Emily J. McWalter[6], Marc E. Levenston[1,2,3], Garry E. Gold[2], and Brian A. Hargreaves[2,3,5]
		[1]Mechanical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Bioengineering, Stanford University, Stanford, CA, United States, [4]Radiology, Massachusetts General Hospital, Boston, MA, United States, [5]Electrical Engineering, Stanford University, Stanford, CA, United States, [6]Mechanical Engineering, University of Saskatchewan, Saskatoon, SK, Canada
		T2-mapping can be used to detect changes in cartilage following ACL injury that are indicative of cartilage degeneration. We imaged subjects at 3-weeks and 3-months post-ACL-reconstruction surgery to obtain T2 relaxation times for the femoral cartilage of both knees. A trend in increasing T2 relaxation times was observed for the injured knee at 3-months relative to 3-weeks, although this increase was not significant, while T2 remained consistent for the contralateral knee in this time. This work demonstrates that changes to cartilage may be occurring earlier than expected in the injured knee following ACL-reconstruction surgery.

5037	Computer 53	T2 texture features can detect differences between the discs of patient with and without low back pain
		Vahid Abdollah[1,2,3], Eric C Parent[4], Maria Beketskaia[1,2], and Jeff F. Dunn[1,2,3]
		[1]Radiology, University of Calgary, Calgary, AB, Canada, [2]Experimental Imaging Centre, University of Calgary, Calgary, AB, Canada, [3]McCaig Institute for Bone and Joint Health, University of Calgary, Calgary, AB, Canada, [4]Physical Therapy, University of Alberta, Edmonton, AB, Canada
		Conventional MRI is often clinically inconclusive in diagnosing the pathology of back pain, as both symptomatic and asymptomatic individuals demonstrate the same abnormal features. We hypothesized that texture driven features could be deployed to identify the underlying pathology of low back pain. Fourteen patients with chronic back pain were matched (age, weight, and gender) with 14 healthy volunteers. A grey-level co-occurrence matrix with one- to four-pixel offset and four directions was constructed to extract texture features. The texture analysis results indicated the discs of the healthy subjects were more uniform (lower contrast) than those of the participants with back pain.

5038	Computer 54	Compositional assessment of low-grade cartilage lesions using T2 mapping at 3 and 7 Tesla MRI: a one year follow-up study
		Vladimir Juras[1,2], Markus Schreiner[3], Didier Laurent[4], Stefan Zbyn[5], Vladimir Mlynarik[1], Pavol Szomolanyi[1], Celeste Scotti[4], Joerg Goldhahn[4], Harry Haber[4], Ewa Kubiak[4], Stefan Marlovits[6], Rahel Heule[7], Oliver Bieri[7], Ivan Frollo[8], and Siegfried Trattnig[1,9]
		[1]Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [2]Department of Imaging Methods, Institute of Measurement Science, Bratislava, Slovakia, [3]Department of Orthopedics, Medical University of Vienna, Vienna, Austria, [4]Novartis Institutes for Biomedical Research, Basel, Switzerland, [5]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [6]Department of Traumatology, Medical University of Vienna, Vienna, Austria, [7]Division of Radiological Physics, Department of Radiology, University of Basel Hospital, Basel, Switzerland, [8]Slovak Academy of Sciences, Institute of Measurement Science, Bratislava 4, Slovakia, [9]Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria
		T2 maps were assessed as a potential marker for the long-term follow-up of the patients with cartilage lesions ICRS Grade I-II in five time points (baseline, 8 days, 3, 6 and 12 months). For the T2 mapping, a 3D triple echo steady state sequence which is capable of delivering high quality high-resolved T2 maps at ultra-high field MRI was used. We observed a significant decrease in T2 values at 3T over time in superficial zone of the cartilage defect. There was no statistically significant change at 7T. T2 mapping could be used in the future as a good alternative to cartilage biopsies in clinical trials on new therapies aimed at cartilage regeneration.

5039	Computer 55	A composite metric R2-R1ρ measures an incomplete anisotropic R2 of human femoral cartilage at 3T
		Yuxi Pang[1], Riann M Palmieri-Smith[2,3], and Thomas L Chenevert[1]

[1]Radiology, University of Michigan, Ann Arbor, MI, United States, [2]Orthopedic Surgery, University of Michigan, Ann Arbor, MI, United States, [3]School of Kinesiology, University of Michigan, Ann Arbor, MI, United States

The composite relaxation metric R_2-$R_{1\rho}$, a potential MR imaging biomarker for detecting early cartilage degeneration, was shown as an incomplete orientation-dependent R_2 at 3T. Both R_2 and $R_{1\rho}$ mappings of femoral cartilage were performed on two subjects, and the constructed composite metrics were compared to the anisotropic R_2 values that were extracted from a single 3D T2W dataset using a newly developed method. The preliminary results demonstrated that the orientation-dependent information derived from two completely different methods was comparable, implying that the diagnostically most relevant information in knee or other joint cartilage could be easily and efficiently obtained.

5040 | Computer 56

DESS vs T1-FLASH 3D-MRI for Knee Cartilage Segmentation: An Evaluation Using Deep 3D-CNN

Archit Raj[1] and Harsh Kumar Agarwal[1]

[1]Health and Medical Equipment, Samsung R&D Institute India Bangalore Pvt. Ltd., Bangalore, India

Automated knee cartilage segmentation can potentially improve the clinical utility of the MRI assessment of knee osteoarthritis due to the convoluted structure of the knee cartilage in 3D. Recently deep convolutional neural network (CNN) have shown better performance for knee cartilage segmentation. Unlike other segmentation algorithms deep-CNN techniques learn the model parameters from the data itself. Therefore, this abstract proposed that deep 3D-CNN techniques can be used to determine the optimal MRI sequence for knee cartilage segmentation and demonstrated that 3D-DESS MRI have statistically better segmentation performance as compared to 3D-T_1-FLASH MRI.

5041 | Computer 57

Prediction of the mechanical properties of articular cartilage with QSM and T2* in equine post traumatic osteoarthritis model

Olli Juhani Nykänen[1], Juuso Ketola[2], Henri Leskinen[1], Jaakko Sarin[1,3], Nikae te Moller[4], Irina A.D. Mancini[4], Harold Brommer[4], Rene van Weeren[4], Jos Malda[4,5], Juha Töyräs[1,3], and Mikko J Nissi[1]

[1]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland, [2]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [3]Diagnostic Imaging Center, Kuopio University Hospital, Kuopio, Finland, [4]Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, Utrecht, Netherlands, [5]Department of Orthopaedics, University Medical Center Utrecht, Utrecht, Netherlands

		In this study, we investigated the potential of quantitative susceptibility mapping (QSM) and T2* mapping to predict the mechanical properties of equine articular cartilage. To assess the potential of these parameters, they were used to predict the biomechanical properties of cartilage using artificial neural network (ANN) modelling of the 235 mechanical testing points in 20 equine samples representing variable tissue properties. The results indicated that both T2* and QSM correlate moderately with biomechanics (r=0.648 and r=0.652, respectively) and combining these parameters improved the correlation slightly (r=0.714). The study highlights the potential of both quantitative MRI and ANN-analysis in cartilage imaging.

5042	Computer 58	Simplified method for estimating chemical exchange rate in human knee cartilage from R1rho dispersion
		Ping Wang[1] and John C. Gore[1]
		[1]Radiology and Radiological Sciences, Vanderbilt University Institute of Imaging Science, Nashville, TN, United States
		Chemical exchange between water and exchangeable protons in macromolecules in knee cartilage can be quantified by fitting $R_{1\rho}$ dispersion data to a model. However, acquiring the entire dispersion curve is time consuming, which therefore hampers the application in clinical practice. We propose a simple three-point method for $R_{1\rho}$ dispersion data to estimate exchange rate. The method requires data acquired at three selected spin-locking frequencies instead of acquiring a full dispersion curve. The results show good agreement between the proposed method and measurements from the full dispersion data.

5043	Computer 59	3D Ultrashort Echo Time MRI for Evaluation of Cartilaginous Endplate of Lumbar Disc In Vivo: Feasibility and Correlation with Disc Degeneration in T2 weighted Spin Echo Sequence
		Yeoju Kim[1], Jang Gyu Cha[2], Gwang Pyo Hong[1], and Juhyuen Ryu[1]
		[1]Radiology, Inha University Hospital, Incheon, Republic of Korea, [2]Soonchunhyang University Bucheon Hospital, Bucheon, Republic of Korea
		Total 165 discs of 33 patients were imaged with sagittal 3D UTE (TR = 16.1 ms, TE = 0.032 ms and 6.6 ms, echo-subtraction) with 3D cones trajectory technique and conventional sagittal T2 weighted (TR = 3232, TE = 91.4) SE in 3T MRI. Two musculoskeletal radiologists evaluated the CEP abnormalities such as irregularity, thickening, thining, and defects in the 3D UTE with consensus and correlated with the Pfirrmann grading system in the sagittal T2 SE. In result, all of the CEP abnormalities were positively correlated with the Pfirrmann grading system with statistical significance ($p < 0.001$).

5044	Computer 60	MR Evaluation of Disco-Vertebral Junction: Effects of Sequence and Parameters on SNR and CNR

		Palanan Siriwananrangsun[1,2], Tim Finkenstädt[1,3], Tailynn S Chen[4], Michael Carl[5], Reni Biswas[1,6], Colin Bae[4], Sheronda Statum[1,6], Graeme M Bydder[1], Christine B Chung[1,6], and Won C Bae[1,6]
		[1]Department of Radiology, University of California, San Diego, La Jolla, CA, United States, [2]Department of Radiology, Siriraj Hospital, Bangkok, Thailand, [3]Institute of Diagnostic and Interventional Radiology, University of Zurich, Zurich, Switzerland, [4]Canyon Crest Academy, San Diego, CA, United States, [5]General Electric Healthcare, La Jolla, CA, United States, [6]Department of Radiology, VA San Diego Healthcare System, San Diego, CA, United States
		The disco-vertebral junction of lumbar spine contains thin structures with short T2 values, including cartilaginous endplate (CEP) sandwiched between the bony vertebral endplate (VEP) and nucleus pulposus (NP). We have demonstrated that ultrashort echo time MRI is able to capture signal from cartilaginous endplate, and we sought to further refine the technique by characterizing contrast-to-noise ratio of these tissues when varying echo times are used. Optimal contrast between CEP and VEP was achieved with UTE source image at the shortest TE, while a balanced contrast between all tissues was achieved by Cones Subtraction imaging at a long 2nd TE.

5045	Computer 61	A comparative study of diffusion kurtosis imaging and T2* mapping in quantitative evalutation of lumbar intervertebral disc degeneration
		Feifei Zeng[1], Yunfei Zha[1], and Yang Fan[2]
		[1]Radiology, Renmin Hospital of Wuhan University, Wuhan, China, [2]GE Healthcare China, Beijing, China
		The purpose of this study is to compare the diagnostic value of diffusion kurtosis imaging (DKI) and T2* mapping in assessing lumbar intervertebral disc degeneration. DKI related parameters, such as mean kurtosis (MK), mean diffusivity (MD), fractional anisotropy (FA), FA of Kurtosis (FAK) and T2* values of nucleus pulposus (NP), anterior annulus fibrosus (AAF) and posterior annulus fibrosus (PAF) were measured and correlated with Pfirrmann grades, disc level, gender and age. It was found that DKI related parameters and T2* values had significantly correlation with Pfirrmann grades, disc leveland, age, but had no significantly correlation with gender. In addition, DKI was more sensitive than T2* mapping in quantitative detection of early lumbar intervertebral disc degeneration.

5046	Computer 62	Comparison of DENSE-FISP and DENSE-FID for assessment of cartilage strain computation under compressive loading.
		Willy Zavenbergen[1], Willy Gsell[2], Maria-Ioana Pastrama[1], Deva Chan[3], Corey Neu[4], Uwe Himmelreich[2], and Ilse Jonkers[1]
		[1]Human movement biomechanics research group, Department of kinesiology, KU Leuven, Leuven, Belgium, [2]Biomedical MRI, KU Leuven, Leuven, Belgium, [3]Department of Biomedical Engineering, Rensselaer Polytechnic Institute, Troy, NY, United States, [4]5. Department of Mechanical Engineering, University of Colorado Boulder, Boulder, CO, United States

		While true-FISP provides increased signal to noise ratio, it is also prone to banding artefacts due to incoherent dephasing. We thus here compare true-FISP DENSE with FID-DENSE to estimate cartilage strain under compressive loading. As FID-DENSE will be artefact free however at the expense of a lower signal to noise ratio, we investigate if DENSE-FID or DENSE-FISP will provide a more robust computation of cartilage strains under compressive loading.

5047	Computer 63	T1ρ dispersion assessment of articular cartilage in a rabbit ACL transection model
		Abdul Wahed Kajabi[1,2], Victor Casula[1,2], Simo Ojanen[1,3], Mikko Finnilä[1,3], Rami K. Korhonen[3], Walter Herzog[4], Simo Saarakkala[1,2], Mikko J. Nissi[3], and Miika T. Nieminen[1,2,5]
		[1]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [2]Medical Research Center, University of Oulu and Oulu University Hospital, Oulu, Finland, [3]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland, [4]Human Performance Laboratory, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada, [5]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland
		T1ρ dispersion measurements were performed to assess early degenerative changes in articular cartilage in an experimentally induced anterior cruciate ligament transection (ACLT) rabbit model. T2 and T1ρ with spin-lock field amplitudes of 500 Hz, 1 kHz and 2 kHz were measured at 9.4 T. Cartilage mechanical properties and proteoglycan content were determined using indentation testing and quantitative histology, respectively. T1ρ dispersion identified degenerative alterations in cartilage as early as two weeks after ACL transection. The dispersion parameters were statistically correlated with biomechanical properties and proteoglycan content.

5048	Computer 64	T2 Relaxometry of Cartilage and Meniscus and Semi-Quantitative Assessment of the Osteoarthritic Knee using a fast 3D Quantitative DESS Scan
		Susanne Eijgenraam[1], Akshay Chaudhari[2], Max Reijman[3], Edwin Oei[1], Brian Hargreaves[2], and Garry Gold[2]
		[1]Radiology & Nuclear Medicine, Erasmus University Medical Center, Rotterdam, Netherlands, [2]Stanford University Medical Center, Stanford, CA, United States, [3]Orthopedic Surgery, Erasmus University Medical Center, Rotterdam, Netherlands
		In this study, we investigated quantitative and semi-quantitative MR imaging biomarkers of knee OA, obtained with a **5-minute DESS sequence**, in increasing stages of **knee OA**. 54 patients were included: 20 patients with no knee OA, 18 patients with mild knee OA and 16 patients with moderate knee OA. All patients were scanned using DESS and a routine clinical knee MRI protocol. Simultaneous quantitative T2 and morphological assessment of cartilage and meniscus with a 5-minute DESS-sequence showed consistent outcomes with increasing stages of degeneration, making this sequence a useful tool for OA research.

5049	Computer 65	Optimizing $T_{1\rho}$ dispersion measurements for correlation time mapping in articular cartilage at 9.4 T
		Hassaan Elsayed[1,2,3], Stefan Zbyn[1,2,3], Nina Hänninen[1], Timo Liimatainen[4], Mikko J. Nissi[5], Miika T. Nieminen[1,2,3], and Matti Hanni[1,2,3]
		[1]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [2]Medical Research Center, University of Oulu and Oulu University Hospital, Oulu, Finland, [3]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland, [4]Clinical Imaging Center, Kuopio University Hospital, Kuopio, Finland, [5]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland
		Correlation time (τ_c) is an intrinsic property of molecules that can be probed from $T_{1\rho}$ dispersion measurement. The aim of this study was to evaluate the effect of low and high spin-lock frequencies (SLFs) on τ_c fitting and to find the optimum SLFs set within the typical clinical range. One bovine and two human cartilage samples were scanned to obtain $T_{1\rho}$ dispersion with 22 SLFs between 10 to 2500 Hz. τ_c maps were obtained by fitting Lorentzian function to different subsets of $T_{1\rho}$ dispersion. Our results show that τ_c fitting is significantly affected by low SLFs compared to high SLFs.

5050	Computer 66	T2 mapping pseudo-color pictures and FS-FSE- PDWI in grading diagnosis of patellar cartilage damage：a retrospective study compared with arthroscopy
		Shaowei Zheng[1], Jing Chen[1], Weisheng Zhang[1], and Qingwei Song[1]
		[1]The first affiliated hospital of Dalian medical university, Dalian, China
		Our institution use arthroscopy as the gold standard, apply T2mapping and FS-FSE- PDWI for the evaluation of patellar cartilage damage, to investigate value of T2 mapping pseudo-color pictures in assessment of patellar cartilage injury grading. This group of 45 cases of patellar cartilage damage, the correlations of T2mapping pseudo color grading，FS-FSE- PDWI grading and arthroscopic grading were analyzed, found the correlation between T2mapping pseudo color and arthroscopy precedes that between FS-FSE- PDWI and arthroscopy. Therefore, we believe that the T2mapping pseudo color can be used to evaluate the patellar cartilage damage, and better than FS-FSE- PDWI.

5051	Computer 67	Orientation anisotropy of qMRI parameters in degenerated human articular cartilage
		Nina Hänninen[1,2], Olli Nykänen[2], Mithilesh Prakash[2], Matti Hanni[1,3,4], Miika Tapio Nieminen[1,3,4], and Mikko Johannes Nissi[2]

		[1]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [2]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland, [3]Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland, [4]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland
		Quantitative MR relaxation parameters have been used for evaluation of composition and structure of articular cartilage, and demonstrated to have variable sensitivity to orientation of the tissue in magnetic field. The orientation dependence of multiple relaxation parameters was assessed in human cartilage of varying degree of degeneration, and correlated with biomechanical testing. T_2 and CW-$T_{1\rho}$ at 400Hz spin-lock demonstrated most clear anisotropy patterns which varied among the samples of different cartilage quality.

5052	Computer 68	Ultra-high-field (7 Tesla) MRI study of the articular cartilage in normal subjects
		Giacomo Aringhieri[1], Massimo Marletta[1], Sara Toscano[1], Laura Biagi[2], Gianluigi Tiberi[2], Michela Tosetti[2], Mirco Cosottini[3], and Virna Zampa[4]
		[1]Radiology, University of Pisa, Pisa, Italy, [2]Imago 7 foundation, Pisa, Italy, [3]Neuroradiology, University of Pisa, Pisa, Italy, [4]Radiology, University Hospital of Pisa, Pisa, Italy
		Ultra High Field MRI gives the opportunity to study in vivo articular cartilage with optimal signal-to-noise ratio, contrast-to-noise ratio and spatial resolution in comparison with lower field strength systems. We obtained the mean T2 and T2* maps values for under and over 50 years aged healthy subjects, both mean values increase with the subjects' age. With dedicated multichannel coils and specific cartilage sequences, it is possible to make both a qualitative and a quantitative evaluation of early and pre-clinical cartilage ageing-related changes in estimating the water content and the integrity of the cartilage matrix.

5053	Computer 69	Accelerated T1ρ Dispersion Data Acquisition for Correlation Time Mapping of Cartilage at 3T
		Stefan Zbyn[1,2,3], Mikko J. Nissi[4], Hassaan Elsayed[1,2,3], Victor Casula[1,2,3], Matti Hanni[1,2,3], Timo Liimatainen[5], and Miika T. Nieminen[1,2,3]
		[1]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [2]Medical Research Center, University of Oulu and Oulu University Hospital, Oulu, Finland, [3]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland, [4]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland, [5]Clinical Imaging Center, Kuopio University Hospital, Kuopio, Finland

		Correlation time (τ_c) is novel MRI parameter that can be calculated from time demanding dispersion measurements of longitudinal relaxation times in the rotating frame ($T_1\rho$). Therefore methods able to accelerate data acquisition are needed for τ_c mapping of cartilage *in vivo*. Present results demonstrate that partial k-space acquisition and Parallel Imaging can reduce imaging time while having small influence on τ_c values. Although long TurboGRE readout train significantly decreases τ_c values, it allows the τ_c mapping of cartilage in clinically acceptable measurement times. The τ_c mapping may therefore serve for the noninvasive *in vivo* evaluation of cartilage at 3T.

5054	Computer 71	Sodium Imaging of Untreated Cartilage Lesions in the Knee Joint: 3-months and 6-months Follow-up Study at 7T
		Stefan Zbyn[1,2,3], Markus Schreiner[4], Vladimir Mlynarik[1], Vladimir Juras[1], Pavol Szomolanyi[1], Didier Laurent[5], Celeste Scotti[5], Harry Haber[5], Joerg Goldhahn[5], Ewa Kubiak[5], Xeni Deligianni[6], Oliver Bieri[6], Stefan Marlovits[7], Miika T. Nieminen[2,8,9], and Siegfried Trattnig[1,3]
		[1]High Field MR Center, Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [2]Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [3]CD Laboratory for Clinical Molecular MR Imaging, Vienna, Austria, [4]Department of Orthopaedics, Medical University of Vienna, Vienna, Austria, [5]Novartis Institutes for Biomedical Research, Basel, Switzerland, [6]Division of Radiological Physics, Department of Radiology, University of Basel Hospital, Basel, Switzerland, [7]Department of Traumatology, Medical University of Vienna, Vienna, Austria, [8]Medical Research Center, University of Oulu and Oulu University Hospital, Oulu, Finland, [9]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland
		Sodium MRI was used for the follow-up of patients with cartilage lesions at 7T. MRI was obtained at baseline, 8-days, 3-months and 6-months follow-up. Regions-of-interest evaluations were performed in weight-bearing, non-weight-bearing and lesion area of femoral cartilage. Sodium values were significantly lower in lesion than in weight-bearing and non-weight-bearing regions at all follow-up measurements. On the other hand, weight-bearing and non-weight-bearing cartilage regions showed stable sodium values over the follow-up time. Sodium imaging allows noninvasive *in vivo* monitoring of changes in cartilage GAG content and thus can be useful for the evaluation of cartilage degeneration or cartilage regenerating therapies.

5055	Computer 70	Texture features from T2 mapping of talar dome cartilage in normal volunteers and dancers
		Hon J. Yu[1], Saya Horiuchi[1], Alex Luk[1], Adam Rudd[1], Jimmy Ton[1], Edward Kuoy[1], Jeff Russell[2], Kelli Sharp[3], and Hiroshi Yoshioka[1]
		[1]Radiological Sciences, University of California, Irvine, CA, United States, [2]Science and Health in Artistic Performance, Ohio University, Athens, OH, United States, [3]Arts-Dance, University of California, Irvine, CA, United States

		This study demonstrates a feasibility of texture analysis based on T2 mapping of the talar-dome cartilage. Some of the investigated texture features showed statistically significant differences between healthy volunteers and ballet dancers that are regional in nature and also very much dependent on how the spatial distribution of T2 pixels is defined during calculation of texture features. More conventional analytic approach, such as comparison based on cartilage-averaged T2 value, failed to show any difference between the groups. The results in this study demonstrate an alternative analytical approach based on texture features as surrogate variables for the evaluation of cartilage properties.

5056	Computer 72	Improved 3D T1rho and T2 Mapping with Synovial Fluid Suppression for the Knee Cartilage on 3T
		Qi Peng[1], Can Wu[2], Xiaojuan Li[3], and Karen Sperling[1]
		[1]Department of Radiology, Albert Einstein College of Medicine and Montefiore Medical Center, Bronx, NY, United States, [2]Philips Healthcare, Gainesville, FL, United States, [3]Department of Biomedical Engineering, Cleveland Clinic, Cleveland, OH, United States
		T1rho and T2 values of synovial fluid are more than twenty times larger than those of the normal cartilage tissue at 3T. The potential signal contamination originated from synovial fluid within the joints adjacent to the concerned articular cartilage could be a major source of errors associated with current T1rho and T2 mapping sequences in clinical research. In this study, we presented a long-T2-selective suppression module to null synovial fluid signal while preserve cartilage signal for acquisition. Its performance in 3D continuous-wave T1rho, adiabatic T1rho, and T2 mapping sequences was evaluated in phantom and human studies.

Electronic Poster

MSK: Muscle 1

Exhibition Hall	Wednesday 16:15 - 17:15

5057	Computer 73	Evaluation of Resting-State BOLD MRI of Calf Muscles in Healthy Volunteers and Patients with Peripheral Arterial Disease
		Shiteng Suo[1], Qing Lu[1], Lan Zhang[2], Hui Tang[1], Qihong Ni[2], Suqin Li[1], Haimin Mao[1], Xiangyu Liu[1], Jianxun Qu[3], and Jianrong Xu[1]
		[1]Department of Radiology, Renji Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai, China, [2]Department of Vascular Surgery, Renji Hospital, School of Medicine, Shanghai Jiao Tong University, Shanghai, China, [3]GE Healthcare China, Shanghai, China

		BOLD MRI is a helpful imaging modality for assessing tissue oxygenation/perfusion characteristics in skeletal muscles. However, few studies have explored the utility of resting-state BOLD MRI in healthy subjects and patients with peripheral arterial disease (PAD). We conducted this study aimed at addressing this question, and results showed that (1) T2* was found to be independent of age factor in calf muscles; (2) T2* was useful for differentiating PAD patients with age-matched older healthy subjects, as well as mild-to-moderate PAD patients with severe ones; and (3) T2* correlated well with ankle-brachial index in PAD patients.

5058	Computer 74	Comparison thigh skeletal muscles between snowboarding halfpipe athletes and healthy volunteers by using quantitative multi-parameter MR imaging at rest
		Shinong Pan[1], He Sun[1], Mengtao Xu[2], Xiaoqi Wang[3], Menghu Wang[2], Baoheng Wang[2], and Fengzhe Wang[1]
		[1]Radiology, Shengjing Hospital of China Medical University, Shenyang, China, [2]Shenyang Sport University, Shenyang, China, [3]Philips Healthcare, Beijing, China
		To quantitatively investigate thigh skeletal muscles difference between snowboarding halfpipe athletes and healthy volunteers via MRI.

5059	Computer 75	Decreasing Water T2 based on multi-TE single-voxel MRS in fatty infiltrated skeletal muscles of patients with neuromuscular diseases
		Sarah Schlaeger[1,2], Dominik Weidlich[1], Elisabeth Klupp[2], Federica Montagnese[3], Marcus Deschauer[4], Benedikt Schoser[3], Sarah Bublitz[4], Claus Zimmer[2], Ernst J. Rummeny[1], Jan S. Kirschke[2], and Dimitrios C. Karampinos[1]
		[1]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Department of Diagnostic and Interventional Neuroradiology, Technical University of Munich, Munich, Germany, [3]Friedrich-Baur-Institut, Ludwig Maximilian University, Munich, Germany, [4]Department of Neurology, Technical University of Munich, Munich, Germany
		Quantitative imaging techniques are emerging in the field of magnetic resonance imaging of neuromuscular diseases. Water T2 and proton density fat fraction are the most important imaging markers to assess edematous and fatty transformation in the patients' muscle tissue. To validate the accuracy of quantitative methods ^{1}H magnetic resonance spectroscopy can be used as a reference standard. The present study investigates water T2 of remaining muscle tissue in regions of higher proton density fat fraction in 42 patients with various neuromuscular diseases using multi-TE single-voxel MRS.

5060	Computer 76	Effectiveness of Diffusion-Tensor Imaging adapted to chemical-shift-encoded water-fat MRI in dystrophic skeletal muscle

		Sarah Keller[1], Zhiyue J. Wang[2], Annette Aigner[3], Amir Golsari[4], Hendrik Kooijman[5], Gerhard Adam[6], and Jin Yamamura[6]
		[1]Diagnostic and Interventional Radiology and Nuclear Medicine, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [2]Childrens' Medical Center Dallas, Dallas, TX, United States, [3]Medical Biometry and Epidemiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [4]Neurology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [5]MR Clinical Science, Philips Medical Systems, Hamburg, Germany, [6]University Medical Center Hamburg-Eppendorf, Hamburg, Germany
		Diffusion tensor imaging of the skeletal muscle has been successfully applied in various conditions such as inflammation, age, and trauma. However it remains challenging in dystrophic skeletal muscle as reliable acquisition of tensor metrics is hampered due to fatty infiltration. This study aimed to assess the effectiveness of a simple clinical approach on region-of-interest localization choosing either a custom, whole muscle ROI or a selective ROI excluding areas of fatty replacement. The effect of ROI localization on tensor metrics was calculated based on mixed effect models.

5061	Computer 77	Do MR biomarkers for muscular fat infiltration and atrophy correlate with functionality and the DMPK CTG repeat length in myotonic dystrophy type 1?
		Linda Heskamp[1], Marlies van Nimwegen[2], Guillaume Bassez[3], Cecilia Jimenez-Moreno[4], Marieke Ploegmakers[1], Jean-Francois Deux[5], Grainne Gorman[6], Darren Monckton[7], Baziel van Engelen[2], and Arend Heerschap[1]
		[1]Radiology and Nuclear Medicine, Radboud university medical center, Nijmegen, Netherlands, [2]Neurology, Radboud university medical center, Nijmegen, Netherlands, [3]Neuromuscular Reference Center, Henri Mondor university Hospital, Paris, France, [4]Institute of Genetic Medicine, Newcastle University, Newcastle upon Tyne, United Kingdom, [5]Radiology, Henri Mondor university Hospital, Paris, France, [6]Institute for Ageing and Health, Newcastle University, Newcastle upon Tyne, United Kingdom, [7]Institute of Molecular, Cell and System Biology, College of Medical, Veterinary and Life Sciences, University of Glasgow, Glasgow, United Kingdom
		Quantitative MRI provides objective non-invasive biomarkers for muscle pathology in muscular dystrophy disorders. In this work we show that MR biomarkers for muscular fat infiltration and atrophy accurately reflect clinical outcomes for disease severity and physical capacity in myotonic dystrophy type 1 (DM1) patients. Furthermore, we found that 37% of the variation in fat infiltration in DM1 patients was explained by age. Interestingly, an additional 9.7% of the variation in fat infiltration was associated with the over life time increase in the *DMPK* CTG repeat length, i.e. the genetic defect causing DM1.

5062	Computer 78	Reproducibility of Diffusion Tensor Imaging (DTI) in the hamstrings of healthy athletes
		Jithsa R. Monte[1], Melissa T. Hooijmans[1], Martijn Froeling[2], Jos Oudeman[2], Johannes L. Tol[1], Mario Maas[1], Gustav J. Strijkers[1], and Aart J. Nederveen[1]

		[1]Radiology & Nuclear Medicine, Academic Medical Center, Amsterdam, Netherlands, [2]University Medical Center Utrecht, Utrecht, Netherlands
		Muscle injuries are diagnosed using T2-weighted scans, but these techniques lack specificity for assessing tissue repair. DTI seems more suitable for this purpose, but reproducibility data is lacking. Therefore, the aim of this study was to determine the reproducibility of DTI, expressed as the within subject CV per DTI parameter in the hamstrings of healthy athletes. The wsCV values reported here for DTI parameters are superior or similar to previously reported wsCV. In conclusion, our protocol allows us to perform DTI on both upper legs simultaneously with an overall high SNR and high reproducibility.

5063	Computer 79	Combined accelerated 4D Phase Contrast and 3D Diffusion Tensor Imaging reveals a complex relation between strain and muscle architecture in contracting leg muscles
		Valentina Mazzoli[1,2,3], Martijn Froeling[4], Lukas M Gottwald[1], Nico Verdonschot[3], Melissa T Hooijmans[1], Aart J Nederveen[1], and Gustav J Strijkers[2,5]
		[1]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands, [2]Biomedical NMR, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands, [3]Orthopaedic Research Laboratory, Radboud UMC, Nijmegen, Netherlands, [4]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [5]Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands
		Skeletal muscles are geometrically complex 3D structures, and cannot be fully characterized by 2D imaging. Therefore, a complete understanding of mechanisms of force transmission and strain development in relation to muscle architecture during contraction requires a 3D approach. We measured strain rate in the lower leg using a 4D accelerated Phase Contrast protocol and 3D muscle architecture with DTI. Our 3D strain rate data revealed a planar pattern, with one negative and one positive strain rate eigenvalue. Strain rate data combined with 3D muscle architecture, suggested a complex and heterogeneous behavior of strain development during muscle contraction.

5064	Computer 80	Modeling skeletal muscle perfusion through application of the continuous time random walk model to diffusion-weighted images
		David Reiter[1,2], Fatemeh Adelnia[2], Donnie Cameron[3], Christopher Bergeron[2], Richard G. Spencer[2], and Luigi Ferrucci[2]
		[1]Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States, [2]National Institute on Aging, Baltimore, MD, United States, [3]Clinical Magnetic Resonance Physics, University of East Anglia, Norwich, United Kingdom

		The continuous time random walk (CTRW) model provides a flexible framework for representing complex diffusive processes, allowing for smooth interpolation between sub- and super-diffusion. This work presents supporting arguments for the application of the CTRW model to the measurement of skeletal muscle perfusion. We present model fit parameters from DW images of human skeletal muscle and compare estimates of intravascular volume fraction with previously reported values obtained using intravital microscopy.

5065	Computer 81	Effectiveness of fatty fraction by high-speed T2-corrected multi-echo SVS (HISTO) and multi-echo 3D DIXON (mDIXON) in rapid and robust acquisition for Duchenne Muscular Dystrophy
		Xiaolei Zhu[1], Guijin Li[2], and Zhiyong Li[3]
		[1]MR SMK, Siemens Healthcare, NE Asia, Guangzhou, China, [2]CS App, Siemens healthcare, NE Asia, Guangzhou, China, [3]Department of Radiology, Shenzhen Children Hospital, Shenzhen, China
		The purpose of this study is to assess a potential fat quantitative technique in Duchenne muscular dystrophy (DMD), one of High-Speed T2-corrected multi echo (HISTO) acquisition with multi echo MRS, which is a rapid way in quantifying fatty content of pelvic and thigh muscles with confound effect, and then a rapid multi echo 3D Dixon technique was performed with multi peak fitted and R2* correction method to further evaluated the un-confounded fat fraction and the region of fat content in muscles. Proposed protocol was used to quantify the accuracy of fat fraction in DMD patients; both of measurements demonstrate strong consistency in fat quantification.

5066	Computer 82	Quantitative water T2 mapping and 31P NMR spectroscopy to evaluate disease progression and activity in GNE myopathy patients
		Harmen Reyngoudt[1,2], Julien Le Louër[1,2], Ericky CA Araujo[1,2], Benjamin Marty[1,2], Pierre-Yves Baudin[3], Jean-Yves Hogrel[4], Teresa Gidaro[5], Laurent Servais[5], and Pierre G Carlier[1,2]
		[1]NMR Laboratory, Institute of Myology, Paris, France, [2]NMR Laboratory, CEA, DRF, IBFJ, MIRCen, Paris, France, [3]Consultants for Research in Imaging and Spectroscopy, Tournai, Belgium, [4]Neuromuscular Physiology Laboratory, Institute of Myology, Paris, France, [5]5 I-Motion, Research Centre for Pediatric Neuromuscular Diseases, Armand Trousseau Hospital, Paris, France
		GNE myopathy (GNEM) is a neuromuscular disorder, characterized by distal lower limb muscle atrophy known for the relative preservation of quadriceps muscles. Quantitative NMRI including fat fraction and water T_2 mapping as well as ^{31}P NMRS were performed in 10 GNEM patients and controls. In contrast to functional and strength tests, qNMRI and ^{31}P NMRS could detect significant changes in FF and ^{31}P NMRS indices such as pH over the course of 1 year. More interestingly, we could also demonstrate highly significant correlations between water T_2 and the rate of transformation of muscle tissue into fat, demonstrating the strength of water T_2 as an indicator of disease activity.

5067	Computer 83	Skeletal muscle tissue characterization of Duchenne muscular dystrophy patients by 1H- and 23Na-MRI
		Teresa Gerhalter[1,2], Lena V. Gast[2], Benjamin Marty[1], Regina Trollmann [3], Sophia Rügner [3], Stephanie Schüssler[3], Frank Roemer[2], Frederik B. Laun[2], Michael Uder[2], Pierre G. Carlier[1], and Armin M. Nagel[2]
		[1]NMR Laboratory, Institute of Myology, Paris, France, [2]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany, [3]Department of Pediatrics, Division Neuropediatrics, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany
		Duchenne muscular dystrophy (DMD) is a hereditary neuromuscular disease leading to progressive muscle wasting. As there is a need to identify NMR variables as potential early sensitive indicators of dystrophic muscle response to treatment, we evaluated the sensitivity of ^{23}Na NMR in DMD in comparison to the commonly used water T2 and fat fraction. Sodium anomalies seemed to be systematically present and precede water T2 increases and fatty degenerative changes, also in muscles that were relatively spared. Although still limited in the small number of subjects, the data supports that ^{23}Na could be used to characterize early dystrophic muscle alteration.

5068	Computer 84	Assessment for Lumbar Paraspinal Muscle Activation Before and After Exercises Using BOLD and T2-Mapping Imaging
		Bo He[1], Yilong Huang[1], Jialong Zhou[1], Wei Zhao[1], Dan Han[1], and Weibo Chen[2]
		[1]Department of Medical Imaging,the First Affiliated Hospital of Kunming Medical University Yunnan, Kunming, China, [2]Philips Healthcare, Shanghai, China
		BOLD and T2-mapping might serve as noninvasive methods to evaluate the muscle activation of paraspinal muscles, thus providing deeper insights into muscle physiology. This has made possible the evaluation of the efficacy of early clinical exercise therapy for patients with lower-back pain.

5069	Computer 85	Rapid Measurement of ATP Kinetics in Human Skeletal Muscle at 7T
		Jimin Ren[1,2], A. Dean Sherry[1,2,3], and Craig R. Malloy[1,2,4]
		[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Department of Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Department of Chemistry, University of Texas at Dallas, Richardson, TX, United States, [4]VA North Texas Health Care System, Dallas, TX, United States

		Measuring ATP energy metabolism in human subjects by conventional 31P saturation transfer (ST) is challenging because of multiple competing metabolic pathways, high SAR, and artifacts caused by the prolonged B1-saturation pulses. EKIT (exchange kinetics by inversion transfer) allows magnetization transfer (MT) to evolve in the absence of B1 pulsing and multiple pathways can be probed by inverting all spins individually, but the process is time consuming and MT effects are small. A multi-module EBIT technique (exchange kinetics by band inversion transfer) addresses these issues and provides a comprehensive picture of ATP kinetics in human skeletal muscle.

5070	Computer 86	Semi-automatic segmentation of individual muscles in MR images: A new tool dedicated to the follow-up of patients with neuromuscular disorders
		Augustin C Ogier[1,2], Linda Heskamp[3], Alexandre Fouré[2], Marc-Emmanuel Bellemare[1], Arnaud Le Troter[2], Arend Heerschap[3], and David Bendahan[2]
		[1]Aix Marseille Univ, Université de Toulon, CNRS, ENSAM, LSIS, UMR 7296, Marseille, France, [2]Aix Marseille Univ, CNRS, Centre de Résonance Magnétique Biologique et Médicale (CRMBM), UMR 7339, Marseille, France, [3]Department of Radiology and Nuclear Medicine, Radboud university medical center, Nijmegen, Netherlands
		Quantitative magnetic resonance imaging can monitor intramuscular fat accumulation and has proven value for follow-up and therapy evaluation of neuromuscular disease. So far, segmentation processes of individual muscles from quantitative MRI data have been recognized as challenging in healthy subjects and even more challenging in patients for whom borders between muscles can be compromised by the disease process. We designed a semi-automatic segmentation pipeline of individual leg muscles in MR images based on automatic propagation of a minimal number of manually segmented MR slices. This segmentation pipeline allows an accurate follow-up of any MRI biomarkers in neuromuscular disorders.

5071	Computer 87	How reliable is DTI of the lower extremity muscles at high-field (3T) and ultra-high-field (7T) MRI?
		Chiara Giraudo[1], Stanislav Motyka[1], Michael Weber[1], Thorsten Feiweier[2], Siegfried Trattnig[1], and Wolfgang Bogner[1]
		[1]High Field MR Center, Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [2]Siemens Healthcare GmbH, Erlangen, Germany
		The feasibility of DTI at 7T was already demonstrated for brain and muscles but, to date, the assessment of its reliability for calf muscles and a comparison with the reliability at 3T were still missing.Our results showed excellent ICCs(>.750) at 7T and 3T mainly for single muscles(e.g.,gastrocnemii's tracks number).The comparison of absolute differences of the two consecutive measurements with each device demonstrated similar variability except for tracks' number of the whole-calf(lower absolute difference at 7T;p=0.034) and FA of the gastrocnemius lateralis(lower absolute difference at 3T;p=0.032).Larger studies should further assess the overall performance of 7T for specific healthy and injured muscles.

5072	Computer 88	SVD Compression for Quantification of 31P Relaxation Time and Creatine Kinase Reaction Rate by 31P Magnetic Resonance Fingerprinting
		Yuning Gu[1], Mingrui Yang[2], Charlie Y. Wang[1], Debra F. McGivney[2], Mark A. Griswold[2], and Xin Yu[1,2,3]
		[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States, [3]Department of Physiology and Biophysics, Case Western Reserve University, Cleveland, OH, United States
		Magnetic resonance fingerprinting (MRF) provides the opportunity for efficient quantification of ATP synthesis using ^{31}P magnetization transfer (MT) spectroscopy. However, the multi-compartment, multi-parametric nature of ^{31}P MT experiments renders dictionary-matching computationally infeasible. In this study, singular value decomposition was employed for parameter estimation in a ^{31}P MRF study that quantified creatine kinase activity. Such approach allowed dictionary compression by 16 fold and accelerated parameter matching by up to 80% without compromising matching accuracy. In vivo experiments on rat hindlimb (N=21) showed a 2.7-fold increase in measurement efficiency comparing to the conventional MT method using saturation transfer.

5073	Computer 89	Exercise-induced muscle hypoxia and re-oxygenation in the calf: A comparison between Near Infra-Red Spectroscopy (NIRS) and BOLD MRI
		Christopher C Conlin[1], Jiawei Dong[1], Stephen Decker[2], Gwenael Layec[2], Vivian S Lee[1], and Jeff L Zhang[1]
		[1]Department of Radiology and Imaging Sciences, University of Utah School of Medicine, Salt Lake City, UT, United States, [2]Division of Geriatrics, University of Utah School of Medicine, Salt Lake City, UT, United States
		This study compared calf-muscle oxygenation measurements from BOLD MRI and near-infrared spectroscopy (NIRS) in a group of healthy subjects after plantar-flexion exercise. NIRS measurement of deoxyhemoglobin (dHb) was limited to the medial gastrocnemius, while BOLD imaging allowed for R2* mapping of the entire calf. Post-exercise R2* recovery dynamics in the calf indicated significant functional differences between different calf muscle groups. This advantage of BOLD makes it potentially valuable for assessing peripheral arterial disease (PAD), where impairment of muscle function can vary depending on the location of upstream stenosis.

5074	Computer 90	Repeatability and Reproducibility of Diffusion Tensor MRI and 2-Point Dixon Fat Fraction Measurements in the Muscle
		Matthew Farrow[1,2], Ai Lyn Tan[1,2], Maya Buch[1,2], Paul Emery[1,2], Andrew Grainger[2], Steven Tanner[2], and John Biglands[2]

		[1]*Leeds Institute of Rheumatic and Musculoskeletal Medicine, University of Leeds, Leeds, United Kingdom,* [2]*NIHR Leeds Biomedical Research Centre, Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom*
		Muscle deterioration is associated with fat infiltration and alterations in muscle fibre architecture. Quantitative MRI measurements may be able to detect subtle muscle changes. However, before these can be considered for research and clinical use, the repeatability and reproducibility of these measurements must be established. 19 healthy participants had two scans separated by 30 minutes and diffusion and fat fraction measurements were obtained in the thigh. Test-retest repeatability, intra-rater repeatability and inter-rater reproducibility were assessed. Both diffusion and fat fraction measurements showed excellent repeatability and reproducibility suggesting that these measurements may be sufficiently precise to allow the study of subtle changes in muscle.

5075	Computer 91	Skeletal muscle acetylcarnitine in fasting and postprandial state: 1H MRS 7T pilot study.
		Radka Klepochová[1,2], Martin Gajdošík[1,2,3,4], Siegfried Trattnig[1,2], Michael Krebs[3], and Martin Krššák[1,2,3]
		[1]*High-Field MR Center, Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria,* [2]*Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria,* [3]*Division of Endocrinology and Metabolism, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria,* [4]*Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York City, NY, United States*
		Acetylcarnitine plays an important role in fat metabolism. A long TE proton magnetic resonance spectroscopy was applied for detection of skeletal muscle acetylcarnitine during the day in fasting and postprandial conditions at whole body 7T MRsystem in the vastus lateralis muscle. Our observation points towards big variations of acetylcarnitine in postprandial state and no significant changes in acetylcarnitine concentrations during the fasting. Moreover, excellent repeatability of the acetylcarnitine 1H MRS based measurement was estimated during three different days in three weeks. Our data emphasize the need for strict standardization of dietary conditions and time point for the measurement of acetylcarnitine.

5076	Computer 92	Muscle specific role of acetylcarnitine concentration and IMCL accumulation as a marker for long term glycemic control: 3T 1H MRS study
		Radka Klepochová[1,2], Magdalena Bastian[3], Michael Krebs[3], Siegfried Trattnig[1,2], Alexandra Kautzky-Willer[3], and Martin Krššák[1,2,3]
		[1]*High-Field MR Center, Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria,* [2]*Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria,* [3]*Division of Endocrinology and Metabolism, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria*

		Acetylcarnitine can be observed non-invasively in 1H MRspectra in skeletal muscle and its inverse relationship to intramyocellular lipids and metabolic markers of chronic hyperglycemia was suggested. This study aimed to compare the acetylcarnitine concentrations and intramyocellular lipids content in tibialis anterior and soleus of four different groups of volunteers with broad range of glycemic control by 1HMRS on 3Tscanner. Differences in the patient phenotype were mirrored by increased intramyocellular lipids in the tibialis anterior and decreased acetylcarnitine in soleus of type2diabetes patients. This muscle specific behavior of intramyocellular metabolites could represent different fiber composition in examined muscles.

5077	Computer 93	Drug efficacy monitoring using magnetic resonance imaging in a cancer cachexia model
		Ho-jin Kim[1], Sun Kyu Park[2], Jeom Yong Kim[2], Chul-Woong Woo[3], Sang-Tae Kim[3], Kyung Won Kim[4], and Dong-Cheol Woo[5,6]
		[1]Department of Biomedical Sciences, Asan Institute for Life Sciences, Asan medical center, University of Ulsan College of Medicine, Seoul, Republic of Korea, [2]Green Cross WellBeing Coporation, Seongnam, Gyeonggi-do, Republic of Korea, [3]MR Core Laboratory, Asan Institute for Life Sciences, Asan medical center, Seoul, Republic of Korea, [4]Department of Radiology, Asan medical center, University of Ulsan College of Medicine, Seoul, Republic of Korea, [5]MR Core Laboratory, Asan Institute for Life Sciences, Asan medical center, University of Ulsan College of Medicine, Seoul, Republic of Korea, [6]Department of Convergence Medicine, Asan medical center, University of Ulsan College of Medicine, Seoul, Republic of Korea
		Most studies in the field of cachexia research show photographs and H&E-stained sections of hindlimb muscles to demonstrate changes in fat/muscle volume. However, these methods do not capture the global changes in fat/muscle volume in a cachexia model. In this study, we established a cachexia animal model induced by tumor and ant-cancer drug and examined the efficacy of an anticachexia drug by monitoring fat/muscle volume using magnetic resonance imaging (MRI). Our results illustrated that MRI is a useful tool for drug development owing to its ability to monitor fat/muscle volumes in the cachexia model.

5078	Computer 94	Intravoxel Inchoerent Motion MRI to Evaluate Post-Occlusive Reactive Hyperemia in Calf Muscles
		Alfonso Mastropietro[1], Simone Porcelli[1], Marcello Cadioli[2,3], Letizia Rasica[1,4], Elisa Scalco[1], Simonetta Gerevini[3], Mauro Marzorati[1], and Giovanna Rizzo[1]
		[1]Institute of Bioimaging and Molecular Physiology, Consiglio Nazionale delle Ricerche, Segrate, Italy, [2]Philips Healthcare, Monza, Italy, [3]Department of Neuroradiology, Ospedale San Raffaele, Milano, Italy, [4]Department of Biomedical Sciences for Health, Università degli Studi di Milano, Milano, Italy

		The main goal of this study was to evaluate changes of IVIM parameters related to muscle perfusion changes occurring in the calf of healthy subjects before, during and after transitory ischemia of lower limb. MRI acquisitions were performed on 11 healthy volunteers on a 3T scanner. IVIM was performed on the right calf before, during and after arterial occlusion. A slight redcution of D* and fD* was observed during ischemia whereas a significant increase of D*, fD* and D was observed during hyperemia. IVIM appears as a promising tool to evaluate muscle perfusion related parameters in ischemia/hyperemia.

5079	Computer 95	Anisotropy of water T2* in murine skeletal muscle at rest
		Aurea B. Martins-Bach[1,2], Ericky C. A. Araujo[1,2], and Pierre G. Carlier[1,2]
		[1]NMR Laboratory, Institute of Myology, Paris, France, [2]NMR laboratory, CEA/DRF/IBFJ/MIRCen, Paris, France
		Modelling ultra-short TE (UTE) signal decay allows the extraction of multiple T2* components, an interesting approach to evaluate collagen-rich tissues with short T2 values. UTE can be promising to assess skeletal muscle fibrosis, whose non-invasive evaluation is still challenging. There are, though, indications that muscle T2* during ischemia can change when altering muscle orientation in the static magnetic field. Here we showed that muscle T2* at rest is indeed sensitive to muscle positioning in B_0, with variable orientation-dependent changes in different muscles. We hypothesize that muscle structure might lead to orientation-dependent local susceptibility-induced B_0 gradients, resulting in anisotropy of water-T2*.

5080	Computer 96	Association of thigh muscle fat infiltration with isometric strength measurements based on chemical shift encoding-based water–fat MRI
		Thomas Baum[1], Sarah Schlaeger[1], Stephanie Inhuber[2], Florian Kreuzpointer[2], Michael Dieckmeyer[3], Friedemann Freitag[3], Elisabeth Klupp[1], Barbara Cervantes[3], Ansgar Schwirtz[2], Jan S Kirschke[1], and Dimitrios C Karampinos[3]
		[1]Department of Neuroradiology, Technical University of Munich, Munich, Germany, [2]Department of Sport and Health Sciences, Technical University of Munich, Munich, Germany, [3]Department of Radiology, Technical University of Munich, Munich, Germany
		Chemical shift encoding-based water–fat MRI derived proton density fat fraction (PDFF) of the thigh muscles has been emerging as surrogate marker in subjects with osteoarthritis, sarcopenia, and neuromuscular disorders. However, little is known about the relationship of thigh muscle PDFF and corresponding muscle strength measurements. The present study demonstrated that PDFF measurements improve the prediction of thigh muscle strength beyond muscle cross-sectional area in healthy subjects. Thus, chemical shift encoding-based water–fat MRI can provide clinically important information and may potentially track early changes in muscles that are not severely atrophied or fattily infiltrated.

Electronic Poster

Electrical Property Imaging

Exhibition Hall	Wednesday 17:15 - 18:15

5081	Computer 1	Electro-Magnetic Property Mapping Using Kalman Filtering with a Single Acquistion at 3.0 T and 7.0 T MRI
		Han-Jae Chung[1,2], Jong-Min Kim[1,2], You-Jin Jeong[1,2], Jeong-Hee Kim[3], Chulhyun Lee[4], and Chang-Hyun Oh[1,2]
		[1]Electronics and Information Engineering, Korea University, Seoul, Republic of Korea, [2]ICT Convergence Technology for Health and Safety, Korea University, Sejong, Republic of Korea, [3]Research Institute for Advanced Industrial Technology, Korea University, Sejong, Republic of Korea, [4]Korea Basic Science Institute, Cheongju, Chungbuk, Republic of Korea
		The phase-based Electro-Magnetic (EM) MR property imaging such as Quantitative Susceptibility Mapping (QSM) and MR Electric Properties Tomography (MREPT) shows great potential clinically. The main post-processing steps in QSM and MREPT are high-pass filtering and Laplacian of MR images. They, however, cause severe artifacts and noise during conventional calculations. In this work, we propose a novel reconstruction method of EM property MRI using Kalman filter algorithm and show the utility of the proposed method by comparing the imaging results.

5082	Computer 2	Development of Carbon Electrodes for Current Density Mapping during DBS
		Neeta Ashok Kumar[1], Munish Chauhan[1], and Rosalind Sadleir[1]
		[1]SBHSE, Arizona State University, Tempe, AZ, United States
		We used MR phase mapping techniques in a preclinical DBS model to image current distributions nearby deep brain stimulation electrodes. To avoid safety issues and artifacts associated with imaging typical platinum-iridium (Pt-Ir) DBS leads, we developed custom carbon electrodes. We compared carbon electrode performance to size-matched Pt-Ir and clinical DBS electrodes at 7 T, using uniform phantoms and fixed brain tissue. Artifacts surrounding carbon electrodes were smaller than for Pt-Ir electrodes. Current density distributions derived from phase images were similar for both electrode types in uniform phantoms and fixed tissue.

5083	Computer 3	In vivo Current Density and Conductivity Tensor Imaging of Human Brain During TACS using DT-MREIT
		Munish Chauhan[1], Aprinda Indahlastari[2], Aditya Kumar Kasinadhuni[3], Christopher Saar[1], Bakir Mousa[1], Kevin Castellano[4], Thomas H Mareci[4], and Rosalind J Sadleir[1]

		[1]SBHSE, Arizona State University, Tempe, AZ, United States, [2]Department of Clinical and Health Psychology, University of Florida, Gainesville, FL, United States, [3]GE Healthcare, Wausau, WI, United States, [4]Dept. of Biochemistry & Molecular Biology, University of Florida, Gainesville, FL, United States
		Knowledge of the electrical properties of brain tissue is key to developing better understanding of whole brain function. In this study, we present the first *in vivo* images of anisotropic conductivity distribution in the human head, measured at a frequency of ~10 Hz. We used MREIT techniques to encode phase changes caused by transcranial AC current flow (TACS) within the head via two independent electrode pairs. These results were then combined with DTI data to reconstruct full anisotropic conductivity distributions in 5 mm-thick slices of the brains of two participants. Conductivity values recovered in the study were broadly consistent with literature values.

5084	Computer 4	Sequences for transceive phase mapping: a comparison study and application to conductivity imaging
		Soraya Gavazzi[1], Stefano Mandija[2], Cornelis AT van den Berg[1,2], Yulia Shcherbakova[2], Mick Bennis[3], Jan JW Lagendijk[1], Lukas JA Stalpers[3], Hans Crezee[3], and Astrid LHMW van Lier[1]
		[1]Department of Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands, [2]Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [3]Department of Radiation Oncology, Academic Medical Center Amsterdam, Amsterdam, Netherlands
		Electrical properties imaging relies on accurate transceive phase determination. We explored the use of PLANET, an ellipse fitting approach on phase-cycled bSSFP data, for transceive phase mapping for the first time. We compared its accuracy, precision and time-efficiency with conventional SE and bSSFP techniques. Additionally, we reconstructed conductivity maps based on these techniques. We found that bSSFP and PLANET were as accurate as SE, but more precise. Also, bSSFP was the most time-efficient. Nevertheless, banding artefacts corrupting bSSFP transceive phase were, instead, intrinsically removed by PLANET. PLANET had clinically acceptable scan-time and was generally more suitable for conductivity mapping.

5085	Computer 5	Noninvasive Assessment of Electrical Conductivity Characteristics of Normal and Diseased Liver Using Electric Properties Tomography
		Khin Khin Tha[1,2], Ulrich Katscher[3], Kinya Ishizaka[4], Kohsuke Kudo[1,2], and Hiroki Shirato[2]
		[1]Department of Diagnostic and Interventional Radiology, Hokkaido University Hospital, Sapporo, Japan, [2]Global Station for Quantum Medical Science and Engineering, Hokkaido University, Sapporo, Japan, [3]Philips Research Laboratories, Hamburg, Germany, [4]Department of Radiological Technology, Hokkaido University Hospital, Sapporo, Japan

		The feasibility of Electric Properties Tomography (EPT) in distinguishing between the normal and diseased liver tissues was evaluated. A 2D steady state free precession sequence was used to acquire the RF transceive phase needed for a simplified version of EPT; and a total of 10 dynamic sagittal scans of the liver were obtained under single breath-hold, in 10 healthy volunteers and 11 patients with hepatic lesions. Despite the need of technical improvements, noninvasive electrical conductivity assessment of the liver by EPT was possible. Its potential utility in identifying hepatocellular carcinomas with intratumoral necrosis and/ or high vascularity was also shown.

5086	Computer 6	Diffusion Tensor Magnetic Resonance Electrical Impedance Tomography versus Magnetic Resonance Conductivity Tensor Imaging
		Mehdi Sadighi[1], Figen S. Oktem[1], and B. Murat Eyuboglu[1]
		[1]Electrical and Electronics Engineering, METU, Ankara, Turkey
		In this study, recently proposed diffusion tensor magnetic resonance electrical impedance tomography (DT-MREIT) is compared with magnetic resonance conductivity tensor imaging (MRCTI) using simulated measurements generated by means of a finite element model. Both methods are used to reconstruct conductivity tensor images of an anisotropic conductivity distribution. In DT-MREIT, extra cellular conductivity and diffusivity ratio (ECDR) is recovered from its transverse gradient. In MRCTI, the conductivity tensor is reconstructed from two current profiles by using anisotropic B_z sensitivity (AB_zS) method with a stronger regularization. Reconstructed conductivity images suggest that MRCTI provides better accuracy than DT-MREIT, at lower SNR levels.

5087	Computer 7	Transceive Phase Corrected Contrast Source Inversion-Electrical Properties Tomography
		Peter R.S. Stijnman[1], Stefano Mandija[1], Patrick S. Fuchs[2], Rob F. Remis[2], and Cornelis A.T. van den Berg[1]
		[1]Center for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [2]Circuits and Systems Group, Delft University of Technology, Delft, Delft, Netherlands
		Contrast Source Inversion Electrical Properties Tomography (CSI-EPT) is an integral-based method that aims to reconstruct tissue electrical properties through an iterative minimization procedure. This method requires complex $$$B_1^+$$$ data as input. In practice, however, the transmit phase cannot be measured in MRI-experiments. Only the transceive phase can be calculated from MR-measurements. In this work, the CSI-EPT reconstruction algorithm is reformulated to take the transceive phase into account. This transceive phase correction opens the possibility to exploit higher sensitivity of EPT at higher field strengths with regular quadrature setups. Additionally, for the first time CSI-EPT reconstructions from MR-measurements are shown.

5088	Computer 8	Evaluating Validity of MREPT Assumptions for 21.1 T
		Ghoncheh Amouzandeh[1,2], Jens T Rosenberg[2], Frederic Mentink-Vigier[2], Nastaren Abad[2,3], and Samuel Colles Grant[2,3]
		[1]Physics, Florida State University, Tallahassee, FL, United States, [2]Center for Interdisciplinary MR, National High Magnetic Field Laboratory, Tallahassee, FL, United States, [3]Chemical & Biomedical Engineering, Florida State University, Tallahassee, FL, United States
		This study examines conductivity mapping using MR Electrical Properties Tomography (MREPT) at ultra-high field (21.1 T). The accuracy of reconstructing conductivity using the complex B_1^+ field (Full-form) versus only the B_1^+ phase (Phase-based) is evaluated. Phantoms containing different NaCl concentrations were tested to compare these reconstructions with actual conductivities measured by dielectric probe at 900 MHz. Also, these methods were evaluated for experiments acquired with volume and surface coil configurations operated in either linear or quadrature transceiver. Conductivity maps of Full-form versus Phase-based MREPT from in vivo MCAO rats were acquired, with both providing similar variations across the ischemic brain.

5089	Computer 9	bSSFP Phase Correction and its use in MREPT
		Safa Ozdemir[1] and Yusuf Ziya Ider[1]
		[1]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey
		Balanced steady state free precision (bSSFP) has various advantages, namely high speed, high SNR, motion insensitivity and eddy current compensation. However, due to the B_0 inhomogeneity, the so called "banding artifact" occurs at certain frequency regions. In this paper, phase correction method for the bSSFP sequence is proposed utilizing B_0 and T_2 maps. As an application, acquired B_0 insensitive phase maps are used to obtain artifact-free conductivity maps.

5090	Computer 10	Implementation of Conductivity Tensor Imaging (CTI) using MRI
		Nitish Katoch[1], Bup Kyung Choi[1], Saurav ZK Sajib[1], Hyung Joong Kim[1], Oh In Kwon[2], and Eung Je Woo[1]
		[1]Biomedical Engineering, Kyung Hee University, Seoul, Republic of Korea, [2]Konkuk University, Seoul, Republic of Korea

		Electrical conductivity is a passive material property primarily determined by concentrations of charge carriers and their mobility. The macroscopic conductivity of biological tissue at low frequency may exhibit anisotropy related with its structural directionality. When expressed as a tensor and properly quantified, the conductivity tensor can provide diagnostic information of numerous diseases. Imaging of conductivity distributions inside the human body requires probing it by externally injecting conduction currents or inducing eddy currents. Here we propose a novel method to reconstruct conductivity tensor images using an MRI scanner without any current injection.

5091	Computer 11	A Fast and Dedicated First-Order Differencing EPT Reconstruction Method
		Patrick Stefan Fuchs[1], Stefano Mandija[2], Peter Stijnman[2], Wyger Brink[3], Cornelis van den Berg[2], and Rob Remis[1]
		[1]Circuits and Systems, Delft University of Technology, Delft, Netherlands, [2]Centre of Image Sciences, University Medical Centre Utrecht, Utrecht, Netherlands, [3]C.J. Gorter Center for High Field MRI, Leiden University Medical Center, Leiden, Netherlands
		A new method for reconstructing electrical properties from $$$B_1^+$$$ data based on Maxwell's equations in an E polarized field (found in the midplane of a birdcage coil) is presented. This first-order EPT (foEPT) method uses first order spatial derivatives as opposed to the second order Helmholtz based MR-EPT methods and is thus less susceptible to noise. Furthermore, the method does not rely on any homogeneity assumptions. The method is validated using an in-vivo phantom measurement and compared to an MR-EPT reconstruction. FoEPT conductivity reconstructions show less noise-amplification and less boundary artefacts compared to Helmholtz-based MR-EPT reconstructions.

5092	Computer 12	An Explicit Method for MR-Based Electrical Properties Reconstruction Free from Their Boundary Values
		Motofumi Fushimi[1] and Takaaki Nara[1]
		[1]The University of Tokyo, Tokyo, Japan
		This paper presents a new explicit reconstruction method for Magnetic Resonance Electrical Properties Tomography (MREPT) in a circular region of interest (ROI) that does not require EP values on the boundary of the ROI. Starting from the complex form of Maxwell's equations, we solved the D-bar equation of the electric field with the Neumann boundary condition. The proposed method reconstructs EPs successfully without giving any knowledge of EP values on the boundary of the ROI. To extend the method to, for example, a rectangular ROI, is our future work.

5093	Computer 13	LCF Artifact Elimination in cr-MREPT using Phased-Array Receive Coil
		Gulsah Yildiz[1] and Yusuf Ziya Ider[1]

		[1]*Electrical and Electronics Engineering Department, Bilkent University, Ankara, Turkey*
		Convection-reaction equation based MREPT (cr-MREPT)[1] conductivity images suffer from LCF artifact at low convective field (LCF) regions. Padding[2] method has been proposed to overcome this issue but it requires additional acquisition, prolonging the total time. In this paper, we propose using data from different channels of phased-array receive coil to eliminate LCF artifact without requiring extra acquisitions.

5094	Computer 14	Automated Seed Selection for Gradient-based Electrical Properties Tomography and Its in vivo Validation in the Brain
		Yicun Wang[1], Pierre-Francois Van de Moortele[2], and Bin He[1,3]
		[1]*Department of Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States,* [2]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States,* [3]*Institute for Engineering in Medicine, University of Minnesota, Minneapolis, MN, United States*
		Electrical Properties Tomography (EPT) retrieves tissue electrical conductivity and permittivity at Larmor frequency which potentially provides diagnostic information and facilitates subject-specific local SAR estimation. Gradient-based EPT (gEPT) significantly alleviates boundary artifact encountered by conventional EPT methods, yet its implementation requires subjective assignment of integration seed points. In this study, we developed an automated seed selection strategy based on locally calculated conductivity values, and evaluated the effect of seed number for human brain imaging. This new strategy was validated in eight healthy subjects to produce robust and accurate results, paving the path for an unbiased and fully-automated process for EP quantification.

5095	Computer 15	Global Maxwell Tomography with Match Regularization for accurate electrical properties extraction from noisy B1+ measurements
		Jose E.C. Serralles[1], Athanasios G. Polimeridis[2], Luca Daniel[1], Daniel K. Sodickson[3,4,5], and Riccardo Lattanzi[3,4,5]
		[1]*Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, United States,* [2]*Center for Computational and Data-Intensive Science and Engineering, Skolkovo Institute of Science and Technology, Moscow, Russian Federation,* [3]*Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States,* [4]*Bernard and Irene Schwartz Center for Biomedical Imaging (CBI), Department of Radiology, New York University School of Medicine, New York, NY, United States,* [5]*Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States*

		We introduce a new regularization approach, “Match Regularization”, and show that in tandem with Global Maxwell Tomography (GMT) it enables accurate, artifact-free volumetric estimation of electrical properties from noisy B1+ measurements. We demonstrated the new method for two numerical phantoms with completely different electrical properties distributions, using clinically feasible SNR levels. Estimated electrical properties were accurate throughout the volume for both phantoms. Our results suggest that GMT with match regularization is robust to noise and can be employed to map electrical properties in phantoms and in vivo experiments.

5096	Computer 16	In-vivo validation of water content Electrical Properties Tomography reconstructions in white matter using independent MR-EPT measurements
		Stefano Mandija[1], Petar I Petrov[2], Jord T Vink[2], Sebastian F.W. Neggers[2], Peter R. Luijten[1], and Cornelis A.T. van den Berg[1]
		[1]Center for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [2]Rudolf Magnus Institute for Neuroscience, UMC Utrecht, Utrecht, Netherlands
		MR-Electrical Properties Tomography (MR-EPT) can provide accurate mean conductivity values in large homogeneous tissues such as the white matter, provided sufficient erosion to avoid boundary regions. Water-content-EPT (wEPT) has been recently proposed to reconstruct EPs on a voxel-to-voxel basis. However, wEPT uses an empirical model calibrated with literature EPs values, assumed correct, obtained from *ex-vivo* probe measurements. In this work, the validity of the model employed in wEPT is verified for white matter conductivity reconstructions by using in the wEPT model calibration the mean white matter conductivity value obtained from *in-vivo* MR-EPT reconstructions as an independent modality.

5097	Computer 17	Error Analysis of Helmholtz-based MR-Electrical Properties Tomography
		Stefano Mandija[1], Alessandro Sbrizzi[1], Ulrich Katscher[2], Peter R. Luijten[1], and Cornelis A.C. van den Berg[1]
		[1]Center for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [2]Philips Research Laboratories, Hamburg, Germany
		The numerical error arising from the computation of spatial derivatives using finite difference kernels is investigated for Helmholtz-based MR-Electrical-Properties-Tomography conductivity reconstructions. We show that this numerical error is one major cause of limited accuracy in Helmholtz-based MR-EPT reconstructions, even if mitigation strategies such as Gibbs ringing correction and Gaussian apodization in k-space are adopted. Ultimately, large derivative kernels lead to more noise-robust conductivity reconstructions, at the cost of more spatially-extended boundary errors. If boundaries are not explicitly taken into account during reconstructions, the accuracy of MR-EPT is severely hampered, particularly for spatially convoluted tissues such as the human brain.

5098	Computer 18	Spatial resolution of Full cr-MREPT: 2D and 3D evaluation
		Yusuf Ziya Ider[1], Celik Boga[1], and Gulsah Yildiz[1]
		[1]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey
		Determining the spatial resolution (SR) of Magnetic Resonance Electrical Property Tomography (MREPT) is important for assessing its utility in clinical applications. This study aims at finding the SR of Full cr-MREPT which yields images without internal boundary artifact. It is shown by simulations and experimental results that SR in general is determined by the resolution of the MR data. With noise-free simulation data SR is 2-2.5 pixels. With noisy and real data it may go up to 4-4.5 pixels due to Low Pass filtering and regularization. SR appears to be equal in all three directions.

5099	Computer 19	A Dictionary-Based Method for Conductivity Tensor Mapping
		Kathleen M. Ropella-Panagis[1], Scott J. Peltier[1,2], and Douglas C. Noll[1]
		[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Functional MRI Laboratory, University of Michigan, Ann Arbor, MI, United States
		Measuring conductivity tensors provides an additional layer of information as to how tissues in the body conduct electric current. Tissues with anisotropic conductivity values may include white matter tracts and muscle. Measurement of the tensor requires the object to rotate with respect to the main magnetic field of the MRI scanner, but the degree of rotation is severely limited in human subjects. We propose a dictionary-based approach that provides an estimate of the tensor given small rotation angles of the object.

5100	Computer 20	In Vitro Imaging of Therapeutic Effect of Curcumin on Liver Cirrhosis using MR-based Electrical Conductivity Imaging Method
		Bup Kyung Choi[1], Nitish Katoch[1], In Ok Ko[2], Ji Ae Park[2], Jin Woong Kim[3], Hyung Joong Kim[1], Oh In Kwon[4], and Eung Je Woo[1]
		[1]Biomedical Engineering, Kyung Hee University, Seoul, Republic of Korea, [2]Korea Institute of Radiological and Medical Sciences, Seoul, Republic of Korea, [3]Radiology, Chonnam National University Medical School, Gwangju, Republic of Korea, [4]Konkuk University, Seoul, Republic of Korea

		Curcumin has been used for the treatment of inflammatory diseases in oriental medicine, and its anti-inflammatory effect was recently reported. In this feasibility study, hepato-protective effect of curcumin was imaged in rat liver cirrhosis model, which was induced with dimethylnitrosamine (DMN). Magnetic resonance (MR)-based electrical conductivity imaging method was applied to evaluate tissue condition associated with protective effect. From electrical conductivity images, damaged liver tissues by DMN showed decreased conductivity than normal liver tissues. In contrast, cirrhotic tissues with curcumin treatment showed increased conductivity which was similar to normal tissue.

5101	Computer 21	Contrast source inversion global Maxwell tomography: a technique for electric properties MR imaging without phase information.
		Alessandro Arduino[1,2], Oriano Bottauscio[2], and Luca Zilberti[2]
		[1]Dipartimento Energia, Politecnico di Torino, Torino, Italy, [2]Metrologia per la qualità della vita, Istituto Nazionale di Ricerca Metrologica (INRiM), Torino, Italy
		The possibility to perform MR imaging of the electric properties relying only on the measurable magnitude of transmit sensitivity, without any hypothesis on its phase, is an extremely interesting task pursued by the scientific community in the last years. Here, the adoption of the contrast source inversion technique in the context of the global Maxwell tomography is proposed. The lack of phase information affect the numerical minimisation procedure by introducing local minima in the cost functional. The convergence of the method is restored by the adoption of multi-channel transmit coils, which can increase the data by measuring multiple transmit sensitivities.

5102	Computer 22	Dictionary-based Electric Properties Tomography for brain conductivity imaging
		Ulrich Katscher[1], Max Herrmann[1], Thomas Amthor[1], Christian Findeklee[1], and Mariya Doneva[1]
		[1]Philips Research Europe, Hamburg, Germany
		Electric Properties Tomography (EPT) derives tissue conductivity and permittivity according to the Helmholtz equation via the second derivative of the measured complex B1 map, or by iteratively solving the corresponding forward problem. This abstract presents a different type of EPT reconstruction: the measured B1 map is compared locally with entries of a dictionary, which are small B1 maps of a priori known electric properties. This "dictionary-based EPT" (db-EPT) could be able to solve the transceive phase problem as well as the boundary problem of EPT. This study demonstrates the feasibility of db-EPT by measuring brain conductivity of healthy volunteers.

5103	Computer 23	Evaluation of the Noise Behavior of Gradient-based vs. Helmholz-based Reconstruction of Electrical Properties Tomography in Simulation

		Yihe Hua[1], Ileana Hancu[1], Seung-Kyun Lee[2], Teck Beng Desmond Yeo[1], and Jiaen Liu[3]
		[1]GE Global Research, Niskayuna, NY, United States, [2]Department of Biomedical Engineering, Sungkyunkwan University, Seoul, Republic of Korea, [3]Laboratory of Functional and Molecular Imaging, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States
		Electrical properties tomography (EPT) is a promising technique that has the potential to generate high resolution images of tissue electrical properties in vivo. One limitation of EPT is its high sensitivity to noise in the measured data. In this study, a comparison was performed between the so-called gradient-based EPT (gEPT) algorithm and the Helmholtz-based EPT method in a simulation. The result suggests significantly improved performance using gEPT and provides useful insight into the noise behavior of various EPT algorithms for optimization of the algorithm design.

5104	Computer 24	Mapping the Brain's water content and low-frequency electrical properties through T1-weighted MRI imaging
		Cornelia Wenger[1], Catherine Tempel-Brami[2], Hadas Sara Hershkovich[2], Moshe Giladi[2], and Zeev Bomzon[2]
		[1]Novocure GmbH, Root, Switzerland, [2]Novocure, Haifa, Israel
		This study investigates the possibility to extend the water-content based electrical properties tomography (wEPT) technique to lower frequencies. The wEPT approach assumes that electrical properties (EP) of brain tissues can be estimated from water-content (WC) which is derived from two T1-weighted MRIs. Adapted wEPT model parameters were evaluated from ex-vivo measurements of calf brain tissue samples. We performed wEPT estimations in an in-vivo rat brain tumor model, followed by ex-vivo measurements of brain extracted samples. Results predict good correlation between WC ex-vivo measurements and in-vivo wEPT estimations. Yet, mapping EPs with wEPT at lower frequencies needs further investigation.

Electronic Poster

Advancements in CEST Methodology & Applications

Exhibition Hall	Wednesday 17:15 - 18:15

5105	Computer 25	Spin-lock Imaging of 3-o-Methyl-D Glucose (3oMG) in Brain Tumors
		Zhongliang Zu[1], Xiaoyu Jiang[1], Junzhong Xu[1], and John C Gore[1]

		[1]Radiology Department, Vanderbilt University, Nashville, TN, United States
		We evaluated the ability of spin-lock imaging to detect the uptake of 3-o-methyl-D-glucose (3oMG) in normal brain and brain tumors in animals. We used $$$\triangle R_{1\rho}^{diff}$$$ to isolate the contribution from only the injected agent. We found that $$$\triangle R_{1\rho}^{diff}$$$ in tumors increased rapidly after injection, whereas intact brain showed a gradual increase up to 1h. $$$\triangle R_{1\rho}^{diff}$$$ was significantly different between tumors and contralateral normal tissues

5106	Computer 26	Chemical Exchange Rotation Transfer imaging of Phosphocreatine in Muscle
		Zhongliang Zu[1], Eugene C Lin[1], Elizabeth A Louie[1], Xiaoyu Jiang[1], Christopher L Lankford[1], Bruce M Damon[1], Mark D Does[1], John C Gore[1], and Daniel F Gochberg[1]
		[1]Radiology Department, Vanderbilt University, Nashville, TN, United States
		CEST imaging of Creatine has been reported, whereas selective mapping of PCr in vivo has not been implemented. We found that CEST imaging of Creatine may be influenced by other molecules in muscle, but CERT imaging of PCr is more specific and thus should be a better indicator of changes of flux through the CK reaction.

5107	Computer 27	Chemical Exchange Saturation Transfer imaging of prostate cancer at 3T: Repeatability, and initial results of an acquisition and multi-pool analysis protocol
		Vincent Evans[1], Francisco Torrealdea[1], Marilena Rega[2], Mina Kim[3], Mrishta Brizmohun Appayya[1], Arash Latifoltojar[1], Shonit Punwani[1], Xavier Golay[3], and David Atkinson[1]
		[1]Centre for Medical Imaging, UCL, London, United Kingdom, [2]Institute of Nuclear Medicine, UCLH, London, United Kingdom, [3]Brain Repair and Rehabilitation, Institute of Neurology, UCL, London, United Kingdom
		An optimised acquisition and post-processing protocol for multi-pool Lorentzian analysis of CEST data in the prostate at 3T is described. The repeatability of the technique is evaluated in five healthy volunteers and the contrast observed between healthy tissue, TZ tumour and PZ tumour in two prostate cancer patients is evaluated.

5108	Computer 28	Toward CEST MRI of renal masses: protocol optimization and first preliminary data
		Shu Zhang[1], Bian Li[1], Joshua Greer[1,2], Ananth J Madhuranthakam[1,3], Jochen Keupp[4], Ivan E Dimitrov[3,5], Robert E Lenkinski[1,3], Ivan Pedrosa[1,3], and Elena Vinogradov[1,3]

		[1]Radiology Department, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Biomedical Engineering, University of Texas Dallas, Dallas, TX, United States, [3]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [4]Philips Research, Hamburg, Germany, [5]Philips Healthcare, Gainesville, FL, United States
		Chemical Exchange Saturation Transfer (CEST) MRI is emerging as a tool for the studies of human malignancy. However, the translation of CEST into a successful tool for renal cancer characterization has been slow and hampered by technical difficulties associated with body imaging, such as motion, contaminating lipid signals and increased B0 ingomogeneity. Here we optimize CEST protocol for characterization of renal masses and demonstrate CEST measurements are feasible in kidneys using combination of motion synchronization, post-processing registration and lipid artifact removal. In addition, first Renal Cell Carcinoma patient CEST-mDixon data is shown and imaging results are correlated with the pathology.

5109	Computer 29	APT-CEST post Gadolinium. Should it be avoided? Comparison of pre- & post-Gadolinium CEST on glioma at 3T.
		Francisco Torrealdea[1], Joe Hearle[2], Vincent Evans[1], Moritz Zaiss[3], Ana Carvalho[4], Anath Shankar[5], Harpreet Hyare[4], David Atkinson[1], Xavier Golay[4], Anna Barnes[4], and Marilena Rega[4]
		[1]Centre for Medical Imaging, UCL, london, United Kingdom, [2]Medical school, UCL, london, United Kingdom, [3]High Field Magnetic Resonance, Max Plank Institute, Tubinghen, United Kingdom, [4]Institute of Nuclear Medicine, UCLH, London, United Kingdom, [5]Teenage Cancer Unit, UCLH, london, United Kingdom
		This study compares APT-CEST between pre- and post-gadolinium in patients with gliomas at 3T, and evaluates the feasibility of performing CEST after administration of T1 contrast. The results of the study demonstrate that Gd administration does not significantly affect the quality of the APT-CEST image, encouraging the acquisition of CEST data, even after the administration of T1 contrast agents.

5110	Computer 30	Phase-locked CEST – Introducing dynamic B0-correction to gagCEST
		Johannes Windschuh[1], Moritz Zaiss[2], Jae-Seung Lee[1,3], Alexej Jerschow[3], and Ravinder Regatte[1]
		[1]Center of Biomedical Imaging, New York University Langone Health, New York, NY, United States, [2]Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Thuebingen, Germany, [3]Department of Chemistry, New York University, New York, NY, United States

		Even a small frequency drift of less than 1Hz/min of the MRI scanner can have a strong impact on gagCEST measurements. We propose a dynamic B_0-correction that tracks the frequency shift using the phase images provided by the GRE readout. We show that this correction eliminates the influence of the frequency drift on gagCEST without the need of additional measurement time allowing higher accuracy, reproducibility, and comparability of gagCEST studies.

5111	Computer 31	Accelerating CEST with Patch-based Global Orthogonal Dictionary Learning
		Huajun She[1], Xinzeng Wang[1], Shu Zhang[1], Ece Ercan[1], Jochen Keupp[2], Anath Madhuranthakam[1,3], Ivan Dimitrov[1,4], Robert Lenkinski[1,3], and Elena Vinogradov[1,3]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Philips Research, Hamburg, Germany, [3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [4]Philips Healthcare, Gainesville, FL, United States
		This work investigates accelerating CEST imaging using patch-based global spatial-temporal dictionary learning (G-KSVD). We extend the dictionary learning for CEST acceleration. CEST data has high spatial-temporal correlation, so we can utilize the global Z-Spectrum information as well as the spatial information to form the global spatial-temporal dictionary. The dictionary is learned iteratively from overlapping patches of the dynamic image sequence along both the spatial and temporal directions. The proposed method performs better than the BCS and k-t FOCUSS methods for both phantom and in vivo brain data at high reduction factor of R=8.

5112	Computer 32	Accelerated CEST Imaging with Parallel Deep Convolutional Neural Networks
		Huajun She[1], Shu Zhang[1], Xinzeng Wang[1], Ece Ercan[1], Jochen Keupp[2], Anath Madhuranthakam[1,3], Ivan Dimitrov[1,4], Robert Lenkinski[1,3], and Elena Vinogradov[1,3]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Philips Research, Hamburg, Germany, [3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [4]Philips Healthcare, Gainesville, FL, United States
		CEST is a new contrast mechanism in MRI. However, a successful application of CEST is hampered by its slow acquisition. This work investigates accelerating CEST imaging using parallel convolutional neural networks (PCNN). We extend the Cascade-CNN into a multi-channel model and train the network establish a mapping from the multi-coil input to multi-coil output. This work is the first try to apply deep learning and convolutional neural networks technique in accelerating CEST imaging. The in vivo brain results show that the proposed method demonstrates a high quality reconstruction of the MTR_{asym} maps with different saturation pulses at R=4.

5113	Computer 33	Accelerating 3D CEST Imaging with Low Rank Sparse Reconstruction

Huajun She[1], Ece Ercan[1], Shu Zhang[1], Xinzeng Wang[1], Jochen Keupp[2], Anath Madhuranthakam[1,3], Ivan Dimitrov[1,4], Robert Lenkinski[1,3], and Elena Vinogradov[1,3]

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Chemical exchange saturation transfer (CEST) is a new contrast mechanism in MRI. However, a successful application of CEST is hampered by its slow acquisition especially in the 3D applications. Compressed sensing (CS) is powerful for reconstruction of highly undersampled data. This work implements the 3D pulsed steady-state CEST acquisition sequence and extended the low rank plus sparse (L+S) method to a 3D version. The phantom and in vivo human brain results demonstrate our design has the potential to accelerate the 3D CEST imaging about 4 times.

5114 Computer 34

Quantitative Magnetization Transfer Imaging in Murine Kidneys with Renal Artery Stenosis

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Quantitative magnetization transfer (qMT) imaging was used to measure bound water fraction in mouse kidneys with renal artery stenosis (RAS). MT-weighted images at variable offset frequencies and amplitudes, as well as B_0, B_1, and T_1 maps of control and RAS kidneys, were acquired. A two-pool qMT model was used to estimate the bound water fraction as well as other relaxation and exchange parameters. An increased bound water fraction was found in the cortex, outer medulla, and inner medulla of the RAS kidneys. In conclusion, qMT imaging offers potential new biomarkers for assessment of RAS kidneys.

5115 Computer 35

Assessing changes in kidney pH in acute kidney injury model using acidoCEST MRI

Atul Singh Minhas[1,2], Jack Sharkey[2], Edward A Randtke[3], Patricia Murray[2], Bettina Wilm[2], Mark "Marty" Pagel[4], and Harish Poptani[2]

[1]School of Engineering, Macquarie University, Sydney, Australia, [2]Centre for Pre-Clinical Imaging, University of Liverpool, Liverpool, United Kingdom, [3]Department of Medical Imaging, University of Arizona, Tucson, AZ, United States, [4]Department of Cancer System Imaging, MD Anderson Cancer Centre, Houston, TX, United States

		Kidneys are responsible for regulation of pH homeostasis, and cytotoxicity caused by cancer therapeutics can significantly alter renal function and homeostasis. Chemical exchange saturation transfer (acidoCEST) MRI has been proposed to measure tissue pH in-vivo using exogenous contrast agents. In this study, we used the acidoCEST technique to measure changes in kidney pH after acute kidney injury (AKI) in rodents. Typically, CT contrast agents such as Iopamidol (300 mg iodine/mL) are used as CEST contrast agent in acidoCEST MRI. However, the accuracy of acidoCEST using CT contrast agents relies on the delivery of the contrast agent to the target organ. To address this issue, we performed acidoCEST and FAIR-EPI based perfusion imaging to assess pH and blood flow changes in a mouse model of AKI. Results show that perfusion of kidneys affect pH measurements.

5116	Computer 36	Detection of the accumulation of mannitol in rat brains using CEST MRI
		Jing Liu[1], Chengyan Chu[1], Lin Chen[1], Jia Zhang[1], Rohit Kumar Srivatava[1,2], Piotr Walczak[1,2], Jiadi Xu[1], Peter van Zijl[1], Miroslaw Janowski[1,2], and Guanshu Liu[1]
		[1]Radiology, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Institute for Cell Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States
		Mannitol is a clinically widely-used osmotic agent. Accumulation of mannitol in the interstitium of the brain, however, can cause severe adverse effects. Here we used CEST MRI to detect mannitol directly through its inherently carried exchangeable hydroxyl protons. After comprehensively characterizing the CEST properties of mannitol in vitro, we demonstrated that the intra-arterial infusion of mannitol at an excess dose led to a significantly elevated CEST signal at 0.9 ppm, indicating that CEST MRI has great clinical potential to be used as a monitoring tool for mannitol treatment.

5117	Computer 37	Nuclear Overhauser enhancement effect of low $$$B_{1}$$$ power CEST RF in human brain at 3.0 T
		Yuki Kanazawa[1], Masafumi Harada[1], Mitsuharu Miyoshi[2], Ikuho Kosaka[3], Kotaro Baba[3], Hiroaki Hayashi[1], and Yuki Matsumoto[4]
		[1]Institute of Biomedical Sciences, Tokushima University Graduate School, Tokushima, Japan, [2]Global MR Applications and Workflow, GE Healthcare Japan, Hino, Japan, [3]School of Health Sciences, Tokushima University, Tokushima, Japan, [4]Graduate school of Health Science, Tokushima University, Tokushima, Japan
		The purpose of this study is to clarify the relationship between APT and NOE effects derived from CPE fitting of the human brain on a 3 T MR scanner. CEST imaging with different B_1 values of the brain was performed in healthy subjects. The mean NOE values of white matter at 0.5 μT were higher than all regions ($P < 0.05$). CPE-spectrum shows greater sensitivity for both APT and NOE peaks than conventional Z-spectrum and MTR_{asym}. It is found that NOE imaging on a 3.0 T scanner is sensitive on low-B_1 power regardless of the CEST fitting process.

5118	Computer 38	GluCEST MRI: Reproducibility, background contribution and source of glutamate changes in the MPTP mouse model of Parkinson's disease
		Puneet Bagga[1], Stephen Pickup[1], Dan Martinez[2], Rachelle Crescenzi[1], Ari Borthakur[1], Gaurav Verma[1], Joel Greenberg[3], John Detre[3], Hari Hariharan[1], and Ravinder Reddy[1]
		[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Children's Hospital of Philadelphia, Philadelphia, PA, United States, [3]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States
		Glutamate Chemical Exchange Saturation Transfer (GluCEST) MRI provides indirect detection of glutamate in vivo by measuring the exchange of glutamate amine protons with bulk water. The GluCEST contrast is potentially contaminated by a contribution of other metabolites exhibiting proton chemical exchange. We evaluated the reproducibility and background contamination to the GluCEST and source of the GluCEST changes in MPTP mouse model. Approximately 28% of GluCEST contrast appears to be derived from sources other than glutamate that are also not detectable by MRS. Glial proliferation caused by neuroinflammation was found to be the cause of elevated glutamate in mice exposed to MPTP.

5119	Computer 39	Toward Safer Monitoring of Glucose Transport in a Rat Brain Tumor Necrosis using 3-O-Methyl-Glucose Chemical Exchange-sensitive Spin-Lock Magnetic Resonance Imaging
		Julius Juhyun Chung[1,2], Moon-Sun Jang[3,4], Geun Ho Im[3,4], Wonmin Choi[1,5], Tao Jin[6], Seong-Gi Kim[1,2,5], and Jung Hee Lee[1,2,4,5]
		[1]Center for Neuroscience Imaging Research, Institute for Basic Science SKKU, Suwon, Republic of Korea, [2]Samsung Advanced Insitute for Health Sciences and Technology, SKKU, Seoul, Republic of Korea, [3]Center for Molecular and Cellular Imaging, Samsung Biomedical Research Institute, Seoul, Republic of Korea, [4]Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea, [5]Biomedical Engineering, Sungkyunkwan University, Suwon, Republic of Korea, [6]Radiology, University of Pittsburgh, Pittsburgh, PA, United States
		Glucose exchange-sensitive spin lock imaging has been shown to have promise in monitoring glucose uptake with reasonable sensitivity. There are design choices that can be made in such an experiment such as whether to use an analog for better sensitivity and how to establish an efficient spin-lock. We examine metabolic uptake of a rat brain tumor with necrosis using 3-O-methyl-glucose, a safer glucose analog than 2DG, and examine differences between using an adiabatic pulse and a paired self-compensated pulse with lower peak power. Both pulses demonstrated delayed uptake in the infarcted tumor region although with higher sensitivity using adiabatic pulses.

5120	Computer 40	Magnetization Transfer in Lipids - Role of Exchangeable Groups and Water Binding
		Weiqi Yang[1], Jae-Seung Lee[1], Johannes Windschuh[2], Maureen Leninger[1], Nate Traaseth[1], and Alexej Jerschow[1]

		[1]New York University, New York, NY, United States, [2]New York University, 10003, NY, United States
		We study the magnetization exchange mechanism in lipid systems, with relevance to imaging myelin via MT contrast. Studies of samples with different lipid compositions reveal exchange time scales, and the role of structural features in the contrast mechanism. Insights from molecular dynamics provide estimates of the contribution of the dipolar pool equilibration to the MT amplitude. The effect of lipid head groups, and the contribution of cholesterol and proteins are examined. It is hoped that these findings will help explaining the origin of White Matter MT contrast and will allow better myelin quantification by tailored saturation sequences.

5121	Computer 41	In vivo Kinetic CEST MRI of sodium salicylate(NaSA): Comparison of MTRasym and Subtraction of saturation-weighted images
		Yanrong Chen[1,2], Chengwang Jin[1,3], Yan Luo[4], Chongxue Bie[2], Yingcheng Zhao[2], Xiaowei He[2], and Xiaolei Song[1]
		[1]The Johns Hopkins University, Baltimore, MD, United States, [2]School of Information and Technology, Northwest University, Xi'an, China, [3]Medical Imaging, The First affiliated Hospital of Xian Jiaotong University, Xi'an, China, [4]Radiology Department Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China
		Salicylate analogues feature chemical shift far from water ($\Delta\omega$ = 8-10 ppm), however, there are almost no available reports on their *in vivo* detection of salicylate upon intravenous administration. We aim to optimize the *in vivo* detection of NaSA, by comparing compared MTRasym and a Dynamic Salicylate Enhancement (DSE). For the mice brain with LPS-induced inflammation, there are ~4% DSE signal which displays a clear kinetic trend. While MTRasm values are very small, oscillating between -2% to 0% due to the unsymetric MTC. In conclusion, our DSE method is able to track the dynamic signal changes following the infusion of NaSA.

5122	Computer 42	Assessment of a clinically feasible Bayesian fitting algorithm using a simplified description of Chemical Exchange Saturation Transfer (CEST) Imaging
		Aaron Kujawa[1], Mina Kim[1], Eleni Demetriou[1], Annasofia Anemone[2], Dario Longo[3], Moritz Zaiss[4], and Xavier Golay[1]
		[1]Brain Repair and Rehabilitation, University College London, London, United Kingdom, [2]Molecular Biotechnology and Health Sciences, University of Torino, Turin, Italy, [3]Institute of Biostructure and Bioimaging, University of Torino, Turin, Italy, [4]Magnetic Resonance Center, Max-Planck institute for biological cybernetics, Tübingen, Germany

		A Bayesian fitting algorithm was combined with analytical approximations of the Bloch-McConnell (BM) equations with the aim to considerably reduce processing time. The accuracy of the algorithm was assessed with simulated data and data from phantom experiments and compared to fit results obtained with the numerical solution of the BM equations. Continuous-wave and pulsed saturation was considered. The results showed agreement between estimates and ground truth as well as between the approximate analytical and numerical model implementations of the Bayesian algorithm. A considerable reduction of processing time was achieved.

5123	Computer 43	Including water nutation in an analytic solution for pulsed CEST
		Christopher Lynn Lankford[1], Zhongliang Zu[1,2], Elizabeth A Louie[1], Mark D Does[1,2,3,4], and Daniel F Gochberg[1,2,5]
		[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States, [3]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [4]Electrical Engineering, Vanderbilt University, Nashville, TN, United States, [5]Physics and Astronomy, Vanderbilt University, Nashville, TN, United States
		Pulsed chemical exchange saturation transfer (CEST) MRI lacks an analytical solution, impeding data analysis and optimization efforts. A recently proposed solution has mitigated this problem, but it ignores water pool nutation and is thus inaccurate near the water resonance frequency. This work proposes a solution that accounts for water nutation assuming a known flip angle function which can be numerically estimated with no *a priori* knowledge about tissue parameters. The nutation-corrected solution closely matches numerical Bloch-McConnell simulation, even near the water resonance frequency.

5124	Computer 44	Chemical exchange saturation transfer magnetic resonance imaging of functionalized poly(N, N'-methylene bisacrylamide 4-aminobutanol) gel
		Weiqiang Dou[1], Jos M.J. Paulusse[2], Heinz Peter Janke[3], Xiaolei Song[4], Jiadi Xu[4], J.W.M Bulte[4], and Arend Heerschap[1]
		[1]Radiology and Nuclear Medicine, Radboud University Medical Center, Nijmegen, Netherlands, [2]Biomaterials Science and Technology, University of Twente, Enschede, Netherlands, [3]Experimental Urology, Radboud University Medical Center, Nijmegen, Netherlands, [4]Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

		Poly (amido amine)s like poly(N, N'-methylene bisacrylamide 4-aminobutanol) (MBA-ABOL) are compounds with promising biomedical applications, which, however, require that they can be visualized without contrast application. In this study we investigated if they can be imaged in a "label free fashion" by CEST MRI making use of their exchangeable amide and hydroxyl protons. We systematically determined optimal conditions for CEST in MBA-ABOL in solution and then demonstrated that the material can be imaged both in vitro and ex vivo, implanted in a rat leg, with a strong CEST effect from the amide protons and substantial effect from the hydroxyl protons.

5125	Computer 45	Clinically Feasible Model-based Analysis of Amide Proton Transfer MRI in Acute Ischaemic Stroke
		Paula L. Croal[1], Yunus Msayib[1], Kevin J. Ray[2,3], James R. Larkin[2], Brad A. Sutherland[4,5], George Harston[4], Alistair Buchan[4], Peter Jezzard[3], James Kennedy[4], Nicola Sibson[2], and Michael Chappell[1]
		[1]Institute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom, [2]CRUK & MRC Oxford Institute for Radiation Oncology, University of Oxford, Oxford, United Kingdom, [3]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [4]Acute Stroke Programme, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [5]School of Medicine, Faculty of Health, University of Tasmania, Hobart, Australia
		Model-based analysis of CEST MRI is a robust quantitative method, however, the lengthy acquisition and processing times make it less clinically feasible. It has recently been proposed that partial acquisition of Z-spectra provides a faster approach, but at the cost of increased variability and large alterations in baseline Amide Proton Transfer (APT) effect. Here we present a refined approach, accounting for magnetisation transfer effects, which reduces acquisition and processing times and also decreases variability in the data. We demonstrate its ability to detect pathological reductions in the APT effect in both preclinical and clinical cohorts of acute ischaemic stroke respectively.

5126	Computer 46	Improved quantification of amide proton transfer effect with direct water saturation- and magnetization transfer-correction in a glioma rat model at 3 Tesla
		Yin Wu[1], Yinsheng Chen[2], Yiying Zhao[2], Shasha Yang[1], Jing Zhao[1], Zhongping Chen[2], and Phillip Zhe Sun[3]
		[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Neurosurgery, Cancer Center, Sun Yat-Sen University, Guangzhou, China, [3]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States

		Quantification of in vivo APT effect with routine asymmetry analysis is problematic due to concomitant contributions. Herein, a steady-state CEST signal solution was utilized to estimate direct water saturation (DWS) to improve Z-spectral quantification in a pulsed-RF CEST imaging. Specifically, APT effect was measured from the DWS and magnetization transfer (MT)-corrected CEST signals in glioma rat brains post-chemoradiotherapy at 3 Tesla. The proposed method revealed significant APT signal difference among regions of control (3.13±0.38%), necrosis (3.95±0.31%) and tumor (4.56±0.34%), consistent with histological observations and superior than routine asymmetry analysis.

5127	Computer 47	In-vivo Z-spectra acquisition with decreased direct saturation using adiabatic spin-lock pulses at 9.4T
		Kai Herz[1], Chirayu Gandhi[1], Klaus Scheffler[1,2], and Moritz Zaiss[1]
		[1]Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Department of Biomedical Magnetic Resonance, University of Tübingen, Tuebingen, Germany
		Off-resonant spin-lock imaging enables a lot of possibilities for $T_{1\rho}$ and chemical exchange (CE) sensitive applications. For this purpose, a matching amplitude of the tipping and the locking pulse is required, which can be difficult due to the high power requirements of adiabatic pulses. In this work, we present a newly shaped adiabatic half-passage pulse, usable at low power to match the amplitude of the pulses. Off- and on-resonant saturated images acquired at 9.4T are shown. The new pulse shape is able to generate robust images with comparatively low power at ultra-high-field strengths.

5128	Computer 48	Optimization of overlap-resolved CEST for specific mapping of Glutamate and GABA
		Frederico Severo[1] and Noam Shemesh[1]
		[1]Champalimaud Centre for the Unknown, Lisbon, Portugal
		Glutamate-CEST (GluCEST) has been recently emerging as a powerful new technique for mapping Glutamate in the brain. A recent development termed overlap-resolved CEST (orCEST) has demonstrated that other metabolites may contaminate GluCEST contrast, and proposed how to resolve the wanted signals; here we optimize orCEST contrast to reflect Glutamate and GABA with very high sensitivity and good specificity. orCEST experiments are optimized on metabolite phantoms, and then are applied in-vivo in the rat. The results are promising for neurotransmitter mapping in-vivo.

Electronic Poster

MSK: Muscle 2 & Other Original Research

Exhibition Hall	Wednesday 17:15 - 18:15

5129	Computer 49	Non-invasive Detection of NADH+NAD+ in Human Muscle Using 31P MR Spectroscopy at 3T Rajakumar Nagarajan[1], Miles Bartlett[2], Kwan-Jin Jung[1], Jane A Kent[2], and Nagendra Yadava[3,4,5] *[1]Human Magnetic Resonance Center, Institute for Applied Life Sciences, University of Massachusetts, Amherst, MA, United States, [2]Department of Kinesiology, UMass, Amherst, MA, United States, [3]Department of Biology, UMass, Amherst, MA, United States, [4]Pioneer Valley Life Sciences Institute (PVLSI), Springfiled, MA, United States, [5]Department of Medicine, University of Massachusetts Medical School (UMMS)-Baystate Regional Campus, Springfiled, MA, United States* NAD+ and NADH act as coenzymes in metabolic reactions. The reduction of NAD+ to NADH is linked with generation of ATP through glycolysis and oxidative phosphorylation. The consumption of NAD+ by various signaling proteins regulates protein modification, cell fate and survival. Therefore, NAD+ and NADH measurements have the potential to inform about tissue energetics and health. Recently, some investigators have suggested that NADH and NAD+ may be detected in human muscle using 31-phosphorus MRS. However, the utility and reliability of this measure is not clear. The goals of this project were to 1) determine whether the NADH+NAD peak can be resolved in human skeletal muscle at 3T, 2) compare peak resolution with and without a decoupling technique, and 3) evaluate the reliability of this measure. Interpretation of these data and their potential for studying alterations in NAD+ and NADH homeostasis in human muscle remain to be determined.

5130	Computer 50	Altered Microcirculation and Oxygenation of Skeletal muscle in Type 2 Diabetes Mellitus (T2DM) Rhesus Monkeys with Non-contrast MRI Perfusion and Oximetry Techniques Yushu Chen[1], Li Gong[2], Yu Zhang[1], Wen Zeng[2], Jie Zheng[3], and Fabao Fao[1,2] *[1]West China Hospital, Sichuan University, Sichuan 610041, China;, Chengdu, China, [2]Sichuan Primed Bio-Tech Group Co., Ltd., Chengdu, China, Chengdu, China, [3]Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri, USA, St. Louis, MO, United States* In this study, the altered microcirculation and oxygenation of skeletal muscle in T2DM rhesus monkeys were evaluated by non-contrast skeletal muscle MR perfusion and oximetry techniques. We found that the perfusion of skeletal muscle decreased, especially in fast-twitch fiber muscles, and with an air-cuff caused muscle hyperemia, the ability to reperfusion in slow-twitch muscle is higher than in fast-twitch muscle. The oxygen extraction fraction of skeletal muscle significantly increased in all skeletal muscle angiosomes. These results suggest the diverse adaptation of slow- and fast-twitch skeletal muscles to T2DM.

5131	Computer 51	OpenForce MR: A Low-Cost Open-Source MR-Compatible Force Sensor Francesco Santini[1,2], Oliver Bieri[1,2], and Xeni Deligianni[1,2]

		[1]Radiological Physics, University Hospital Basel, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland
		This work presents an open design for a low-cost (100 USD) MR-compatible force sensor to be used in the context of dynamic muscle MRI/MRS. The sensor is both based on commercial nonmagnetic components and custom manufactured parts. The electronics is realized using Arduino and a prototype software interface is presented. The sensor is calibrated using a commercial dynamometer and shows good linearity in the sensitivity. The setup is proven to function in an MR environment without disturbing the signal acquisition.

5132	Computer 52	Multi-Nuclei Functional Imaging of the Skeletal Muscle during Synchronized Electrical Stimulation: Interleaving 1H Velocity Mapping with 31P Spectroscopy
		Francesco Santini[1,2], Dirk Fischer[3], Oliver Bieri[1,2], and Xeni Deligianni[1,2]
		[1]Radiological Physics, University Hospital Basel, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland, [3]Neuro- and Developmental Pediatrics, University Children's Hospital Basel, Basel, Switzerland
		In this work, we present a novel multi-nuclei interleaved acquisition sequence that acquires three-directional phase contrast images and phosphorus spectra during muscle exercise. The sequence is combined with electrical muscle stimulation to achieve a comprehensive investigation method of the functionality of the skeletal muscle.

5133	Computer 53	Diffusion, perfusion, and T2 analyses of lower leg muscles after intermittent pneumatic compression
		Kento Furihata[1], Tosiaki Miyati[1], Naoki Ohno[1], Yuki Hiramatsu[1], Yurina Ohta[2], and Toshifumi Gabata[1]
		[1]Graduate School of Medical Sciences, Kanazawa University, Kanazawa, Japan, [2]School of health Sciences, College of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan
		Although the IPC supposedly changes regional muscle functions, this mechanism has not been clarified. Therefore, to quantitatively assess the effect of IPC, we simultaneously acquired functional information on diffusion, perfusion, and transverse relaxation time (T_2) for lower-leg muscles before and after IPC using single-shot diffusion echo-planar imaging (SSD-EPI) with different b-values and echo times (TE). IPC reduces water molecule diffusion in the soleus muscle. Our method makes it possible to simultaneously obtain regional functional information on diffusion, perfusion, and T_2 in lower-leg muscles before and after IPC.

5134	Computer 54	3D Fiber Aligned Strain Rate: Application to Unilateral Limb Suspension Induced Atrophy Usha Sinha[1], Vadim Malis[2], and Shantanu Sinha[3] *[1]Physics, San Diego State University, San Diego, CA, United States, [2]Physics, UC San Diego, La Jolla, CA, United States, [3]Radiology, UC San Diego, San Diego, CA, United States* 2D and 3D strain rate imaging has been recently introduced to study local tissue deformations. The strain rate tensors are represented in the principal basis while further relevant physiological information can be obtained by extracting 3D strain rate tensors in the muscle fiber basis; the latter is determined by diffusion tensor imaging. Here, we present the methodological developments to extract 3D fiber aligned strain rate images and application to study atrophy induced by Unilateral limb suspension. FASR indices were much smaller than those extracted in the principle basis and further studies are required to understand FASR changes with suspension.

5135	Computer 55	Signal-to-Noise Assessment for Diffusion Tensor Imaging of Muscles Using Single Data Set Zhiyue J. Wang[1,2], Jin Yamamura[3], and Sarah Keller[3] *[1]University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Children's Medical Center, Dallas, TX, United States, [3]University Medical Center Hamburg-Eppendorf, Hamburg, Germany* The DTI metric are prone to bias if the SNR is too low, such as in muscular dystrophies where fat infiltration decreases the partial volume of the muscle. DTI is usually acquired using parallel imaging so the noise level from the background air space is unreliable for SNR assessment. SNR can be measured using a difference image method from 2 image sets acquired repeatedly, but in many studies only one data set is acquired. Here high-pass k-space filtering method for measuring SNR of muscle DTI from single data set was optimized using a difference image method as reference.

5136	Computer 56	Reproducibility of calf-muscle perfusion measurements from dynamic contrast-enhanced MRI Christopher C Conlin[1], Jiawei Dong[1], Stephen Decker[2], Nan Hu[3], Mariya A Chadovich[1], Michelle T Mueller[4], Lillian L Khor[5], Christopher J Hanrahan[1], Gwenael Layec[2], Vivian S Lee[1], and Jeff L Zhang[1] *[1]Department of Radiology and Imaging Sciences, University of Utah School of Medicine, Salt Lake City, UT, United States, [2]Division of Geriatrics, University of Utah School of Medicine, Salt Lake City, UT, United States, [3]Division of Biostatistics, University of Utah School of Medicine, Salt Lake City, UT, United States, [4]Division of Vascular Surgery, University of Utah School of Medicine, Salt Lake City, UT, United States, [5]Division of Cardiovascular Medicine, University of Utah School of Medicine, Salt Lake City, UT, United States*

		This study examined the reproducibility of calf-muscle perfusion measurements from DCE-MRI following plantar-flexion exercise, which is a promising technique for assessing calf-muscle function and viability. In a group of healthy subjects, the same post-exercise DCE-MRI protocol was repeated on two different days and calf-muscle perfusion measurements were compared between the two visits. High correlation and agreement of perfusion between visits was observed for the posterior calf muscles, demonstrating that a plantar-flexion exercise protocol followed by DCE-MRI is suitable for achieving precise measurements of calf-muscle perfusion.

5137	Computer 57	Deformable registration of calf muscle MRI using an improved Demons approach
		Sarath Chintalapati[1], Christopher C Conlin[2], Gwenael Layec[3], Stephen T Decker[3], Nan Hu[4], Jiawei Dong[2], Christopher Hanrahan[2], Michelle Mueller[5], Lillian Khor[6], Vivian S Lee[2], and Jeff L Zhang[2]
		[1]Electrical and Computer Engineering, University of Utah, Salt Lake City, UT, United States, [2]Department of Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States, [3]Department of Internal Medicine, Division of Geriatrics, University of Utah, Salt Lake City, UT, United States, [4]Department of Internal Medicine, Division of Bioinformatics, University of Utah, Salt Lake City, UT, United States, [5]Department of Internal Medicine, Division of Vascular surgery, University of Utah, Salt Lake City, UT, United States, [6]Department of Internal Medicine, Division of Cardiology, University of Utah, Salt Lake City, UT, United States
		Lower-extremity peripheral arterial disease (PAD) as a major clinical problem and MRI, which measures multiple aspects of the function of the calf muscles, such as muscle perfusion and oxygenation has not been significantly used for this. The reason being no efficient scanning and processing to compare data acquired during the course of treatment. Here we propose to register the calf MRI images using a modified Demons registration method which is more efficient. This method involves first a fast rigid registration and then the Demons deformable registration, by first applying rigid translation and rotation which substantially improved the registration performance for the calf muscle images.

5138	Computer 58	The interplay of MRS measured skeletal muscle acetylcarnitine, mitochondrial function and glucose availability
		Anne Tonson[1], Robert W Wiseman[1,2], Ronald A Meyer[1], Taylor Ann Callahan[2], Ashley Lang[2], and Jill M Slade[2]
		[1]Physiology, Michigan State University, East Lansing, MI, United States, [2]Radiology, Michigan State University, East Lansing, MI, United States

		Recently resting muscle acetylcarnitine content (AC) has been proposed as a marker for peripheral insulin resistance. However, muscle oxidative capacity and glucose availability may largely contribute to interindividual AC fluctuations independent of peripheral insulin sensitivity. In this study we monitored resting muscle AC in healthy subjects using ^{1}H MRS in response to carbohydrate ingestion and examined the relationship of fasting muscle AC to muscle oxidative capacity measured by ^{31}P MRS. Our results show a strong relationship between mitochondrial capacity and fasting muscle AC and also show that carbohydrate ingestion causes a rapid sharp decline in muscle AC.

5139	Computer 59	Rectus capitis posterior minor and nuchal ligament work as a mydural bridge complex-from 3D MR Imaging in vivo
		Mei-yu Sun[1], Ai-lian Liu[1], Qing-wei Song[1], Li-Zhi Xie[2], Sheng-bo Yu[3], and Hong-jin Sui[3]
		[1]radiology department, The first affiliated Hospital of Dalian Medical University, Dalian, China, [2]GE Healthcare, MR Research China, Beijing, China, [3]Department of Anatomy, Dalian Medical University, Dalian, China
		Myodural bridges (MDB) are soft tissue connections crossing the cervical epidural space to link suboccipital muscles, ligament and cervical dura. It may transmit tensile force from its connection components to dura mater which correlates with spinal cord circulation and chronic headache. The MDB was first described as a dense connective tissue bridge located between the rectus capitis posterior minor (RCPmi) muscle and the spinal dura. RCPmi mass has been suggested as a biomechanical contributor to injury severity in mild traumatic injury and cervicogenic headache. The fibers from nuchal ligament (NL) have also been demonstrated to attach to the cervical dura mater and may affect the RCPmi muscle mass. However, the correlation between RCPmi and NL remains unclear and is investigated in this work.

5140	Computer 60	A static MR follow-up study of injured levator ani muscle recovery
		yujiao zhao[1], wen shen[2], and zhizheng zhuo[3]
		[1]radiology, Tianjin first center hospital, china, tianjin, china, China, [2]tianjin first center hospital, tianjin, China, [3]Philips Healthcare, Beijing, China
		The abnormal structure or function of Levator ani muscle(LAM) is the basis for pelvic floor dysfunction disease. Our study is to assess the recovery of injured LAM resulting from vaginal delivery by using static MRI.The primiparas who presented LAM injury at six weeks after delivery were brought into MRI follow-up study(reviewed at three months and six months).54 pubovisceralis injury with edema in a bilateral summary, there was significant difference among different postpartum time points. To summarise, the injured LAM has the ability to recover after delivery. LAM edema may exaggerate the true severity and extent of LAM injury.

5141	Computer 61	Quantitative and qualitative analysis of paraspinal back muscle with focus on fat content using CT and MRI in asymptomatic volunteers Eun Kyung Khil[1], Jung-Ah Choi[1], Eunjin Hwang[1], Sabrilhakim Sidek[2], Jang Gyu Cha[3], and Il Choi[4] *[1]Radiology, Hallym University Dongtan Sacred Heart Hospital, Hwaseong-si, Gyeonggi-do, Republic of Korea, [2]Medical Imaging Unit, Faculty of Medicine, Universiti Teknologi MARA (UiTM), Sg. Buloh, Malaysia, [3]Radiology, Soonchunhyang University Bucheon Hospitial, Bucheon-si Gyeonggi-do, Republic of Korea, [4]Neurosurgery, Hallym University Dongtan Sacred Heart Hospital, Hwaseong-si, Gyeonggi-do, Republic of Korea* MRI and CT can be reliably used for qualitative and quantitative analysis of para-spinal back muscles in healthy volunteers, especially regarding fat content. Good correlation was found between the two methods. Female gender and older age were associated with higher fat content of para-spinal back muscles.

5142	Computer 62	Reproducibility of MR elastography of lumbar paraspinal muscle in healthy volunteers Chia-Hui Chen[1] and Chien-Kuo Wang[2] *[1]Department of Medical Imaging and Radiological Science, Central Taiwan University of Science and Technology, Taichung, Taiwan, [2]Department of Radiology, National Cheng Kung University Hospital, Tainan, Taiwan* The abnormal tissue stiffness of lumbar paraspinal muscle in symptomatic patients can be diagnosed by palpation in clinical practice. MRE can measure tissue stiffness quantitatively and noninvasively. The objective of this pilot study was to evaluate the reproducibility of MRE of lumbar paraspinal muscles in healthy volunteers. The strong positive relationship between 2 MRE exams was demonstrated by the Pearson's correlation coefficient.

5143	Computer 63	Variation of Strain Rate with Force Output in the Medial Gastrocnemius During Isometric Contractions in Young and Senior Subjects Shantanu Sinha[1], Vadim Malis[2], and Usha Sinha[3] *[1]Radiology, UC San Diego, San Diego, CA, United States, [2]Physics, UC San Diego, La Jolla, CA, United States, [3]Physics, San Diego State University, San Diego, CA, United States*

		Strain rate tensor mapping can be conveniently computed from velocity encoded phase contrast imaging. It provides a tool to explore local tissue deformations including the magnitude and directions of the principal axes of deformations. The study of the variation of strain rate indices with force output (% Maximum Voluntary Contraction (MVC) can provide additional information similar to stress-strain relationships measured at the whole muscle level. Here, we present the methodological developments to extract 2D Strain rate indices as a function of %MVC in 6 normal young (3) and senior (3) subjects. An approximately linear variation of SR indices with %MVC force was seen in the range of 20-50% MVC in young and senior subjects.

5144	Computer 64	Muscle Activation using 3D Cones Sodium, T2-Weighted Imaging, and T2 Mapping: Comparison of Techniques
		Logan Thorneloe[1], Neal Bangerter[1], Victoria Violette[2], Clint Frandsen[1], Michael Mendoza[1], Wayne Johnson[2], and Grayson Tarbox[1]
		[1]Electrical Engineering, Brigham Young University, Provo, UT, United States, [2]Exercise Science, Brigham Young University, Provo, UT, United States
		We present a comparison of muscle functional magnetic resonance imaging (mfMRI) techniques in order to determine the most accurate method of measuring muscle activation via MRI that is practical and easy-to-use in numerous research environments.

5145	Computer 65	Diffusion tensor imaging of the human calf in healthy and diseased subjects during plantar-flexion exercise
		Masoud Edalati[1], Christopher Sorensen[1], Mary K Hastings[1], Mohamed Zayed[1], Michael Mueller[1], and Jie Zheng[1]
		[1]Washington University School of Medicine in St. Louis, St. Louis, MO, United States
		This study aims to elucidate diffusion variations between human healthy and diseased calf muscles. Subjects were assigned into three groups: healthy, diabetes mellitus (DM), and peripheral artery disease (PAD). DTI echo planar imaging was performed at rest and ankle plantar-flexion to provide fractional anisotropy (FA), mean diffusivity (MD), and fiber length for calf medial gastrocnemius (MG), lateral gastrocnemius (LG), and soleus (SOL). Our initial results revealed noticeable diffusion indices variations from resting to contraction of the above muscles between healthy and diseased groups and demonstrated a good accordance with previous healthy studies in the literature.

5146	Computer 66	Real-time MRI of the larynx: detecting phonation contrasts
		Sarah E Johnson[1], Marissa Barlaz[1], Shuju Shi[1], Ryan K Shosted[1], and Brad P Sutton[2]

[1]Linguistics, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States

The present study assesses the ability of rt-MRI to detect subtle laryngeal configuration changes during varying phonation contrasts. One subject lay supine within a 3T Siemens Trio scanner while producing a variety of phonation types including breathy, modal, and creaky voice. An analysis of axial and coronal slices of the larynx detected predictable changes at the ventricular folds, vocal folds and arytenoid cartilages. We conclude that rt-MRI of the larynx may have further application in the study of phonation in both research and clinical settings as a non-invasive measure of laryngeal function.

5147 | Computer 67

Can 5-Minute 3D Isotropic Turbo Spin-Echo MR Imaging Replace 2D Standard Knee MR Imaging at 3T?

Seung hee Han [1], Na Hye Han[1], Won-Hee Jee[2], Joon-Yong Jung[2], Jun-Pyo Myoung[3], Yoonho Nam[1], Young In[4], and Won-Hee Jee[5]

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2D TSE intermediate(IM) or T2-weighted images have been traditionally used to evaluate internal derangements of knee. However partial volume effect due to relatively thick image section and gap and long acquisition time due to impossible reformation is limitation of standard 2D TSE technique. Newly developed 3D isotropic T2 or IM weighted image is made by isotropic voxel data, which allows 3D reformation and reduce acquisition time. The purpose of this study is to compare the image quality and diagnostic performance of 5-minute sagittal fat-suppressed 3D isotropic turbo spin-echo sequence (MSK VIEW) and 2D standard knee magnetic resonance (MR) imaging at 3T.

5148 | Computer 68

Rapid enhanced SPI imaging using inductively coupled local coils for metal artifact reduction

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		As a pure phase encoding technique, Single Point Imaging (SPI) has a great potential to reduce metal-induced artifacts, at the cost of long acquisition times normally not suited for clinical use. In this contribution, we present an approach combining SPI with reduced field-of-view imaging and SPARSE-SENSE reconstruction techniques, by using inductively coupled coils (ICC) for local signal boosting and multi-element receive coils. Initial phantom and in-vivo results show reduced metal artifacts at clinically acceptable scan times with the proposed techniques.

5149	Computer 69	MAVRIC SL Compressed Sensing STIR Imaging using a Total Generalized Variation (TGV) Reconstruction
		Suryanarayanan Sivaram Kaushik[1], Graeme McKinnon[1], Matthew Koff[2], Hollis Potter[2], and Kevin Koch[3]
		[1]MR Applications and Workflow, GE Healthcare, Waukesha, WI, United States, [2]Hospital for Special Surgery, New York City, NY, United States, [3]Medical College of Wisconsin, Milwaukee, WI, United States
		3D Multi-spectral imaging sequences like MAVRIC SL have been used overcome susceptibility artifacts caused by metallic hardware. Several studies have attempted to reduce long scan times by using parallel imaging and compressed sensing, but PD images are commonly displayed with evident blurring. MAVRIC STIR images, due to their sparseness, may be more amenable to compressed sensing acceleration. The current work focuses on accelerating MAVRIC SL STIR images using compressed sensing and a total generalized variation reconstruction (TGV).

5150	Computer 70	Comparison of DESS and conventional clinical sequences for imaging the lumbosacral plexus
		Daehyun Yoon[1], Adam Luce Bartret[1], Peter Cipriano[1], Brian Andrew Hargreaves[1], Sandip Biswal[1], and Amelie Lutz[1]
		[1]Stanford University, Stanford, CA, United States
		Peripheral nerve imaging with MRI has gained increasing attention for non-invasive detection of nerve diseases. Unfortunately, the current performance of clinical sequences (T2-weighted fast spine echo with fat saturation and other supporting sequences) in spatial resolution, fat-saturation, and nerve-vessel distinction is often insufficient to make a convincing diagnosis. We conducted a radiologic review of lumbosacral plexus images from 3D double-echo in steady state (DESS) in comparison with images from conventional sequences in our current clinical protocol. Our results demonstrate the improved nerve visualization with the DESS sequence with comparable sensitivity to pathology.

5151	Computer 71	A New Contrast Mechanism for Parametric Segmentation of MRI Using Alternating RF Pulses in bSSFP Sequence
		Joonsoo Kim[1,2], Hyunseok Seo[2], Sungpil Jung[2], JaeMoon Jo[2], Seohee So[1], and HyunWook Park[1]

		[1]Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea, [2]Samsung Electronics, Suwon, Republic of Korea
		Magnetic resonance imaging (MRI) technology offers the most important diagnostic information for musculoskeletal (MSK) disorders, in comparison to other imaging modalities (1). However, human MSK system contains a lot of fat, by which the important tissue signals from the cartilage and the synovial fluid are obstructed. Even with fat suppression techniques, it is still difficult to distinguish tissues having similar proton density (PD), T_1, and T_2 values. In this abstract, a new contrast enhancing method for the color MR image based on parametric segmentation is introduced, using the modified bSSFP pulse sequence.

5152	Computer 72	Pressure-Triggered Gated MRI Acquisition of a Vibrating Scaled Vocal Fold Model
		Grayson Tarbox[1], Cassandra Smith[2], Bradley D. Bolster[3], Scott Thomson[2], and Neal Bangerter[1]
		[1]Electrical Engineering, Brigham Young University, Provo, UT, United States, [2]Mechanical Engineering, Brigham Young University, Provo, UT, United States, [3]Siemens Medical Solutions USA, Inc., Malvern, PA, United States
		In this work, we present a technique for MR gated imaging of a scaled model of the vocal folds vibrating in the 13-17 Hz frequency range. The vocal fold model was scaled to roughly 4X human size to decrease the frequency of vibration and make gating feasible. The model contained an embedded grid of markers such that biomechanical motion of the laryngeal model could be accurate tracked across multiple phases of the periodic vibrational cycle.

Electronic Poster

MSK: Bone, Tumours & Emerging Methods

Exhibition Hall	Wednesday 17:15 - 18:15

5153	Computer 73	Inversion-Recovery sat-UTE sequence for short-T2 structures positive contrast generation and quantification
		Lucas Soustelle[1], Ericky Caldas de A. Araujo[2,3], François Rousseau[4], Jean-Paul Armspach[1], Pierre G. Carlier[2,3], and Paulo Loureiro de Sousa[1]
		[1]Université de Strasbourg, CNRS, ICube, FMTS, Strasbourg, France, [2]NMR laboratory, Institute of Myology, Paris, France, [3]NMR laboratory, CEA/DRF/IBFJ/MIRCen, Paris, France, [4]Institut Mines Télécom Atlantique, INSERM, LaTIM, Brest, France

		Short-T2 structures such as myelin and cortical bone often requires the use of inversion-recovery modules in UTE sequences to provide a selective contrast in the components of interest. The sat-UTE sequence allows for an effective slice selection, and avoid issues found in commonly used 2D IR-UTE sequences concerning the use of reshaped half-radiofrequency pulses to achieve a minimal echo time. In this work, we propose to make use of an Inversion-Recovery-prepared sat-UTE sequence to provide a short-T2 positive contrast and quantification in the white matter and in the cortical bone of a fixed mouse head.

5154	Computer 74	MR Imaging of Patients Receiving Anterior Cervical Discectomy and Fusion Surgery Using MAVRIC-SL-STIR Technique
		Renjie Yang[1], Yunfei Zha[1], Yu Zhang[1], Changsheng Liu[1], and Yang Fan[2]
		[1]Department of Radiology, Renmin Hospital of Wuhan University, Wuhan, China, [2]GE Healthcare, Beijing, China
		Metal implants are now very common in modern joint and spine surgeries. However, conventional MR images are significantly compromised by implant-induced magnetic susceptibility artifacts. A novel metal artefacts reduction technique, termed MAVRIC-SL was proposed. The purpose of this study is to evaluate its clinical feasibility and diagnostic value in patients after anterior cervical discectomy and fusion surgery compared with routine 2D FSE images at 3 T. As a result, although the image quality of MAVRIC-SL is limited at 3 T, it can still provide important additional diagnostic information through substantially reduced metal artefacts.

5155	Computer 75	Ultra-short echo time (UTE) imaging with Three-component fitting analysis of human cortical bone
		Xing Lu[1,2], Saeed Jerban[1], Michael Carl[3], Wenhui Yang[2], Annette von Drygalski[4], Eric Y Chang[5], and Jiang Du[1]
		[1]Department of Radiology, University of California, San Diego, San Diego, CA, United States, [2]Institute of Electrical Engineering, Chinese Academy of Science, Beijing, China, [3]GE Healthcare, San Diego, CA, United States, [4]Department of Medicine, Division of Hematology/Oncology, University of California, San Diego, San Diego, CA, United States, [5]Radiology Service, VA San Diego Healthcare System, San Diego, CA, United States
		Increased cortical porosity is a major cause of the decreased strength of osteoporotic bone, which can be evaluated by MRI based bone water components analysis. The chemical shift caused by fat in the bone may lead to incorrect estimation of water components with a bi-component exponential model. Thus, we propose a tri-component fitting method for accurate bound and pore water quantification incorporating a multi-peak spectral modeling of fat. Nine human cortical bone samples were studied. Our results suggest improved curve fitting and additional information when a tri-component analyses is used.

5156	Computer 76	Image derived arterial input function using popliteal artery for [18F]-sodium fluoride (NaF) PET/MRI Bryan Haddock[1], Feliks Kogan[2], Audrey Fan[2], Charlotte Suetta[1], and Garry Gold[2] *[1]Dep. of Clinical Physiology, Nuclear Medicine and PET, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark, [2]Department of Radiology, Stanford University, Stanford, CA, United States* This study evaluates the feasibility of performing dynamic [18F]-sodium fluoride (NaF) kinetic studies of the knee using PET/MRI with a focus on determining a robust method to produce an image derived input function (IDIF) using MRI images. Input functions are created using an angiography sequence to isolate the popliteal arteries and create intravascular ROIs centred in the artery to measure blood activity. 12 subjects were given two injections 75 min apart and the derived IDIFs were compared for reproducibility and accuracy. The resulting IDIFs had high reproducibility and gave values matching blood samples and literature values. Given its accuracy and robustness, this technique is well suited for clinical PET/MRI examinations.

5157	Computer 77	Time interleaved multi-gradient-echo imaging with UTE and non-UTE sampling for simultaneous PDFF, T2* and magnetic susceptibility mapping of cortical bone Sophia Kronthaler[1], Maximilian Nikolaus Diefenbach[1], Stefan Ruschke[1], Jakob Meineke[2], Holger Eggers[2], Peter Boernert[2], and Dimitrios Karampinos[1] *[1]Department of Diagnostic and Interventional Radiology, TUM Klinikum rechts der Isar, Munich, Germany, [2]Philips Research Laboratory, Hamburg, Germany* Recently, quantitative magnetic susceptibility mapping (QSM) is gaining attention in the context of probing bone microstructure with potential clinical application in the assessment of bone health. Particularly, in bone applications the presence of multiple chemical species including short and long T2* components embedded in the bone environment poses several challenges including rapid signal decay, fieldmap estimation and chemical species separation. Using non-UTE QSM leads to signal voids in cortical bone regions complicating QSM. Therefore, the present study investigates the application of a stack-of-stars time-interleaved multi-gradient echo sequence including UTE and regular echo sampling for bone QSM.

5158	Computer 78	Prognostic value of dynamic MRI in assessing femoral head vascularity of male smokers. lei hu[1] and yang fan[2] *[1]Radiation imaging center of Renmin Hospital of Wuhan University, wuhan, China, [2]GE Healthcare China, Beijing, China., wuhan, China*

		Smokers were at a higher risk of osteonecrosis of the femoral head (ONFH). In this study we aim to evaluate prognostic value of dynamic magnetic resonance imaging in assessing the femoral head vascularity of male smokers. 80 young adult men of whom 40 were smokers and 40 were nonsmokers underwent routine MR and DCE MR examination. The images and data were analyzed. In this study, we found that there was no difference of T1WI and T2WI between smokers and non-smokers. K^{trans} and K_{ep} of femoral head in the smoking group were higher compared to the control group. DCE MR can be a potential tool to detect the early change of femoral head vascularity of male smokers.

5159	Computer 79	Correlation study between micro-architecture of trabecular bone and magnetic resonance transverse relaxation times at multiple spatial resolutions
		DongKyu Lee[1], Youngkyu Song[2], Bumwoo Park[1], Hwapyung Cho[1], Gyunggoo Cho[2], and HyungJoon Cho[1]
		[1]Bio-Medial Engineering, Ulsan National Institute of Science and Technology, Ulsan, Republic of Korea, [2]Division of Magnetic Resonance, Korea Basic Science Institute, Ochang, Republic of Korea
		The effects of magnetic resonance (MR) imaging resolutions on the correlations between standard trabecular structural indices and MR transverse relaxation-times (T_2 and T_2^*) were evaluated by performing Monte Carlo proton diffusion simulations, ex vivo experiments with defatted human trabecular specimens, and bovine knee trabecular samples with intact bone marrow via 7T system. T_2 relaxation-time robustly represented the trabecular micro-architecture, such as trabecular spacing and number, while T_2^* was vulnerable with degrading spatial resolution. T_2 relaxation times may facilitate the radiation-free diagnosis to assess osteoporotic fractures and therapy response for deep trabecular areas within a feasible scan time on a 7T system.

5160	Computer 80	Femoral Head Perfusion Color Mapping using DCE-MRI in Slipped Capital Femoral Epiphysis: Preliminary Experience
		Kojiro Ono[1], Hirofumi Watanabe[1], Yasuhiro Oikawa[2], Takumi Okubo[3], and Akira Shirayama[1]
		[1]Radiology, Chiba Children's Hospital, Chiba, Japan, [2]Orthpedic Surgery, Chiba Children's Hospital, Chiba, Japan, [3]Radiology, Chiba Cancer Center, Chiba, Japan
		There is no established method for diagnosing femoral head necrosis before surgery, because it is difficult to predict AN due to SCFE. In this study, we propose a scheme and optimization to evaluate the femoral head perfusion in children with SCFE. Our objective is to optimize DCE-MRI and to provide useful color maps for diagnosing the femoral head perfusion.Femoral head perfusion color mapping using DCE-MRI in SCFE is useful for decision of surgical treatment method. Color maps of positive enhancement integral and maximum slope of increase contributes to evaluation of perfusion status.

5161	Computer 81	Imaging Scoliosis Using Zero Echo Time MRI Chien-Yuan Eddy Lin[1], Hsiao-Ling Lin[1], Ya-Lin Fang[2], Hung-Ta Wu[3], Chi-Kuang Feng[4,5,6], and Wan-You Guo[3] *[1]GE Healthcare, Taipei, Taiwan, [2]Clinical Evoked Potential Study Room, Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan, [3]Department of Radiology, Taipei Veterans General Hospital, Taipei, Taiwan, [4]Division of Pediatric Orthopedics, Department of Orthopaedics and Traumatology, Taipei Veterans General Hospital, Taipei, Taiwan, [5]Institute of Biomedical Engineering, National Yang Ming University, Taipei, Taiwan, [6]Medicine, National Defense of Medical Center, Taipei, Taiwan* A high resolution, rapid scanning and three-dimensional zero-echo time (ZTE) protocol for cortical bone of whole spine imaging was established in this study. It provides computed tomography-like bone contrast and offers the similar result in the measurement of Cobb angle with conventional radiography, suggesting that the detection scoliosis and measurement of curvature using ZTE is possible, providing a potential alternative radiation-free diagnostic option that is especially relevant to scoliosis patients who need to undergo repeated examinations for evaluating the progress of spinal curvature.

5162	Computer 82	Estimating vertebral bone marrow triglyceride unsaturation based on the extraction of the olefinic peak in short-TE STEAM MRS using a constrained fitting model Jan Syväri[1], Stefan Ruschke[1], Michael Dieckmeyer[1], Daniela Franz[1], Hans Hauner[2], Jan S Kirschke[3], Thomas Baum[3], and Dimitrios Karampinos[1] *[1]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Department of Nutritional Medicine, Technical University of Munich, Freising, Germany, [3]Department of Diagnostic and Interventional Neuroradiology, Technical University of Munich, Munich, Germany* The measurement of vertebral bone marrow triglyceride unsaturation using single-voxel STEAM MRS serves as a potential biomarker for bone health. The required quantifiction of the olefinic fat peak (OFP) is often prevented by an overlapping water signal. The aim of this study was to investigate the feasibility of measuring the OFP by defining a quantification reliability measure (QRM) based on the comparison of two constrained triglyceride models. Result: The feasibility of estimating the OFP depends on the water linewidth and proton density fat fraction, increases with the QRM and may not be achievable if the water peak and OFP are not intercepting.

5163	Computer 83	Sex dependence of age-related vertebral bone marrow PDFF and T2 relaxation time changes in a cohort of nearly 200 subjects using multi-TE single-voxel MR spectroscopy Jan Syväri[1], Stefan Ruschke[1], Michael Dieckmeyer[1], Daniela Franz[1], Hans Hauner[2], Jan S Kirschke[3], Thomas Baum[3], and Dimitrios Karampinos[1]

		[1]*Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany,* [2]*Department of Nutritional Medicine, Technical University of Munich, Freising, Germany,* [3]*Department of Diagnostic and Interventional Neuroradiology, Technical University of Munich, Munich, Germany*
		Fat quantification of vertebral bone marrow (VBM) has been often performed with single-TE MRS. Using MRS the differences in the T_2-decay of water and fat is neglected and therefore the extracted fat fraction (FF) measure comprises T_2-weighting. The aim of this study was to examine differences between T_2-weighted FF and proton density fat fraction (PDFF) using multi-TE single-voxel MRS and to relate the observed differences with changes in T_2-relaxation of water with age in 197 subjects. The T_2-relaxation of water remained constant in males and showed an age dependence in females resulting in amplified gender differences of T_2-weighted FF with age compared to PDFF.

5164	Computer 84	What is the role of MRS-based bone marrow fatty acid unsaturation level compared to fat fraction in predicting vertebral bone strength?
		Michael Dieckmeyer[1], Stefan Ruschke[1], D Anitha[2], Jan S Kirschke[3], Dimitrios C Karampinos[1], Subburaj Karupppasamy[2], and Thomas Baum[3]
		[1]*Department of Diagnostic and Interventional Radiology, Technical University Munich, Munich, Germany,* [2]*Engineering Product Development, Singapore University of Technology and Design, Singapore, Singapore,* [3]*Department of Diagnostic and Interventional Neuroradiology, Technical University Munich, Munich, Germany*
		In addition to bone marrow fat content, bone marrow composition is attracting growing interest as an advanced biomarker in the investigation of osteoporosis and bone metabolism. Finite-element analysis of CT imaging data allows non-invasive assessment of bone fracture risk. The present vertebral specimen study showed that vertebral bone marrow fatty acid unsaturation level (UL) is positively correlated with finite-element analysis based failure load and confirmed the negative correlation between bone marrow fat fraction and failure load. However, UL estimation did not improve failure load prediction beyond bone marrow fat fraction in this in-vitro study.

5165	Computer 85	Comparison of cortical bone visualization in the hip using ZTE and in-phase 3D gradient echo MRI sequences at 3T
		Aiming Lu[1], Krzysztof R Gorny[1], Joel P Felmlee[1], Stephen M Broski[1], and Benjamin Howe[1]
		[1]*Radiology, Mayo Clinic, Rochester, MN, United States*

		Visualizing cortical bone with MRI is challenging, as it appears as signal void in conventional MRI. Both the “black bone” technique and the zero-TE (ZTE) sequence have been proposed for cortical bone visualization. While the “black bone” technique potentially provides better cortical bone to soft tissue contrast, the ZTE sequence enables differentiation from air. This work aimed to compare the two techniques for visualizing cortical bone in the hip. Our results show that cortical bone visualization was compromised using the “black bone” technique due to chemical shift artifacts, while ZTE MRI delivered excellent depiction of the cortical bone.

5166	Computer 86	Cortical Bone Imaging Using Ultrashort Echo Time (UTE) Phase Sensitive Dual Inversion Recovery Subtraction Technique
		Yajun Ma[1], Wei Zhao[1], Adam Searleman [1], Nikolaus M Szeverenyi[1], Jiang Du[1], and Graeme M Bydder[1]
		[1]University of California, San Diego, San Diego, CA, United States
		Imaging of cortical bone is of fundamental importance in clinical MR but signals are low even with ultrashort echo time (UTE) sequences and contamination with high signals from long T2 muscle and fat is a problem 1. Here we propose a new phase sensitive dual inversion recovery subtraction method to obtain pure cortical bone images with zero signal from surrounding long T2 muscle and fat.

5167	Computer 87	Quantitative Dynamic Contrast-enhanced MR Imaging in Different Arterial Input Functions and Measurement Dimensions: Which Method Performs Best in differentiation of Malignant from Benign Soft Tissue Tumors?
		Jimin Yoon[1], Won-Hee Jee[1], Jun-Pyo Myoung[2], Joon-Yong Jung[1], Chan Kwon Jung[3], and Yang-Guk Chung[4]
		[1]Radiology, Seoul St. Mary’s Hospital, School of Medicine, The Catholic University of Korea, Seocho-gu, Republic of Korea, [2]Occupational and environmental medicine, Seoul St. Mary’s Hospital, School of Medicine, The Catholic University of Korea, Seocho-gu, Republic of Korea, [3]Pathology, Seoul St. Mary’s Hospital, School of Medicine, The Catholic University of Korea, Seocho-gu, Republic of Korea, [4]Orthopedics, Seoul St. Mary’s Hospital, School of Medicine, The Catholic University of Korea, Seocho-gu, Republic of Korea
		This study was designed to evaluate the reliability of quantitative dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) according to the different arterial input functions (AIF) at different measurement dimensions in differentiating malignant from benign soft tissue tumors at 3T. Quantitative DCE-MRI parameters of either benign or malignant tumors were obtained in three different measurement dimensions: focal early enhancing area, single-slice average, and whole tumor volume. They were calculated using three different population-averaged AIF (fast, intermediate and slow) and one of the three AIF of the lowest Chi-square, using SyngoVia software. The result showed quantitative DCE-MRI may be reliable and accurate in differentiating malignant from benign soft tissue tumors at 3T, particularly from focal early enhancing area using intermediate or fast AIF.

5168	Computer 88	Differentiation of Pulmonary From Non-Pulmonary Spine Metastases Using Conventional DCE Kinetic Analysis and Machine Learning
		Ning Lang[1], Yang Zhang[2], Enlong Zhang[1], Jiahui Zhang[1], Daniel Chow[2], Peter Chang[3], Melissa Khy[2], Hon J. Yu[2], Huishu Yuan[1], and Min-Ying Su[2]
		[1]Department of Radiology, Peking University Third Hospital, Beijing, China, [2]Department of Radiological Sciences, University of California, Irvine, CA, United States, [3]Department of Radiology, University of California, San Francisco, CA, United States
		DCE-MRI of the spine was analyzed to differentiate metastasis from lung cancer (N=30) and other tumors (N=31, 9 breast, 6 prostate, 7 thyroid, 6 liver, 3 kidney). Using DCE parameters measured from the tumor ROI, CHAID decision tree classification selected the wash-out slope of -6.6% and wash-in SE of 98% as thresholds, which could achieve diagnostic accuracy of 0.79. In machine learning, the enhanced tumor on DCE image was segmented automatically by using the normalized cut algorithm. The Convolutional Long Short Term Memory (CLSTM) network with all 12 sets of DCE images as the input could yield accuracy of 0.75-0.84.

5169	Computer 89	Texture Analysis Based Separation of Osteosarcoma and Ewing's Sarcoma using Diffusion Weighted MRI
		Esha Baidya Kayal[1], Devasenathipathy Kandasamy[2], Jayendra Tiru Alampally[2], Sameer Bakhshi[3], Raju Sharma[2], and Amit Mehndiratta[1,4]
		[1]Centre for Biomedical Engineering, Indian Institute of Technology, Delhi, New Delhi, India, [2]Radiodiagnosis, All India Institure of Medical Sciences, New Delhi, New Delhi, India, [3]Department of Medical Oncology, IRCH, All India Institure of Medical Sciences, New Delhi, New Delhi, India, [4]Department of Biomedical Engineering, All India Institute of Medical Sciences, New Delhi, New Delhi, India
		Osteosarcoma(OS) and Ewing's sarcoma family of tumors(ESFT) are the most common primary malignant bone tumor in children and adolescents. As the patient's age, presenting signs & symptoms and qualitative imaging features are common in both, there could be a diagnostic dilemma that can only be resolved by biopsy & histopathological assessment. Texture analysis in Diffusion Weighted Imaging(DWI) might provide additional useful information as DWI captures early cellular changes within tumors. We computed textural features in patients with OS and ESFT. Experimental results revealed that textural features provided significant discrimination between OS and ESFT; thus might be useful as diagnostic marker.

5170	Computer 90	Texture Analysis of Apparent Diffusion Coefficient (ADC) Maps of Vertebral Bone Marrow in Patients with Multiple Myeloma: Correlation with Clinical Parameters and the Revised International Staging System
		Qin Wang[1], Huadan Xue[1], Tianyi Qian[2], Alto Stemmer[3], Shuo Li[1], Zhaoyong Sun[1], and Zhengyu Jin[1]

		[1]Radiology, Peking Union Medical College Hospital, Beijing, China, [2]Siemens Healthcare, MR Collaboration NE Asia, Beijing, China, [3]Siemens Healthcare, Application Development, Erlangen, Germany
		This study aimed to correlate textural parameters derived from apparent diffusion coefficient (ADC) maps of bone marrow to clinical parameters and the revised international staging system (R-ISS) in patients with multiple myeloma (MM). Sixty-one patients with MM underwent whole-body DWI. Texture analysis of ADC maps on vertebral bodies extracted five parameters, including mean, standard deviation, entropy, skewness and kurtosis. These parameters were significantly correlated with clinical parameters of disease burden. Entropy showed the highest diagnostic capacity for discriminating R-ISS stage III from stage I/II. ADC-based textural parameters may serve as adjunct tools for detecting MM patients with advanced R-ISS stages.

5171	Computer 91	MRI, CT, and histomorphometry co-registration studies: analysis of murine tibia morphology before and after decalcification process
		Marilena Tauro[1], William Dominguez-Viqueira[1], Jan Poleszczuk[2], Conor C Lynch[1], Gary Martinez[1], and Mikalai M Budzevich[1]
		[1]Moffitt Cancer Center, Tampa, FL, United States, [2]Polish Academy of Sciences, Warsaw, Poland
		In this work we evaluate the relative merits of MRI and CT to “gold standard” histopathology assessment, with regard to bone tumor metastases. We also investigate the profound effect that decalcification process has on tumor/bone morphology. MRI shows differences in tumor shape before and after decalcifications, however the differences in total tumor volume were smaller than 5 percent. Co-registered microCT images and MR images exhibit displacement of bone-matrix after decalcification. The question of co-registration between all three modalities remains open, however we believe our algorithm minimizes registration errors.

5172	Computer 92	Evaluation of the therapeutic effect on multiple myeloma patients using IDEAL IQ
		Yichen Ma[1], Li Wang[1], Yanhua Tang[1], Yang Fan[2], and Tao Jiang[1]
		[1]Department of Radiology, Beijing Chaoyang Hospital, Beijing, China, [2]GE Healthcare China, Beijing, China
		Multiple myeloma is the second most common hematologic malignancy which occurs commonly in elderly patients. The alteration of bone marrow microenvironment caused by multiple myeloma may lead to the change of fat content and T2* of the bone. IDEAL IQ is a technique which can simultaneously and quantitatively calculate the fat fraction and R2* value of given tissues. The purpose of this study is to investigate the prognostic value of IDEAL IQ technique for the Blood treatment under M protein test on multiple myeloma.

5173	Computer 93	From Bench to Bedside: Improved Detection of Spondylolysis Using 3D Cones Ultrashort Time to Echo (UTE) MR Technique Tim Finkenstaedt[1,2], Suraj Achar[3], Ibraheem Algarni[3], Michael Carl[4], Palanan Siriwanarangsun[1,5], Nirusha Abeydeera[1,6], Reni Biswas[1,6], Sheronda Statum[1,6], Christine B. Chung[1,6], and Won C. Bae[1,6] *[1]Department of Radiology, University of California, San Diego, School of Medicine, USA, San Diego, CA, United States, [2]Department of Radiology, University Hospital Zurich, Zurich, Switzerland, [3]Department of Family Medicine, University of California, San Diego, San Diego, CA, United States, [4]General Electric Healthcare, San Diego, CA, United States, [5]Department of Radiology, Siriraj Hospital, Bangkok, Thailand, [6]Department of Radiology, VA San Diego Healthcare System, San Diego, CA, United States* Spondylolysis, defined as a bony defect in the pars interarticularis of the vertebral arch, is a frequent condition in the young population in which exposure to ionizing radiation is a major concern. In practice, CT imaging is performed in addition to MRI if spondylolysis is suspected. 3D Cones-based UTE MR techniques providing contrast and resolution similar to CT may have overcome the issue of conventional MR-sequences that do not yield sufficient contrast of short T2 tissues near the pars defect. Our study shows in an exemplary manner that detection of spondylolysis with UTE sequences is feasible in the clinical setting.

5174	Computer 94	Fat Saturation in Musculoskeletal MRI using Spectral Heterogeneity Adaptive RF Pulses (SHARP) Venkata Veerendranadh Chebrolu[1], Matthew Frick[2], Peter Kollasch[1], Benjamin Schmitt[3], Vibhas Deshpande[4], John Grinstead[5], Daniel Spence[2], Joel Felmlee[2], and Kimberly K Amrami[2] *[1]Siemens Healthineers, Rochester, MN, United States, [2]Mayo Clinic, Rochester, MN, United States, [3]Siemens Healthineers, Macquarie Park, Australia, [4]Siemens Healthineers, Austin, TX, United States, [5]Siemens Healthineers, Portland, OR, United States* In this work we propose the use of adaptive RF pulses for achieving uniform fat-saturation (fat-sat) that is robust to B0 and B1 heterogeneity often observed in musculoskeletal MRI. A prototype with Spectral Heterogeneity Adaptive RF Pulses (SHARP) was developed to improve the quality and functionality of fat-sat. SHARP was shown to provide fat-sat with higher robustness to B0 and B1 heterogeneity compared to SPIR and SPAIR fat-sat methodologies.

5175	Computer 95	Water/fat separation imaging at 7T using 3D integrated SSFP Kaibao Sun[1,2], Zhentao Zuo[1,2], Huilou Liang[1,2], Jing An[3], Danny J.J. Wang[4], and Rong Xue[1,2]

[1]State Key Laboratory of Brain and Cognitive Science, Beijing MRI Center for Brain Research, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China, [4]Stevens Neuroimaging and Informatics Institute, University of Southern California, Los Angeles, CA, United States

Balanced SSFP (bSSFP) has been used as a new alternative for water-fat separation imaging due to its fast acquisition and high SNR efficiency. However, it displays characteristic banding artifacts in the presence of field inhomogeneity, especially at the 7T ultrahigh-field MRI system. Complex combination of two phase-cycled bSSFP was used to alleviate the artifact at 3T, but would take more scan time. Integrated SSFP (iSSFP), which was modified from bSSFP, was introduced to separate water and fat while removing banding artifacts in shorter scan time. iSSFP also inherited the advantages of relatively high SNR and bright fluid. 3D iSSFP with high spatial resolution may have great potential to separate water and fat in the clinical application of 7T ultrahigh-field MRI.

Electronic Poster

MSK: Meniscus, Tendons, Ligaments & Emerging Methods

Exhibition Hall	Wednesday 17:15 - 18:15

5176 Computer 97

Protocol for in vivo acquisition and fully-automated segmentation of the anterior cruciate ligament

Laura Bernadette Lane[1], Gabriel della Maggiora[1,2], Nicolás Schlotterbeck[1], Cristián Montalba[1], Pablo Besa[3], Sebastián Irarrazaval[3], Alvaro Burdiles[4], and Pablo Irarrazaval[1,2,5]

[1]Biomedical Imaging Center, Pontificia Universidad Católica de Chile, Santiago, Chile, [2]Department of Electrical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [3]Department of Orthopedics and Traumatology, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]Department of Radiology, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile, [5]Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

In this preclinical study we propose a protocol for rapid 3D imaging and fully automated segmentation to create a standardized healthy ACL image database. The segmentation problem of the ACL is particularly challenging due to its poor contrast. Our protocol demonstrated promising fully-automated segmentation of the ACL. Thus, allowing us to have a 3D computational model of the ACL. Ongoing experimentation explores dynamic imaging of the ACL in motions of flexion-extension. Such work will improve understanding of in vivo knee mechanics with potential to inform treatment of different injuries related to the ACL.

5177 Computer 98

CPPD-diseased, Normal and Degenerated Menisci: Biomechanical and quantitative MRI-derived Properties

		Tim Finkenstaedt[1,2], Reni Biswas[3], Nirusha Abeydeera[3], Palanan Siriwanarangsun[3,4], Robert Healey[5], Sheronda Statum[3], Won C. Bae[3], and Christine B. Chung[3,6]
		[1]Department of Radiology, University of California, School of Medicine, San Diego, CA, USA, San Diego, CA, United States, [2]Department of Radiology, University Hospital Zurich, Zurich, Switzerland, [3]Department of Radiology, University of California, San Diego, School of Medicine, USA, San Diego, CA, United States, [4]Department of Radiology, Siriraj Hospital, Bangkok, Thailand, [5]Department of Orthopaedic Surgery, University of California, San Diego, School of Medicine, USA, San Diego, CA, United States, [6]Department of Radiology, VA San Diego Healthcare System, San Diego, CA, United States
		Calcium pyrophosphate crystal deposition (CPPD) disease of the knee is a frequent condition in the elderly population that might cause chondrocalcinosis of the fibrocartilaginous menisci. Controversy exists whether chondrocalcinosis of the menisci is a cause or consequence of osteoarthritis. Thus, it would be desirable to determine whether CPPD-afflicted menisci exhibit altered biomechanical properties and if they correlate with quantitative MR values. Purpose of this study is to investigate if CPP deposits alter the biomechanical properties as well as the UTE values of menisci compared to grossly normal and degenerated human menisci.

5178	Computer 99	Pre-operative MRI for Predicting Clinical Outcome Following Rotator Cuff Tendon Repair Surgery
		Richard Kijowski[1], Kevin Lian[1], Peter Thurlow[1], Gang Li[1], Michael Tuite[1], and Fang Liu[1]
		[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States
		This study was performed to determine whether pre-operative MRI could provide prognostic information regarding clinical outcome following rotator cuff tendon repair surgery. The study group consisted of 141 patients undergoing surgical repair of a full-thickness rotator cuff tendon tear who completed the Disabilities of Arm, Shoulder and Hand (DASH) and Short Form (SF-12) surveys before and one year after surgery. The pre-operative MRI was reviewed to determine tear size, tear retraction, torn tendon tendinosis, and composite muscle atrophy. There was a significant inverse association ($p<0.05$) between post-operative DASH and SF-12 scores and tear width, tendon retraction, and torn tendon tendinosis.

5179	Computer 100	Usefulness of non-contrast perfusion using arterial spin labeling (ASL) for the differential diagnosis of shoulder pain
		Katsumi Nakamura[1,2], Fumihide Arakami[3], Tomoko Nishi[3], Kenichi Inoue[2], Akiyoshi Yamamoto[4], Asaka Aso[5], and Mitsue Miyazaki[6]

		[1]Radiology, Tobata General Hospital, Kitakyushu, Japan, [2]Radiology, Sakura Clinic, Kitakyushu, Japan, [3]Radiology, Mihagino Hospital, Kitakyushu, Japan, [4]Radiology, Tobata Kyoritsu Hospital, Kitakyushu, Japan, [5]Toshiba Medical Systems, Kasuga, Japan, [6]Radiology, UC San Diego, La Jolla, CA, United States
		We evaluated the usefulness of non-contrast perfusion obtained using arterial spin labeling (ASL) for the assessment and the differential diagnosis of shoulder disorders. Twenty consecutive patients were divided into 4 groups. Group 1 (partial tear or less) had no enhancement at the subacromional region; whereas, group 2 (full thickness tear of rotator cuff) showed significant enhancement due to bursitis. Group 3 (calcific tendinitis) and group 4 (osteoarthritis) also showed well enhancement. ASL perfusion could provide the additional physiological information to the morphological routine shoulder MRI without use of contrast materials, which is valuable for the management of shoulder disorders.

5180	Computer 101	Quantitative MRI in patients with Greater Trochanteric Pain Syndrome and Asymptomatic Volunteers: an Exploratory Study on T2* and T1 mapping.
		Joseph Rudy Dadour[1], Guillaume Gilbert[2], Bernard Leduc[3], Roger Vadeboncoeur[4], Jean Rémillard[5], and Nathalie J Bureau[1]
		[1]Radiology, Centre Hospitalier de l'Université de Montréal, Montreal, QC, Canada, [2]Radiology, Radio-Oncology and Nuclear Medicine, Université de Montréal, Montreal, QC, Canada, [3]Readaptation Medicine, Centre Hospitalier de l'Université de Montréal, Montreal, QC, Canada, [4]Institut de réadaptation Gingras-Lindsay-de-Montréal, Montreal, QC, Canada, [5]Centre de Physiatrie Dorchester, Montreal, QC, Canada
		Greater Trochanteric Pain Syndrome is a debilitating and highly prevalent disorder in women. Quantitative short-TE MRI sequences might overcome conventional MRI limitations in characterizing and staging gluteus tendinopathy. Ten patients and 10 asymptomatic volunteers were evaluated with hip MRI. Manual segmentations of the hip tendons were done to map T1 and T2* relaxation times. Statistically significant results were found for the T1 values of the lateral gluteus medius tendon, and for the T2* values of both parts of the gluteus medius, and the gluteus minimus tendons, indicating very promising results.

5181	Computer 102	Feasibility of Quantitative Ultrashort Echo Time Magnetization Transfer (UTE-MT) Modeling Based on Undersampled Acquisitions and ESPIRiT Reconstruction
		Yanchun Zhu[1,2], Yajun Ma[2], Jie Yang[1], Yinghua Zhao[2], Yaoqin Xie[1], Eric Y. Chang[2,3], and Jiang Du[2]
		[1]Shenzhen Institutes of Advanced Technology, Chinese Academic of Sciences, Shenzhen, China, [2]Department of Radiology, University of California, San Diego, San Diego, CA, United States, [3]Radiology Service, VA San Diego Healthcare System, San Diego, CA, United States

		Recently the ultrashort echo time magnetization transfer (UTE-MT) technique with two-pool modeling has shown promise as a clinically compatible quantitative technique which is resistant to the magic angle effect. However, the UTE-MT quantitative technique requires multiple acquisitions, which result in suboptimal acquisition times. The purpose of this study is to assess the feasibility of undersampled acquisitions for quantitative UTE-MT modeling applications.

5182	Computer 103	Texture features from T2 and T1ρ mapping of meniscus in normal and osteoarthritic knee joints
		Hon J. Yu[1], Shoichiro Takao[1], Shigeo Hagiwara[1], and Hiroshi Yoshioka[1]
		[1]Radiological Sciences, University of California, Irvine, CA, United States
		This study demonstrates a feasibility of texture analysis based on T2 and T1ρ mapping of the meniscus. Some of the investigated texture features showed statistically significant differences for both the medial and lateral meniscus between normal volunteers and patients with osteoarthritic knees. One particular texture feature (contrast) based on T2 was also able to differentiate patients with advanced from early knee osteoarthritis for the lateral meniscus as well. The results in this study demonstrate an alternative analytical approach based on texture features as surrogate variables for the evaluation of meniscus properties using T2 and T1ρ mapping.

5183	Computer 104	Comparison of ZTE vs UTE vs Cones for Ultrashort TE MSK Imaging
		Michael Carl[1], Yajun Ma[2], and Jiang Du[2]
		[1]GE Healthcare, San Diego, CA, United States, [2]UCSD, San Diego, CA, United States
		We compared different center out 3D radial trajectories and assess their advantages and disadvantages for short T2 MSK imaging. We found that while ZTE and Cones may provide some unique capabilities, UTE represents a good compromise between the two.

5184	Computer 105	Super-resolution Reconstruction of Knee MRI
		Pieter Van Dyck[1], Floris Vanhevel[1], Eline De Smet[1], Paul M Parizel[1], Jan Sijbers[2], and Ben Jeurissen[2]
		[1]Dept. of Radiology, Antwerp University Hospital and University of Antwerp, Antwerp, Belgium, [2]Imec/Vision Lab, Dept. of Physics, University of Antwerp, Antwerp, Belgium

		Clinical knee MRI is most commonly performed with 2D-turbo-spin-echo (TSE) sequences in multiple imaging planes. Although these multi-slice sequences provide excellent tissue contrast and high in-plane spatial resolution, they use relatively thick slices, which leads to partial volume effects. This study used super-resolution reconstruction (SRR) to reconstruct isotropic high-resolution knee MR images. Our results indicate that SRR of knee MRI is feasible and compares favorably to direct high-resolution TSE acquisition in terms of image quality and acquisition time. SRR provides an attractive alternative for isotropic 3D-MRI of the knee.

5185	Computer 106	Single- and Bi-component Analyses of T2* Relaxation in Knee Tendon and Ligament by Using 3D Ultrashort Echo Time Cones (UTE Cones) Magnetic Resonance Imaging
		Yinghua Zhao[1], Yajun Ma[2], Yanchun Zhu[2], Shaolin Li[1], and Jiang Du[2]
		[1]Third Affiliated Hospital of Southern Medical University (Academy of Orthopedics · Guangdong Province), Guangzhou, China, [2]University of California, San Diego, San Diego, CA, United States
		For patellar tendon (PT), anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) of the knee joint, the in vivo application of the bound and free water mapping techniques is still limited. In this study, we aimed to develop 3D multi-echo fat saturated ultrashort echo time Cones (3D FS-UTE-Cones) imaging protocol for fast volumetric mapping of free and bound water components of whole knee joints in a clinical 3T scanner. The results showed that, for PT, PCL and ACL, the short and long T2* components and their fractions can be characterized by 3D FS-UTE-Cones acquisitions with bi-component T2* analysis, accompanying with superior resolution and short scanning time.

5186	Computer 107	Novel MR coil hardware and fast 3D imaging sequence in evaluating ankle kinematic instability
		Yuqing Zhao[1], Zheng Zhang[2], Xuanhui Wei[2], Jiayu Zhu[2], Ling Ji[2], Nan-Jie Gong[2], and Huishu Yuan[1]
		[1]Radiology Department of Peking University Third Hospital, Beijing, China, [2]United Imaging Healthcare, Shanghai, China
		A specially designed Ankle & Foot coil that adapts Achilles Tendon Boot is utilized to multiple angle imaging of ankle kinematic instability. With the 3D fast spin echo sequence with compressed sensing based acceleration technique, multi angle high resolution ankle imaging can be achieved in less than 20 minutes. Images from the volunteer with a history of ankle injuries showing anterior talar translation and rotated internally. The integration of novel coil and compressed sensing based acceleration technique enabled ankle kinematic imaging into clinical routine.

5187	Computer 108	Influence of fat saturation on 3D -UTE Cones T2* mapping of tendon tissue
		Paul Baron[1], Dirk H.J. Poot[1,2], Stephan Breda[1], Edwin H.G. Oei[1], and Juan A. Hernandez-Tamames[1]

		[1]Department of radiology and nuclear medicine, Erasmus MC, Rotterdam, Netherlands, [2]Department of medical informatics, Erasmus MC, Rotterdam, Netherlands
		T2* mapping of tendon tissue is important to assess tissue pathology. Fat contamination however may lead to bias in quantification of T2*. The application of fat saturation (FS) to reduce signal contamination is not straight forward, as this may influence the signal of species with short T2* and broader line-widths. Therefore, the influence of FS on T2* was investigated in tendon tissue. No influence of FS on T2* was observed in ex-vivo tendon tissue. However, in-vivo results suggest fat-contamination was present and FS may be beneficial to reduce T2* quantification bias.

5188	Computer 109	Application of Intravoxel incoherent motion diffusion imaging in evaluation of tendon perfusion
		Michael Liu[1], Patrick Quarterman[1], Sachin Jambawalikar[1], and Tony Wong[1]
		[1]Columbia University, New York, NY, United States
		Altered perfusion may be a marker of tendon damage. Measurable perfusion characteristics using non contrast techniques such as Intravoxel Incoherent Motion Diffusion Weighted imaging may be a useful technique for assessing perfusion characteristics of tendon.

5189	Computer 110	Imaging low grade inflammation in post-traumatic osteoarthritis
		Amparo Ruiz[1], Alejandra Duarte[1], Mark Milne[2], Zahid Dewan[1], Len Luyt[2], and José G Raya[1]
		[1]New York University, New York, NY, United States, [2]University of Western Ontario, London, ON, Canada
		Chronic inflammation has been identified as a major driver of joint degradation after injury. MRI is very limited to assess chronic inflammation with high specificity. Here we propose a novel contrast agent that targets the interaction of hyaluronan with RAMM cell receptors that represent an important signaling pathway for chronic inflammation. We validated the contrast agent with optical imaging and showed its value as an MRI contrast agent.

5190	Computer 111	New Tissue Saturation Method for the Detection of Therapeutic Cells in a Knee Joint
		Djaudat Idiyatullin[1], Michael Garwood[1], and Sergey Magnitsky[2]

		[1]Center for Magnetic Resonance Research and Department of Radiology, University of Minnesota Medical School, Minneapolis, MN, United States, [2]Radiology, UCSF, San Francisco, CA, United States
		Synapsis. Mesenchymal Stem Cells (MSCs) have a high potential for a treatment of bone diseases. We develop new acquisition protocol for the detection of therapeutic cells in knee joints. Labeling MSCs with iron oxide particles not only reduce T2* but also induce the resonance frequency shift of labeled cells. This shift enabled us to implement tissue saturation scheme and detect distinct hyperintense signal from grafted cells. New protocol allowed us to detect and quantify therapeutic cells for six days after implantation which was not possible before. Proposed protocol opens new opportunities for in vivo monitoring of cell therapy of bone disorders.

5191	Computer 112	High resolution 1 mm isotropic semi continuous wave gagCEST of articular cartilage using parallel transmit at 7T
		Sander Brinkhof[1], Vitaliy Khlebnikov[1], Fredy Visser[1,2], and Hans Hoogduin[1]
		[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Philips Healthcare, Best, Netherlands
		The purpose of this work was to implement gagCEST imaging in articular cartilage at 7T using a parallel transmit setup. Two alternating sets of four transmit channels were used in quadrature mode to create a semi continuous excitation pulse. Using this setup, an isotropic 1 mm spatial resolution could be achieved with a low coefficient of variation of 1.05% (@0.9ppm) within an acquisition time of 5 minutes. To the best of our knowledge, this is the highest gagCEST resolution shown so far in literature.

5192	Computer 113	SyntheticTSE: Accelerated multicontrast spin-echo knee MRI using a combination of Bloch-simulation models, compressed sensing and simultaneous multislice acquisition
		Akio Yoshimoto[1,2], Noam Ben-Eliezer[1,3,4], Mary Bruno[5], Steven H Baete[1,6], Michael Recht[5], and Ricardo Otazo[1,5]
		[1]Center for Advanced Imaging Innovation and Research (CAI2R), NYU School Of Medicine, New York, NY, United States, [2]Biomedical Engineering, School of Engineering, New York University, Brooklyn, NY, United States, [3]Department of Biomedical Engineering, Tel Aviv University, Tel Aviv, Israel, [4]Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel, [5]Department of Radiology, NYU School Of Medicine, New York, NY, United States, [6]Center for Biomedical Imaging, Department of Radiology, NYU School Of Medicine, New York, NY, United States

		Clinical knee MRI examinations usually consist of a series of 2D acquisitions with different contrasts and orientations. In this work, we propose to simplify and shorten the examination by performing multi-contrast imaging using a single acquisition by directly reconstructing parametric maps (PD and T_2) and then synthesizing the contrasts of clinical interest (PD-weighted and T_2-weighted with and without fat suppression). The proposed SyntheticTSE method uses a Bloch-simulation signal model for parametric mapping and a combination of compressed sensing and simultaneous multislice acceleration. Initial feasibility is demonstrated using retrospective undersampling of multi-spin-echo knee dataset

5193	Computer 114	Effects of Reduced Dead Times on the SNR of Tissue with Short T2* values
		Agazi Samuel Tesfai[1], Johannes Fischer[1], Ali Caglar Özen[1], Ute Ludwig[1], and Michael Bock[1]
		[1]Dept. of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany
		MRI of tissues with short T2* can be realized with ultra-short echo time (UTE) sequences. The effect of lowering TE on relative SNR is calculated and evaluated. The limiting factor for dead time and, consequently, low TE is determined for hardware components of clinical MR system and compared to benchmark results.

5194	Computer 115	3D nerve-sheath signal increased with inked rest-tissue rapid acquisition of relaxation enhancement imaging(3D SHINKEI) in traumatic brachial plexopathy
		Shanshan Wang[1], Guangbin Wang[1], and Weibo Chen[2]
		[1]Shandong medical imaging research institute, Jinan, China, [2]Philips Healthcare,Shanghai,China, Shanghai, China
		3D SHINKEI MRN with high spatial resolution ,is an extremely useful modality to image the traumatized brachial plexus and helps to accurately image the complete brachial plexus and localize as well as describe the lesions from the root still the terminal nerves.

5195	Computer 116	4D MSK MRI: Feasibility of Continuous and Pseudo Real-Time Imaging in the Shoulder and the Wrist
		Mitsue Miyazaki[1,2], Won C Bae[1,3], Cheng Ouyang[4], Dawn Berkeley[5], Sheronda Statum[1,3], and Christine B Chung[1,3]

		[1]Radiology, UCSD, La Jolla, CA, United States, [2]Toshiba Medical Systems, Otawara, Japan, [3]VA San Diego Healthcare System, San Diego, CA, United States, [4]Toshiba Medical Research Institute, Vernon Hills, IL, United States, [5]Toshiba America Medical Systems, Tustin, CA, United States
		For dynamic evaluation of musculoskeletal joints including the shoulder and the wrist, continuous and pseudo real-time techniques were developed in 4D (3D acquisition and time) using single shot FSE (SSFSE). Effective echo time (TEeff) of SSFSE was optimized for the contrast at each joint. Advantages of 4D over existing 2D techniques are volume acquisition with thinner slices, crucial in cases of target structures moving out of a single 2D imaging slice. Both continuous and pseudo real-time images permitted depiction of joint movements with good contrast; however, pseudo real-time gives slightly sharper images as compared to continuous real-time images.

5196	Computer 117	Comparison of gagCEST Effects in Phantoms and Bovine Musculoskeletal Specimens Using 2D Single-Shot Fast Spin Echo and 3D Ultrashort Time-to-Echo at 3-Tesla
		Mitsue Miyazaki[1,2], Cheng Ouyang[3], Nirusha Abeydeera[1,4], Dawn Berkeley[5], Reni Biswas[1,4], Sheronda Statum[1,4], Won C Bae[1,4], and Christine B Chung[1,4]
		[1]Radiology, UCSD, La Jolla, CA, United States, [2]Toshiba Medical Systems, Otawara, Japan, [3]Toshiba Medical Research Institute, Vernon Hills, IL, United States, [4]VA San Diego Healthcare System, San Diego, CA, United States, [5]Toshiba America Medical Systems, Tustin, CA, United States
		3D UTE and 2D single-shot fast spin-echo (SSFSE) gagCEST techniques were used to image varying concentrations of chondroitin sulfate (CS) in long or short T1 solutions. Echo time (TE) in SSFSE and UTE ranged from 10-60 ms, and 0.1-8 ms, respectively. Effect of TE on asymmetric magnetization transfer ratio (MTR_{asym}) was examined around 1.0 and 3.5 ppm. For long T1 saline phantom, we found a general increase in MTR_{asym} with concentration, with similar slopes over different TEs, for either technique. For short T1 MnCl2 doped phantom, while UTE could acquire gagCEST signal unlike SSFSE, no consistent trends were found.

5197	Computer 118	SNR Optimization of Simultaneous Multi-Slice Accelerated TSE Sequences for Diabetic Foot Imaging
		Yauheni Rudzevich[1], Kenneth Buckwalter[1], Chen Lin[1], and Dingxin Wang[2]
		[1]Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States, [2]Department of Radiology, University of Minnesota, Minneapolis, MN, United States

		To optimize Simultaneous Multi-Slice (SMS) accelerated TSE sequences for ultra-fast imaging of patients with diabetic neuropathy, a phantom study was performed to determine the optimal Field of View Shift (FOVS) which is a key parameter for SMS, but depend on other imaging parameters and coil configuration. SNR maps for different FOVS were measured using a subtraction method combined with shifting ROI. The optimal selections of FOVS based on quantitative SNR measurement are in good agreement with the selections derived from visual evaluation of clinical images by radiologists. Such agreement provides additional confidence.

5198	Computer 119	Fully-Automated Segmentation of Knee Joint Anatomy using Deep Convolutional Neural Network Approach
		Fang Liu[1], Zhaoye Zhou[2], and Richard Kijowski[1]
		[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States
		A new fully-automated approach was proposed using a deep convolutional encoder-decoder (CED) network combined with 3D fully-connected conditional random field (CRF) and 3D simplex modeling for performing efficient and accurate multi-class musculoskeletal tissue segmentation from MR images. The deep learning-based segmentation method could be used to create 3D rendered models of all knee joint structures including cartilage, bone, tendon, meniscus, muscle, infrapatellar fat pad, and joint effusion and Baker's cyst which may be sources of pain in patients with knee osteoarthritis. The results of our study serve as a first step to provide quantitative MR measures of musculoskeletal tissue degeneration in a highly time efficient manner which would be practical for use in large population-based osteoarthritis research studies.

5199	Computer 120	Ultrashort Echo Time-MRI of proximal femoral cortical bone in patients with osteoporosis
		Dimitri MARTEL[1], Mary BRUNO[1], H.Michael BELMONT[2], Amit SAXENA[2], Gabrielle TURYAN[1], Stephen HONIG[3], Ravinder R. REGATTE[1], and Gregory CHANG[1]
		[1]Radiology, NYU Langone Health, New York, NY, United States, [2]Department of Rheumatology, NYU Langone Health, New York, NY, United States, [3]Osteoporosis Center, Hospital for Joint Diseases, NYU Langone Health, New York, NY, United States
		Ultra-short echo time MRI (uTE-MRI) allows exploration of the role of cortical bone properties in osteoporosis. OP can be primary or can also be induced by drugs such as glucocorticoids (glucocorticoid-induced osteoporosis, GIO).No previous studies have assessed cortical porosity in GIO patients compared to OP patients.Our aim was to perform uTE-MRI of cortical bone of the proximal femur (a common site of fracture) in GIO patients and compare the results to those of OP patients using a bi-exponential fitting procedure of uTE images.

Electronic Poster

Fiber Orientation & Fiber Tracking

Exhibition Hall	Thursday 8:00 - 9:00

5200	Computer 1	The uncinate fasciculus: hemispheric asymmetries of DTI metrics and curvature mapping
		Lia Talozzi[1,2], Claudia Testa[1,2], Stefania Evangelisti[1,2], Lorenzo Cirignotta[1,2], Claudio Bianchini[1,2], Micaela Mitolo[1,2], Paola Fantazzini[3,4], Caterina Tonon[1,2], David Neil Manners[1,2], and Raffaele Lodi[1,2]
		[1]Department of Biomedical and NeuroMotor Sciences, University of Bologna, Bologna, Italy, [2]Functional MR Unit, Policlinico S.Orsola-Malpighi, Bologna, Italy, [3]Department of Physics and Astronomy, University of Bologna, Bologna, Italy, [4]Centro Enrico Fermi, Roma, Italy
		We reconstructed the uncinate fasciculus bilaterally by probabilistic tractography in a group of 29 healthy subjects, in order to quantitatively investigating hemispheric asymmetries. We evaluated tract volume and DTI metrics. Our tract Laplacian parameterization successfully described curving bundles and allowed the calculation of along-tract measures and curvature mapping. Group variability maps showed a more dorsal route in the left hemisphere, towards the lateral fronto-orbital cortex. We also found a higher fractional anisotropy on the right compared to the left and different tract curvature. These asymmetries could be associated to specific tract functions as semantic and emotional processing, selectively affected in pathologies.

5201	Computer 2	Ischemic optic neuropathy: Using Track-Weighted Imaging to detect changes in the neuroretina
		Arnaud Attyé[1], Felix Renard[1], Clement Jean[1], Laurent Lamalle[2], and Alexandre Krainik[1]
		[1]Grenoble University Hospital, Grenoble, France, [2]Inserm US 17 - CNRS UMS 3552 - Univ. Grenoble Alpes & CHU Grenoble Alpes, UMS IRMaGe, Grenoble, France
		Track-Weighted Imaging was recently introduced as a qualitative tractography-based method with super-resolution properties and high anatomical contrast. We report the use of this method to explore the human retina. In healthy volunteers, we showed that reconstructions of neuroretinal fascicles were influenced by diffusion acquisition parameters, ocular laterality, and ocular dominance. We have raised the hypothesis that patients with anterior ischaemic optic neuropathy, a disease that leads to degeneration of neuroretinal cells, could present with specific neuroretinal fascicle injuries. We demonstrated that presence of the temporal fascicle in the affected eye provides an objective outcome radiological sign correlated with visual recovery.

5202	Computer 3	Tractography-Based Atlas of the Healthy Cortico-Spinal Tract
		Aymeric Stamm[1,2,3], Alessandro Zito[4], Valeria Callioni[4], Ilaria Sartori[4], Luca Torriani[4], and Simone Vantini[1]

		[1]Dpt. of Mathematics, Politecnico di Milano, Milan, Italy, [2]Dpt. of Radiology, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States, [3]Center for Analysis, Decisions, and Society, Human Technopole, Milan, Italy, [4]Politecnico di Milano, Milan, Italy
		The corticospinal tract is a critical white matter pathway as it connects the primary motor cortex to the spinal cord and handles voluntary motion. Atlases of major brain connections do exist, but, surprisingly, atlases that depict the actual localisation of a specific pathway are missing. In this work, we propose a comprehensive statistical methodology for generating an atlas of the healthy CST. This should help designing efficient statistical tests for detecting damaged tissue along the CST and consequently improving patient outcome in a number of brain pathologies (tumors, strokes, Parkinson and related disorders, etc.).

5203	Computer 4	Bootstrapping Fibre Orientation Distributions: Accuracy advantages and other benefits of estimating shape uncertainty
		Marina Rakic[1], Robert Dallyn[2], and Flavio Dell'Acqua[2]
		[1]Natbrainlab & Centre for Neuroimaging Studies, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, [2]Natbrainlab, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom
		Inherently low signal-to-noise ratio in diffusion-MRI results in high uncertainty in the estimated underlying fibre orientation distributions. True bootstrapping and model- based residual bootstrapping approaches have been proposed to estimate the uncertainty in the estimated peak directions. Here we compare the two methods using simulations and observe that more information can be extracted by looking at the variation in the *entire shape* of the FOD, as opposed to just the *peak direction*. Results also suggest that, in this case, residual bootstrapping might not provide a representative estimation of directional uncertainty due to non-negligible model bias.

5204	Computer 5	Biases in classical structural parcellation
		Michael Hejselbak Jensen[1], Henrik Thomsen[1], Sune Darkner[1], Matthew Liptrot[2], Niklas Kasenburg[1], Karl-Anton Dorph-Petersen[3], and Aasa Feragen[4]
		[1]University of Copenhagen, Copenhagen, Denmark, [2]University of Copenhagen and DTU Compute, Copenhagen, Denmark, [3]Aarhus University and University of Pittsburgh, Aarhus, Denmark, [4]Computer Science, University of Copenhagen, Copenhagen, Denmark

		The classical structural parcellation algorithm by Behrens et al[1] remains widely used in clinical research, largely thanks to its simplicity and availability in standard MRI processing software. However, its construction and dependency on tractography leads to several biases that can severely affect the conclusions drawn from it, but which are not well known. We illustrate these biases via the original thalamus parcellation experiment on Human Connectome Project (HCP) data[3]. Based on our experiments, we outline open problems for future structural parcellation algorithms, and possible directions for overcoming them.

5205	Computer 6	Exploring peritumoral neural tracts by using Neurite Orientation Dispersion and Density Imaging
		Shin Tai Chong[1], Hung-Wen Kao[2], Chien-Yuan Eddy Lin[3], Chiao-Chi Chen[4], Chun-Yi Zac Lo[5], Ching-Po Lin[1], and Chen Chang[4]
		[1]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [2]Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan, [3]GE Healthcare MR Research China, Beijing, China, People's Republic of, Taipei, Taiwan, [4]Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan, [5]Institute of Science and Technology for Brain-Inspired Intelligence, Fudan University, Shanghai, China
		We hypothesized that the Neurite Orientation Dispersion and Density Imaging (NODDI)-based tractography could improve the reconstruction of the fiber tracts that by tracking through regions of peritumoral edema. In visual comparison with diffusion tensor imaging (DTI), this model provided similar performance in healthy side and better performance in the corticospinal tract (CST) of the affected side. This technique may help neurosurgeons to define an optimal safe margin for total resection.

5206	Computer 7	The impact of structure tensor informed fibre tractography (STIFT) on structural connectivity
		Kwok-Shing Chan[1], David G. Norris[1], and José P. Marques[1]
		[1]Donders Centre for Cognitive Neuroimaging, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands
		Structure tensor informed fibre tractography(STIFT) incorporating white matter morphology from gradient echo data to diffusion data is beneficial in the presence of kissing and highly curved fibres. However, previous demonstrations of STIFT provide only qualitative results and its performance beyond the initial targets (optic radiation and cingulum) is still unknown. This study investigated the quantitative effects of STIFT through structural connectivity comparison between diffusion tractography and STIFT. We found that there is no change of connectivity with STIFT in major structural connections.

5207	Computer 8	DTI-based Network Analysis of APP/PS1 Mouse Brains with Age and Sex

		Samuel Colles Grant[1,2], David C Hike[1,2], Abdol Aziz Ould Ismail[1,2], Victor Wong[1], Scott Boebinger[1], and Tara Palin[1]
		[1]Chemical & Biomedical Engineering, Florida State University, Tallahassee, FL, United States, [2]Center for Interdisciplinary MR, National High Magnetic Field Laboratory, Tallahassee, FL, United States
		This study utilizes DTI and graph theory as a novel way for identifying early pathology and connectivity changes related to Alzheimer's Disease. As a function of phenotype, age and sex, DTI studies were performed on APP/PS1 mouse brains and age-matched wild type controls at 11.75 T. Current data shows a drop in FA and a decrease in connectivity in the temporal region of the brain. High resolution 3D images acquired at 21.1 T display the presence of amyloid plaques, which temporally correlate with the progression of structural connectivity alterations in this transgenic preclinical model.

5208	Computer 9	The unresolved problem of synaptic connectivity in the context of the cerebro-cerebellar loop
		Fulvia Palesi[1,2], Fernando Calamante[3,4], Giovanni Savini[2,5], Egidio D'Angelo[2,6], and Claudia Angela Michela Gandini Wheeler-Kingshott[6,7,8]
		[1]Department of Physics, University of Pavia, Pavia, Italy, [2]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy, [3]Florey Institute of Neuroscience and Mental Health, University of Melbourne, Heidelberg, Australia, [4]Florey Department of Neuroscience and Mental Health, University of Melbourne, Melbourne, Australia, [5]Department of Physics, University of Milan, Milan, Italy, [6]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, [7]Queen Square MS Centre, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [8]Brain MRI 3T Research Center, C. Mondino National Neurological Institute, Pavia, Italy
		Recently advanced tractography has been used for assessing the feasibility of characterizing cerebro-cerebellar tracts, acknowledging the issue of how tractography deals with polysynaptic connectivity in particular through the thalamus. In this work, four different synaptic connectivity configurations at thalamic level were hypothesized and each one of them was reconstructed using high-quality HCP data. Our findings revealed the key role of thalamic connectivity for characterizing the cerebro-cerebellar connections. We can hypothesize that the relation between streamlines entering/outing the thalamic synapses is multiplicative and our findings using polysynaptc thalamic tracts support the fact that cognitive/associative areas are the mainly involved in the cerebro-cerebellar connections.

5209	Computer 10	Improved fibre tracking with optimized diffusion-weighted single-refocused spin echo EPI
		Manoj Shrestha[1], Pavel Hok[1,2], Ulrike Nöth[1], Bianca Lienerth[1], and Ralf Deichmann[1]
		[1]Brain Imaging Center (BIC), Goethe University Frankfurt, Frankfurt am Main, Germany, [2]Department of Neurology, Palacky University Olomouc and University Hospital Olomouc, Olomouc, Czech Republic

		This study investigates the suitability of data acquired with an optimized diffusion-weighted (DW) single-refocused spin-echo EPI sequence for fibre tracking. The proposed scheme uses dummy scans of 1.5s duration prior to the acquisition of each multi-slice data volume, thus driving eddy-currents into a steady-state, thus allowing to use an optimized parameter setting of the eddy-current correction tool “EDDY”. Results show that the proposed sequence yields better fibre tracking results than conventional DW sequences with a more precise estimation of the subsidiary fibre orientations, showing additional connections to the lateral frontal, parietal and temporal cortices and to the thalamus.

5210	Computer 11	Are Brain Networks Reproducible across Sites?
		Abdol Aziz Ould Ismail[1], Drew Parker[1], Sriram Moparthy[1], Birkan Tunç[2], and Ragini Verma[1]
		[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Psychiatry, University of Pennsylvania, Philadelphia, PA, United States
		The field of connectomics has introduced new computational tools to the system neuroscience domain, facilitating novel investigations into the mechanisms of the human brain. While methodological advancements in connectomics have found numerous applications with exciting interpretations, a systematic analysis on the reliability and reproducibility of the results and inferences drawn from the findings is still missing. We aim to fill this gap by studying the reproducibility of connectomics findings on diffusion data that has been collected at different sites with varying acquisition protocols. Structural network properties at local, meso, and global scales were investigated to determine what is different and what is preserved in the presence of site related variation. Our comprehensive investigation revealed that despite significant differences between local and global properties, the topological features were mostly preserved.

5211	Computer 12	Personalized Lesion Profiling in Multiple Sclerosis
		Sidong Liu[1,2], Alexander Klistorner[1,2,3], Chenyu Wang[1,4], Yang Gao[5], Brittany Gilchrist[2,3], Yang Song[6], Yuyi You[2], Junen Yao[5], Weidong Cai[6], and Michael Barnett[1,4]
		[1]Brain and Mind Centre, University of Sydney, Sydney, Australia, [2]Save Sight Institute, University of Sydney, Sydney, Australia, [3]Faculty of Medicine and Health Sciences, Macquarie University, Sydney, Australia, [4]Sydney Neuroimaging Analysis Centre, Sydney, Australia, [5]School of Instrumentation Science and Opto-Electronics Engineering, Beihang University, Beijing, China, [6]School of Information Technologies, University of Sydney, Sydney, Australia

		The pathology of multiple sclerosis (MS) lesions is highly subject-specific, therefore personalized lesion analysis is important in assessing the degree of disease-related brain damage and the patient's response to therapy. Separating and comparing lesional and non-lesional tissue provides an "internal control" and, therefore, increased precision of measurement of the degree of lesional damage in the brain. Here we present a novel and fully automatic method to create a personalized lesion profile of the subject based on DTI tractography, which can be used to assess whole brain lesional damage. This technique can be applied to measure microstructural change using any MRI modality, and may have high translational impact in clinical trials and neurological research.

5212	Computer 13	Reproducibility of Human Diffusion Connectomes Generated from Different Atlases: A Multicenter Study
		Qiqi Tong[1], Hongjian He[1], Peipeng Liang[2], Ting Gong[1], Tianyi Qian[3], Yi Sun[4], Qiuping Ding[1], Chen Li[1], Kuncheng Li[2], and Jianhui Zhong[1]
		[1]Center for Brain Imaging Science and Technology, Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Department of Radiology, Xuanwu Hospital, Capital Medical University, Beijing, China, [3]MR Collaboration NE Asia, Siemens Healthcare, Beijing, China, [4]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China
		In a multicenter study, high reproducibility among centers is essential. However, the construction of diffusion connectomes requires multiple complex steps. Errors may be easily hidden in the connectome matrix and possible deteriorate the intrinsic neural network analysis. The registration and parcellation based on the brain template are the final steps and are vital to the connectome matrix. A different anatomical and functional image-based atlas may produce variable reproducibility in diffusion connectome matrices. In this work, seven frequently used atlases were compared to test the reproducibility of different templates.

5213	Computer 14	AFQ-Browser: Supporting reproducible human neuroscience research through browser-based visualization tools
		Jason Yeatman[1,2], Adam Richie-Halford[3], Josh Kenyon Smith[4], Anisha Keshavan[1,5], and Ariel Rokem[5]
		[1]Institute for Learning and Brain Sciences, The University of Washington, Seattle, WA, United States, [2]Department of Speech and Hearing Sciences, The University of Washington, Seattle, WA, United States, [3]The Department of Physics, The University of Washington, Seattle, WA, United States, [4]Department of Chemical Engineering, The University of Washington, Seattle, WA, United States, [5]eScience Institute, The University of Washington, Seattle, WA, United States

		MRI research faces various challenges with regards to reproducibility: scientists are generally aware that data sharing is an important component of reproducible research, but it is not always clear how to share data in a manner that allows other researchers to understand and reproduce published findings. Here we describe AFQ-Browser, a software tool that builds an interactive website as a companion to a diffusion MRI study and leverages web-visualization technologies to create linked views between different aspects of a diffusion MRI dataset (anatomy, diffusion metrics, subject metadata). This facilitates exploratory data analysis, fueling new scientific discoveries based on previously published datasets.

5214	Computer 15	Adaptive linear discriminant analysis for complex networks to study extreme prematurity and intrauterine growth restriction effects at school age
		Serafeim Loukas[1,2], Djalel Eddine Meskaldji[1,3], Elda Fischi Gomez[1,4], Lana Vasung[5], Dimitri Van De Ville[2], and Petra Susan Huppi[1]
		[1]Division of Development and Growth, Department of Pediatrics, University of Geneva, Geneva, Switzerland, [2]Institute of Bioengineering, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]Applied statistics, Institute of Mathematics, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [4]Signal Processing Laboratory LTS5, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [5]Department of Pediatrics, Boston Children's Hospital, Boston, MA, United States
		In this study, we combined complex network theory with machine learning in order to grasp potential biomarkers of brain development. The data consists of brain connectomes (brain connectivity matrices) of 53 children aged six years old. For each subject, we estimated brain network-based measures at four different levels: connection, node, module and global levels. Then we applied linear discriminant analysis and support vector machine in order to extract features and we compared their performances. We showed that node and module levels are the best choices to extract relevant and interpretable biomarkers in order to distinguish between different brain development conditions.

5215	Computer 16	Advances in structural and functional connectivity visualization using the Fibernavigator
		Maxime Chamberland[1], Maxime Descoteaux[2], and Derek K. Jones[1]
		[1]CUBRIC, Cardiff University, Cardiff, United Kingdom, [2]SCIL, Computer Science, University of Sherbrooke, Sherbrooke, QC, Canada
		Scientific data visualization is constantly challenged by the continuously growing diffusion MRI (dMRI) field. Exploring and interacting with high-dimensional datasets is central to every analysis pipeline, allowing us to better understand the behavior of a certain tracking algorithm, for example. In this abstract, we present a brief overview of the recent advances in data analysis & visualization available inside the Fibernavigator package.

5216	Computer 17	Enhancing bundle topology for tractography visualization using silhouette rendering Maxime Chamberland[1] and Derek K. Jones[1] *[1]CUBRIC, Cardiff University, Cardiff, United Kingdom* Global illumination rendering techniques are often considered the gold standard for displaying 3D structures. They are however computationally expensive and most neuroimaging software packages do not support such advanced methods. Here, we applied *cartoon-like* shading to tractography-derived bundles to enhance visualization of their topological features. Combined with glass-brain rendering, we believe that this non-realistic rendering technique can help both new comers to the field and experienced scientists to better perceive shape specific features of brain bundles, enhancing both neuroanatomical understanding and neurosurgical planning.

5217	Computer 18	Generation of a muscle fibre orientation atlas of the in vivo tongue Luuk Voskuilen[1,2,3], Ludi E. Smeele[1,4], Alfons J.M. Balm[1,4], Ferdinand van der Heijden[1,5], Gustav J. Strijkers[6], and Aart J. Nederveen[2] *[1]Department of Head and Neck Oncology and Surgery, Netherlands Cancer Institute/Antoni van Leeuwenhoek Hospital, Amsterdam, Netherlands, [2]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands, [3]Department of Oral and Maxillofacial Surgery, Academic Centre for Dentistry Amsterdam and Academic Medical Center, University of Amsterdam and VU University, Amsterdam, Netherlands, [4]Department of Oral and Maxillofacial Surgery, Academic Medical Center, Amsterdam, Netherlands, [5]Department of Robotics and Mechatronics, MIRA Institute, University of Twente, Enschede, Netherlands, [6]Department of Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands* While diffusion tensor imaging based atlases in the brain are common, no muscle fibre atlases for the tongue have been created. An unbiased atlas was generated from ten healthy volunteers, by iteratively registering fibre orientation distributions calculated via constrained spherical deconvolution to a template. The atlas shows good reproducibility and better performance than an image intensity based atlas. Various tongue muscles can be detected in tractography of the atlas. This atlas may facilitate automatic segmentation of tongue muscles after tumour resection to evaluate impaired tongue function.

5218	Computer 19	Functional- and Structural-Connectivity Connectome Fingerprints Correlate With Cognitive Behavior Traits in HCP Datasets Ying-Chia Lin[1,2], Steven H. Baete[1,2], Xiuyuan Wang[1,2], and Fernando E. Boada[1,2] *[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), NYU School of Medicine, New York, NY, United States*

		Connectome analysis of the human brains structural and functional architecture provides a unique opportunity to understand the organization of brain networks. Recently, connectome fingerprinting using brain functional connectivity profiles as the unique traits was able to identify individuals from the group in the Human Connectome Project (HCP) datasets. In HCP s900 datasets, we extend connectome fingerprinting from functional to structural connectivity, identifying multiple relationships between behavioral traits and brain connectivity.

5219	Computer 20	The Benefits Of Cognitive Training Depend On The Wiring Of The Brain
		Karen Caeyenberghs[1], Claudia Metzler-Baddeley[2], Peter Wilson[1], and Derek K Jones[2]
		[1]School of Psychology, Australian Catholic University, Melbourne, Australia, [2]Cardiff University, Cardiff, United Kingdom
		There is strong evidence that task-specific training leads to changes in brain structure, as assessed using MRI-based techniques that probe microstructure or morphology. In the present study, we want to understand the specific mechanisms of action of task-specific training and identify other critical ingredients. Here, we used a well-established working memory training program and state-of-the art neuroimaging methods in 40 healthy adults. Further research on dose, timing, and duration of training is necessary to generalize the training protocols to the field of structural neuroplasticity.

5220	Computer 21	Automated fibre tractography of the optic radiation for epilepsy surgery planning
		Sjoerd B Vos[1,2,3], Matteo Mancini[1,3], Vejay Vakharia[3,4], Rachel Sparks[1,3], Mei Iok Chiang[1,5], M Jorge Cardoso[1], John S Duncan[2,3,4], Gavin P Winston[2,4,6], and Sebastien Ourselin[1,3,4,7]
		[1]Translational Imaging Group, University College London, London, United Kingdom, [2]MRI Unit, Epilepsy Society, Chalfont St Peter, United Kingdom, [3]Wellcome EPSRC Centre for Interventional and Surgical Sciences (WEISS), University College London, London, United Kingdom, [4]Department of Clinical and Experimental Epilepsy, University College London, London, United Kingdom, [5]Center for Disease Control and Prevention, Health Bureau, Macau, Macau, [6]Neuroimaging of Epilepsy Laboratory, Montreal Neurological Institute, McGill University, Montreal, Canada, [7]Dementia Research Centre, University College London, London, United Kingdom
		Fibre tractography of the optic radiation can be helpful in epilepsy surgery, but its widespread clinical use is hampered by the need for time-consuming expert manual ROI delineations and interrater variability. Our automated approach using anatomically constrained geodesic shape-based averaging is evaluated on two diffusion MRI datasets from different scanners. Automatically generated tracts are within the interrater agreement of two expert raters when evaluating for distance between temporal pole and Meyer's loop for both datasets, with a tendency towards a more inclusive Meyer's loop in the automated method.

5221	Computer 22	Decomposition of brain structural connectivity using Independent component analysis
		Farzaneh Keyvanfard[1,2], Abbas Nasiraei Moghaddam[1,3], Alessandra Griffa[2], and Patric Hagmann[2]
		[1]Biomedical Engineering, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran (Islamic Republic of), [2]Department of Radiology, University Hospital Center and University of Lausanne, Lausanne, Switzerland, [3]School of Cognitive Sciences, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran (Islamic Republic of)
		Diffusion imaging provides the capability of investigating brain white matter non-invasively. There is an increasing interest in studying whole brain structural connectivity (SC) as a complex network, but examining multiple structural sub-networks has yet to be investigated. In this study we have proposed a specific pipeline to decompose whole brain structural connectivity into different sub-networks using Independent Component Analysis (ICA). Obtaining two structural gender related sub-networks in line with previous findings confirms the feasibility of the approach.

5222	Computer 23	Reducing Tractogram Endpoint Biases with Surface-Enhanced Tractography
		Etienne St-Onge[1] and Maxime Descoteaux[1]
		[1]Sherbrooke Connectivity Imaging Lab (SCIL), Université de Sherbrooke, Sherbrooke, QC, Canada
		In this work, we highlight the importance and advantages of integrating cortical surfaces with dMRI tractography. Doing so facilitates the integration of gray matter (GM) features in white matter (WM) connectivity analysis. Extending streamlines to cortical meshes allows the study of WM structural features from tractography along the cortex. This combined approach also enables the measurement of streamline connections cortical coverage and density bias with different tractography algorithms.

Electronic Poster

Microstructure: Modeling

Exhibition Hall	Thursday 8:00 - 9:00

5223	Computer 25	Accurate fibre dispersions from varying the b-tensor shape
		Michiel Cottaar[1], Filip Szczepankiewicz[2,3], Matteo Bastiani[1], Stamatios N. Sotiropoulos[1,4], Markus Nilsson[2], and Saad Jbabdi[1]

		[1]*Wellcome Centre for Integrative Neuroscience (WIN) - FMRIB, University of Oxford, Oxford, United Kingdom,* [2]*Clinical Sciences Lund, Department of Radiology, Lund University, Lund, Sweden,* [3]*Random Walk Imaging AB, Lund, Sweden,* [4]*Sir Peter Mansfield Imaging Centre, School of Medicine, University of Nottingham, Nottingham, United Kingdom*
		Accurate measures of fibre dispersion might improve tractography through voxels with bending and/or fanning configurations and also provide more accurate tissue microstructure indices. When estimated from regular diffusion MRI, however, the accuracy of the dispersion estimate depends on the accuracy of the underlying microstructural model. In this work, we find that encoding water diffusion using multiple shapes of the b-tensor leads to an accurate measurement of fibre dispersion within a single b-shell. We show that this holds for complicated sub-voxel geometries using both simulations and in vivo data.

5224	Computer 26	Intra-axonal Fractional Anisotropy from Fiber Ball Imaging
		Hunter Moss[1], Emilie T. McKinnon[2], Andreana Benitez[2], Dorothea D. Jenkins[3], G. Russel Glenn[4], Jens H. Jensen[5], and Joseph A. Helpern[5]
		[1]*Medical University of South Carolina, Charleston, SC, United States,* [2]*Neurology, Medical University of South Carolina, Charleston, SC, United States,* [3]*Pediatrics, Medical University of South Carolina, Charleston, SC, United States,* [4]*Medical College, Medical University of South Carolina, Charleston, SC, United States,* [5]*Neuroscience, Medical University of South Carolina, Charleston, SC, United States*
		Using fiber ball imaging (FBI), we isolate the intra-axonal compartment of the white matter with strong diffusion weighting in order to suppress the extra-axonal water fraction and then calculate its associated fractional anisotropy (FA). We call this parameter the fractional anisotropy axonal (FAA) in contrast to the conventional FA, and we compare these two measures in three subjects: a healthy young adult, a cognitively intact older adult with severe white matter abnormalities, and a neonate with acute hypoxic ischemic injury. Our results indicate that FAA reveals diffusion anisotropy that is not apparent using the conventional FA.

5225	Computer 27	Deep Learning Captures More Accurate Diffusion Fiber Orientations Distributions than Constrained Spherical Deconvolution
		Vishwesh Nath[1], Kurt G Schilling[2], Prasanna Parvathaneni[3], Allison E Hainline[4], Colin B Hansen[1], Camilo Bermudez[2], Andrew J Plassard[1], Justin A Blaber[1], Vaibhav Janve[2], Yurui Gao[2], Iwona Stepniewska[5], Adam W Anderson[2], and Bennett A Landman[3]
		[1]*Computer Science, Vanderbilt University, Nashville, TN, United States,* [2]*Biomedical Engineering, Vanderbilt University, Nashville, TN, United States,* [3]*Electrical Engineering, Vanderbilt University, Nashville, TN, United States,* [4]*Biostatistics, Vanderbilt University, Nashville, TN, United States,* [5]*Psychology, Vanderbilt University, Nashville, TN, United States*

		Confocal histology provides an opportunity to establish intra-voxel fiber orientation distributions that can be used to quantitatively assess the biological relevance of diffusion-weighted MRI models, e.g., constrained spherical deconvolution (CSD). Here, we apply deep learning to investigate the potential of single shell diffusion-weighted MRI to explain histologically observed fiber orientation distributions (FOD) and compare the derived deep learning model with a leading CSD approach. This study (1) demonstrates that there exists additional information in the diffusion signal that is not currently exploited by CSD, and (2) provides an illustrative data-driven model that makes use of this information.

5226	Computer 28	Influence of the size and curvedness of neural projections on the orientationally averaged diffusion MR signal
		Evren Özarslan[1], Cem Yolcu[1], Magnus Herberthson[2], Hans Knutsson[1], and Carl-Fredrik Westin[1,3]
		[1]Department of Biomedical Engineering, Linköping University, Linköping, Sweden, [2]Department of Mathematics, Linköping University, Linköping, Sweden, [3]Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States
		We studied the orientationally averaged diffusion weighted MR signal for diffusion along general curves at all three temporal regimes of the traditional pulsed field gradient measurements. We found that long fibers as well as short fibers that are straight could yield the q^{-1} decay. The absence of such a decay suggests fibers that are short and curvy. We note that the true asymptotic behavior of the signal decay is characterized by the Debye-Porod law, which suggests $\bar{E}(q)\propto q^{-4}$ at very large q-values. This study is expected to provide insights for interpreting the diffusion-weighted images of the central nervous system.

5227	Computer 29	Estimation of the brain microstructure in the presence of crossing fascicles from a dictionary of Monte Carlo signals
		Gaëtan Rensonnet[1,2], Benoit Scherrer[3], Gabriel Girard[1], Jonathan Rafael-Patino[1], Simon K Warfield[3], Benoit Macq[2], Jean-Philippe Thiran[1,4], and Maxime Taquet[3]
		[1]Signal Processing Lab (LTS5), Ecole polytechnique fédérale de Lausanne, Lausanne, Switzerland, [2]ICTEAM, Université catholique de Louvain, Louvain-la-Neuve, Belgium, [3]Computational Radiology Laboratory, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States, [4]Radiology Department, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland
		We estimate microstructural features of crossing fascicles using Monte Carlo simulations to represent the diffusion attenuation of each fascicle. The measured diffusion-weighted MRI signal is reconstructed as a sparse weighted sum of pre-computed signals and microstructural properties are estimated from the selected fascicle configurations. The consistent results obtained on various synthetic phantoms as well as on in vivo brain data suggest the potential of our method for the quantitative estimation of microstructural features in fascicle crossings.

5228	Computer 30	Advanced quantification of dispersion and directionality in three-dimensional electron microscopy images and diffusion MR imaging of injured rat brain Raimo A. Salo[1], Ilya Belevich[2], Eppu Manninen[1], Eija Jokitalo[2], Olli Gröhn[1], and Alejandra Sierra[1] *[1]A. I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland, [2]Institute of Biotechnology, University of Helsinki, Helsinki, Finland* The relationship between orientation distribution functions (ODFs) from advanced dMRI and the real tissue microstructure is under active research. We utilized three-dimensional (3D) serial block-face scanning electron microscopy in the corpus callosum and cingulum, and implemented 3D structure tensor (ST) analysis to produce ODFs comparable to dMRI ODFs from the same locations. The ODFs were parametrized using Watson distribution. Our results showed a clear correspondence in orientation estimates, but dispersion estimates were not as clearly correlated. ST analysis combined with 3D SBEM has great potential to unveil the complexity of the underlying microstructure in biological tissues.

5229	Computer 31	Sensing Von Economo Neurons in the Insula with Multi-shell Diffusion MRI Demian Wassermann[1,2], Van-Dang Nguyen[3], Guillermo Gallardo-Diez[2], Jing-Rebecca Li[4], Weidong Cai[5], and Vinod Menon[5] *[1]Parietal, Inria, CEA, Université Paris-Saclay, Palaiseau, France, [2]Athena, Inria, Sophia-Antipolis, France, [3]Royal Institute of Technology in Stockholm, Stocholm, Sweden, [4]DEFI, Inria, Palaiseau, France, [5]Stanford Medical School, Palo Alto, CA, United States* Sensing microstructural characteristics of human brain tissue with clinical scanners has been an area of heated debate in the diffusion MRI (dMRI) community . In this work we propose that diffusion MRI on clinical scanners is sensitive to the presence of Von Economo neurons. Von Economo neurons, located in the insular and anterior cingular cortices, are large neurons present only in mammals with high cognitive functions. Albeit these neurons' role is not yet known, evidence suggests they facilitate rapid long-range information integration. In this work, we provide theoretical and in-silico evidence that the dMRI signal is sensitive to the presence of Von Economo neurons as well as preliminary evidence on human dMRI images.

5230	Computer 32	Prediction of Neurite Indices From Diffusion Tensor Imaging in the human cerebral cortex. Hikaru Fukutomi[1,2], Thai Akasaka[2], Koji Fujimoto[3], Takayuki Yamamoto[2], Tomohisa Okada[3], Kaori Togashi[2], and Takuya Hayashi[1]

		[1]RIKEN Center for Life Science Technologies, Kobe, Japan, [2]Department of Diagnostic Imaging and Nuclear Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [3]Human Brain Research Center, Graduate School of Medicine, Kyoto University, Kyoto, Japan
		Recent studies suggest that Neurite Orientation Dispersion and Density Imaging (NODDI) provides valuable information about cortical neurites. However, it requires lengthy time to acquire multi-shell data of diffusion weighted imaging (DWI), as well as to calculate parameters, neurite density index (NDI) and orientation dispersion index (ODI). We propose a method to estimate cortical NDI and ODI from diffusion tensor imaging (DTI), which is based on a mathematical relationship between NODDI and DTI assuming negligible cerebrospinal fluid (CSF) in the cortex. We also show the accuracy and time for scanning and computation.

5231	Computer 33	Stick, ball, and plane phantoms for validation of diffusion MRI
		Karin Bryskhe[1], Johan Larsson[2], Dan Lundberg[3], Greta Eklund[1], Hong Jiang[2], Filip Szczepankiewicz[1], and Daniel Topgaard[2]
		[1]Random Walk Imaging, Lund, Sweden, [2]Lund University, Lund, Sweden, [3]CR Competence, Lund, Sweden
		When using quantitative measurements, sensitive to subtle errors, access to a stable reference object is crucial to validate parameter accuracy, and system fluctuations. Here, we propose three complementary phantoms providing ideal systems for validation of metrics of diffusivity, microscopic anisotropy, and compartment orientation. We have used liquid crystals to design phantoms exhibiting local diffusion tensors with normalized anisotropy ($\mathbf{D}_\Delta$) equal to the theoretical values of +1 (sticks), 0 (balls), as well as –½ (planes). We also confirm that our proposed phantoms have the desired properties with regards to voxel-average diffusion tensors and microscopic diffusion tensors.

5232	Computer 34	Microscopic diffusion anisotropy imaging in the kidneys
		Fabio Nery[1], Matt G Hall[1], David L Thomas[2], Enrico Kaden[3], Filip Szczepankiewicz[4,5], Isky Gordon[1], and Chris A Clark[1]
		[1]Developmental Imaging and Biophysics Section, UCL Great Ormond Street Institute of Child Health, London, United Kingdom, [2]UCL Institute of Neurology, Department of Brain Repair and Rehabilitation, London, United Kingdom, [3]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom, [4]Clinical Sciences, Lund, Lund University, Lund, Sweden, [5]Random Walk Imaging AB, Lund, Sweden

		Diffusion tensor imaging (DTI) is a widely used diffusion weighted imaging (DWI) approach, successful owing to its sensitivity to changes in tissue microstructure. Recent advances in diffusion MRI acquisition using arbitrary b-tensor shapes allow the in-vivo estimation of tissue microscopic fractional anisotropy (μFA), which unlike conventional fractional anisotropy (FA) is not confounded by orientation dispersion. The aim of this work is to investigate, for the first time, the feasibility of μFA quantification in the kidneys of healthy volunteers.

5233	Computer 35	Robust and fast MCMC sampling of diffusion MRI microstructure models
		Robbert Leonard Harms[1] and Alard Roebroeck[1]
		[1]Department of Cognitive Neuroscience, Maastricht University, Maastricht, Netherlands
		In this work we extend the Maastricht Diffusion Toolbox (MDT) software package with MCMC capabilities, thereby introducing robust and fast sampling of diffusion MRI microstructure models. MDT's object oriented modular design allows arbitrary specification and combination of models, likelihood functions, prior functions and proposal distributions. GPU based computations allow for ~80x faster MCMC sampling; e.g. the 81 volume example NODDI dataset can be sampled with 15000 samples in 1.5 hour, making MDT suitable for probabilistic inference of all implemented models, both dMRI microstructure as quantitative MRI models. The software is open source and freely available at https://github.com/cbclab.

5234	Computer 36	Unified multi-modal characterization of microstructural parameters of brain tissue using diffusion MRI and multi-echo T2 data
		Erick Jorge Canales-Rodríguez[1,2,3], Marco Pizzolato[2], Yasser Alemán-Gómez[4,5,6], Nicolas Kunz[7], Caroline Pot[8,9], Jean-Philippe Thiran[1,2], and Alessandro Daducci[2,10]
		[1]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [2]Signal Processing Laboratory 5 (LTS5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [3]FIDMAG Germanes Hospitaláries, Barcelona, Spain, [4]Center for Psychiatric Neuroscience, Department of Psychiatry, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [5]Department of Radiology, Centre Hospitalier Universitaire Vaudois (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [6]Medical Image Analysis Laboratory (MIAL), Centre d'Imagerie BioMédicale (CIBM), Lausanne, Switzerland, [7]Centre d'Imagerie BioMédicale (CIBM)-AIT, École polytechnique fédérale de Lausanne (EPFL), Lausanne, Switzerland, [8]Department of Pathology and Immunology, Geneva University Hospital and University of Geneva, Geneva, Switzerland, [9]Laboratories of Neuroimmunology, Division of Neurology and Neuroscience Research Center, Department of Clinical Neurosciences, Lausanne University Hospital, Lausanne, Switzerland, [10]Computer Science Department, University of Verona, Verona, Italy

		In this study we propose a theoretical model to estimate different microstructure indices from diffusion MRI and multi-echo T2 (MET2) data. The proposed estimation framework takes into account the common and complementary information provided by both modalities. While the MET2 data allow us to model the myelin compartment, the diffusion data enable us to better characterize the intra-axonal and extra-axonal compartments. Results from numerical experiments support the hypothesis that the new unified estimation is more accurate than the alternative approach based on the individual sequential fitting of both image modalities. The performance was stable for noise levels commonly found in clinical protocols.

5235	Computer 37	Estimating axon diameter distributions beyond the physical limits of acquisition capabilities
		Mark Drakesmith[1], Suryanarayana Umesh Rudrapatna[1], Silvia de Santis[1], and Derek K Jones[1]
		[1]CUBRIC, Cardiff University, Cardiff, United Kingdom
		Estimation of axon diameter distributions (ADDs) is hindered by the fact that axon diameters below a certain limit, which are prevalent throughout the nervous system, are invisible to a diffusion MRI protocol. Here we propose a simple modification to the AxCaliber protocol where only the portions of the ADD that can feasibly generate a signal are modelled, by fitting to a truncated distribution. We show in simulations and human data acquired on a high-gradient (300mT/m) system that using this approach produces ADD estimates much closer to those observed in histology.

5236	Computer 38	Microstructure characterisation of fixed prostate tissue using ultra high-resolution diffusion-weighted MRI
		Maira Tariq[1], Andrada Ianus[1,2], Nyoman Kurniawan[3], Gary Cowin[4], Daniel C Alexander [1], Roger M Bourne[5], and Eleftheria Panagiotaki[1]
		[1]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom, [2]Champalimaud Neuroscience Programme, Champalimaud Centre for the Unknown, Lisbon, Portugal, [3]Center for Advanced Imaging, University of Queensland, Brisbane, Australia, [4]National Imaging Facility, Queensland Node, Center for Advanced Imaging, University of Queensland, Brisbane, Australia, [5]Discipline of Medical Radiation Sciences, Faculty of Health Sciences, University of Sydney, Sydney, Australia
		This work explores ultra-high field microimaging of prostate tissue using diffusion compartment modelling. The acquired ultra-high-resolution data provides a unique opportunity to investigate the accuracy of the diffusion estimates as well as the contribution of various tissue components to the diffusion signal. We compare several multi-compartment models to explore the best microstructure model for prostate tissue. We find plausible results for the data and models used, which will be compared to corresponding histology. Future work will use more samples and extend the models compared to get a comprehensive analysis of the data.

5237	Computer 39	Voxel size matters: big voxels are required to generate realistic extra-axonal dMRI signals from Monte Carlo simulations
		David Romascano[1,2], Jonathan Rafael-Patino[1], Ileana Jelescu[3], Muhamed Barakovic[1], Tim B. Dyrby[2,4], Jean-Philippe Thiran[1,5], and Alessandro Daducci[1,5,6]
		[1]Signal Processing Lab 5 (LTS5), EPFL, Lausanne, Switzerland, [2]Danish Research Centre for Magnetic Resonance, Center for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark, [3]Centre d'Imagerie Biomédicale, EPFL, Lausanne, Switzerland, [4]Department of Applied Mathematics and Computer Science, Technical University of Denmark, Kongens Lyngby, Denmark, [5]Department of Radiology, University Hospital Center (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [6]Computer Science department, University of Verona, Verona, Italy
		Monte Carlo simulations provide diffusion MRI signals that can be used to evaluate microstructure models, but that can also be incorporated into microstructure reconstruction methods. It is therefore important for the generated signals to be as realistic as possible. This work shows preliminary evidence that, in the case of white matter models, the symmetry of the perpendicular extra-axonal signal generated with Monte Carlo simulations depends on the voxel size. Simulations corresponding to millimeter-sized voxels should therefore be computed using substrates of equivalent size, or by averaging signals generated from multiple small voxels.

5238	Computer 40	Deep learning based segmentation of cardiomyocytes to aid numerical simulations of diffusion cardiovascular magnetic resonance
		Jan N Rose[1], Wee Zhao Chua Khoo[1], Sonia Nielles-Vallespin[2,3], Pedro F Ferreira[3], David N Firmin[3], Andrew D Scott[3], and Denis J Doorly[1]
		[1]Aeronautics, Imperial College London, London, United Kingdom, [2]National Institute of Health, Bethesda, MD, United States, [3]CMR Unit, Royal Brompton Hospital, London, United Kingdom
		To better understand how the underlying microstructure and pathology affect the DT-CMR signal in vivo, more realistic numerical models that account for irregular myocyte configurations such as sheetlets are necessary. We manually segmented cardiomyocytes from pig histology and confirmed that the resulting substrate is representative of the local microstructure through automatic segmentation of the surrounding tissue with a convolutional neural network. Monte Carlo random walk simulations, covering short and long mixing times and varying compartment diffusivities, show a mismatch between the results for the histology-based substrate and a simple cuboid model with comparable ECV and mean cell size.

5239	Computer 41	Diffusion Weighting with Linear and Planar Encoding Solves Degeneracy in Parameter Estimation
		Bibek Dhital[1], Marco Reisert[1], Elias Kellner[1], and Valerij G. Kiselev[1]

		[1]Clinic for Radiology, Medical Physics, Faculty of Medicine, Medical Center - University of Freiburg, Germany, Freiburg, Germany
		While estimating parameters of tissue microstructure models has never been simple, the recently discovered bi-modality (degeneration) of objective function in parameter space render it highly challenging. This study proposes a response to this challenge based on combining the commonly used linear encoding (the b-matrix with the diagonal 0,0,b) with the planar encoding (b,b,0). The signal was simulated in the whole parameter space of the standard model of brain white matter. Exhaustive search in this space demonstrates the absence of bi-modality when results for both encoding schemes are treated together.

5240	Computer 42	Constrained analysis of b-tensor encoding diffusion data with multiple echo times allows estimation of compartment-specific T2 relaxation times in white matter.
		Björn Lampinen[1], Filip Szczepankiewicz[2,3], Daniel Topgaard[4], Oskar Hansson[5], Danielle van Westen[3], and Markus Nilsson[3]
		[1]Clinical Sciences Lund, Medical Radiation Physics, Lund University, Lund, Sweden, [2]Random Walk Imaging AB, Lund, Sweden, [3]Clinical Sciences Lund, Diagnostic Radiology, Lund University, Lund, Sweden, [4]Physical Chemistry, Lund University, Lund, Sweden, [5]Clinical Sciences Malmö, Clinical Memory Research, Lund University, Lund, Sweden
		We used b-tensor encoding and multiple echo times to estimate the separate T2 relaxation times and apparent fractions of white matter compartments. Nineteen elderly subjects were imaged, and data were analyzed using a constrained 'ball-and-stick' diffusion-relaxation model. Results show that the 'ball' T2 relaxation time is inversely related to the fraction of 'sticks' in white matter lesions, and that the 'stick' T2 relaxation time may be sensitive to the axonal diameter. The approach could be useful to characterize white matter damage.

5241	Computer 43	Revised NODDI model for diffusion MRI data with multiple b-tensor encodings
		Michele Guerreri[1,2], Filip Szczepankiewicz[3,4], Björn Lampinen[5], Markus Nilsson[3], Marco Palombo[6], Silvia Capuani[2], and Hui Zhang[6]
		[1]SAIMLAL, Sapienza, università di Roma, Rome, Italy, [2]Institute for Complex Systems, CNR, Rome, Italy, [3]Clinical Sciences Lund, Department of Radiology, Lund University, Lund, Sweden, [4]Random Walk Imaging AB, Lund University, Lund, Sweden, [5]Clinical Sciences Lund, Department of Medical Radiation Physics, Lund University, Lund, Sweden, [6]Department of Computer Science & Centre for Medical Image Computing, University College London, London, United Kingdom

		This work proposes a revision of the NODDI model to relate brain tissue microstructure to the new generation of diffusion MRI data with multiple b-tensor encodings. NODDI was developed originally for conventional multi-shell diffusion data acquired with linear tensor encoding (LTE). While adequate for LTE data, it has been shown to be incompatible with data using spherical tensor encoding (STE). We embed a different set of assumptions in NODDI, while retaining the tortuosity constraint, to accommodate both LTE and STE data. Experiments with human data with multiple b-tensor encodings confirm the efficacy of the revision.

5242	Computer 44	Isotropic Diffusometry MRI of the human brain
		Alexandru V Avram[1], Joelle E Sarlls[2], and Peter J Basser[3]
		[1]NIBIB, National Institutes of Health, Bethesda, MD, United States, [2]NINDS, National Institutes of Health, Bethesda, MD, United States, [3]NICHD, National Institutes of Health, Bethesda, MD, United States
		From diffusion MRI data acquired with isotropic diffusion encoding over a wide range of b-values, we estimate intravoxel distributions of mean diffusivities using a regularized Inverse Laplace Transform analysis. In vivo spectra of intra-voxel mean diffusivities measured in healthy subjects show consistent single-peak distributions in most brain regions, with subtle differences between white matter, cortical gray matter, subcortical gray matter, corpus callosum, and cerebrospinal fluid. This non-invasive, model-free, whole-brain approach to quantifying spectra of intrinsic tissue water mobilities could improve the clinical diagnosis and characterization of stroke, cancer, and other diseases.

5243	Computer 45	Quantification of white matter pathologies by a diffusion MRI technique modeling both intra- and extra-axonal compartments
		Chunyu Song[1], Tsen-Hsuan Lin[2], Peng Sun[3], and Sheng-Kwei Song[3]
		[1]Biomedical Engineering, Washington University in St. Louis, st louis, MO, United States, [2]Radiology, Washington University School of Medicine, St louis, MO, United States, [3]Radiology, Washington University School of Medicine, St Louis, MO, United States
		A new diffusion MRI histology (D-Histo) is proposed to model both intra- and extra-axonal diffusion as well as isotropic diffusion components within an image voxel. Both Monte-Carlo simulation, in vivo MRI of EAE mouse optic nerve, and post-MRI histology were used to validate this approach. The intra-axonal fraction derived from D-Histo more accurately assessed fiber fraction, and the intra-axonal axial diffusivities (AD) it derives more sensitively reflected axonal injury.

5244	Computer 46	Axon Diameter Mapping Independent of Crossing Structures using Spherical Mean Technique

		Qiuyun Fan[1], Aapo Nummenmaa[1], Thomas Witzel[1], Ned Ohringer[1], Qiyuan Tian[1], Lawrence L Wald[1], Susie Y. Huang[1], and Eric C. Klawiter[2]
		[1]Radiology, Massachusetts General Hospital, Boston, MA, United States, [2]Neurology, Massachusetts General Hospital, Boston, MA, United States
		Current approaches to axonal size estimation by diffusion MRI assume a single fiber bundle, which limits its application to a few white matter tracts in the healthy human brain. We introduce a new approach to per-voxel axon diameter and volume fraction estimation inspired by the spherical mean framework that is robust to fiber crossings and orientation dispersion. We use this technique to estimate whole brain axon diameter and volume fraction in 6 healthy subjects scanned on the 3T Connectome scanner and demonstrate the utility of this approach to characterize white matter pathology in a patient with multiple sclerosis.

5245	Computer 47	Assessing feasibility and reproducibility of a bundle-specific framework on in vivo axon diameter estimates at 300mT/m
		Muhamed Barakovic[1,2], Gabriel Girard[1], David Romascano[1], Jonathan Rafael-Patino[1], Maxime Descoteaux[3,4], Giorgio Innocenti[1,5,6], Derek K. Jones[2], Jean-Philippe Thiran[1,7], and Alessandro Daducci[1,7,8]
		[1]Signal Processing Laboratory 5 (LTS5), Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, [2]Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff University, Cardiff, United Kingdom, [3]Sherbrooke Connectivity Imaging Laboratory (SCIL), University of Sherbrooke, Sherbrooke, QC, Canada, [4]Sherbrooke Molecular Imaging Center, Department of Nuclear Medicine and Radiobiology, Faculty of Medicine and Health Science, University of Sherbrooke, Sherbrooke, QC, Canada, [5]Department of Neuroscience, Karolinska Institutet, Stockholm, Sweden, [6]Brain and Mind Institute, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, [7]University Hospital Center (CHUV) and University of Lausanne, Lausanne, Switzerland, [8]Department of Computer Science, University of Verona, Verona, Italy
		In vivo quantitative estimation of axon diameter in the white matter is a potential new tool for studying the structural and functional architecture of the brain. Recently, the feasibility of axon diameter estimation with diffusion-weighted MRI (DW-MRI) has been questioned. In this work, we explore the feasibility of bundle-specific axon diameter mapping in the context of a reproducibility study using the Convex Optimization Modeling for Microstructure informed Tractography (COMMIT) framework. Our results show that DW-MRI axon diameter estimatesof the corpus callosum and of the corticospinal tract are comparable to histological reports in previous studies.

5246	Computer 48	Mapping Normative Mean Apparent Propagator Derived Microstructural Parameters
		Adam Scott Bernstein[1,2], Alexandru V Avram[3], Amber Simmons[1], Martin Cota[4], Neville Gai[5], Neekita Jikaria[4], Anita Moses[4], Christine Turtzo[4], Lawrence Latour[4], Dzung Pham[5], John A Butman[5], and Peter J Basser[1]

[1]NICHD, National Institutes of Health, Bethesda, MD, United States, [2]Biomedical Engineering, University of Arizona, Rockville, MD, United States, [3]NIBIB, National Institutes of Health, Bethesda, MD, United States, [4]NINDS, National Institutes of Health, Bethesda, MD, United States, [5]CC, National Institutes of Health, Bethesda, MD, United States

This work establishes preliminary data as well as a processing pipeline to generate normative MAP-MRI parameter maps. This normative data can be used to better understand the values and variation of different diffusion-derived microstructural parameters found in healthy humans. This information can then be used as a baseline for future research or clinical projects.

Electronic Poster

Brain Microstructure

Exhibition Hall	Thursday 8:00 - 9:00

5247 Computer 49

White Matter Microstructural Change Following Traumatic Brain Injury Assessed by Simultaneous Multi-Slice Multi-Shell Diffusion MRI - A Preliminary Study

Ping-Hong Yeh[1], Nicholas Goh[1], Cheng Guan Koay[1], Chihwa Song[1], Wei Liu[1], Grant Bonavia[1], John Ollinger[1], and Gerard Riedy[1]

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Mild traumatic brain injury (mTBI) is difficult to diagnose and characterize. In this study, we applied simultaneous multi-slice multi-shell diffusion MRI to assess white matter microstructural changes in chronic military mTBI. Preliminary results showed parameters derived from Mean Apparent Propagator MRI method are superior to the parameters derived from diffusion tensor imaging or diffusion kurtosis imaging in differentiating tissues with distinct structural and architectural features, and thus has increased ability to identify microstructural changes in mTBI.

5248 Computer 50

Effects of tissue microstructure on water resonance line-shape in post-mortem rat brain

Sean Foxley[1], Gregory S Karczmar[1], and Kazutaka Takahashi[2]

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		Many neurodegenerative diseases are characterized by microstructural changes in white matter, including demyelination and cell loss. Such changes have been demonstrated to produce measurable effects on the MR signal. This work examines these effects from post-mortem fixed rat brain on voxel-wise, high-resolution water spectra acquired using a multi-gradient echo pulse sequence. Results demonstrate that components of the spectra are differentially affected by both white matter orientation relative to B0 as well as tissue microstructure. This suggests that water proton spectra may be sensitive to the tissue microenvironment and could serve as potential MRI based biomarkers of neurodegenerative diseases.

5249	Computer 51	Effects of early alcohol exposure on functional organization and microstructure of a visual-tactile integrative circuit
		Shiyu Tang[1], Su Xu[1], Alexandre E. Medina[2], and Rao Gullapalli[1]
		[1]Department of Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States, [2]Department of Pediatrics, University of Maryland School of Medicine, Baltimore, MD, United States
		Children with fetal alcohol spectrum disorders (FASD) often have deficits associated with multisensory processing. Because ethanol disrupts activity-dependent neuronal plasticity, a process that is essential for refining connections during cortical development, we hypothesize that early alcohol exposure results in alterations in multisensory cortical networks, which could explain the multisensory processing deficits seen in FASD. Here, we use a gyrencephalic animal model to test the prediction that early alcohol exposure alters the functional connectivity and microstructural features of a visual-tactile integrative area with resting-state functional magnetic resonance imaging and diffusion kurtosis imaging.

5250	Computer 52	Axonal distributions: a simulation study to estimate Diffusion MRI signal contributions in white matter
		Andrea Chiappiniello[1], Valentina Reggioli[2], Roberto Tarducci[2], Marco Catani[3], and Flavio Dell'Acqua[3]
		[1]Physics and Geology Department, University of Perugia, Perugia, Italy, [2]Medical Physics Department, Santa Maria della Misericordia Hospital, Perugia, Italy, [3]NATBRAINLAB, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom
		In the last decade, many techniques that use diffusion MRI to obtain an axon diameter estimate as micro-structural integrity index have been developed. However, recent studies showed that diffusion signal may be not sensitive enough to quantify axon diameters. In this study, we simulated a simplified model of white matter to evaluate the contribution of intra-axonal compartment to diffusion MRI signal in white matter. We found that, even in distributions with a small mean diameter, big axons still substantially contribute to the total axonal volume. We conclude that quantifications of human axon diameters from diffusion MRI may still be possible.

5251	Computer 53	White Matter Fiber Structure Revealed by Synthetic MRI of the Longitudinal Magnetization Relaxation Rate (R1): Effects of Age at 1.5T
		Hernan Jara[1], Stephan W Anderson[1], and Osamu Sakai[1]
		[1]Boston University, Boston, MA, United States
		Purpose: To investigate the potential of R1-weighted Synthetic-MRI for unraveling the microstructure of white matter and for constructing accurate high resolution brain connectomes. Methods: Eighteen research subjects ranging in age from 0.6 to 87years were scanned with multispectral qMRI (T1, R1, T2, and PD) and analyzed with R1-weighted Synthetic MRI. Results: connectome renderings as function of increasing age show the expected increased WM track bundle packing and anatomical distributions evolution as function of age. Conclusion: R1-weighted WM Fibrography is a promising complementary alternative to DTI-WM Tractography for studying the microarchitecture of white matter.

5252	Computer 54	Ultra-High Gradient Diffusion MRI Reveals Distinct Microstructural Changes in Diffuse Gliomas Before and After Radiation Therapy
		Ina Ly[1], Qiuyun Fan[1,2], Barbara Wichtmann[3], Aapo Nummenmaa[1,2], Ovidiu Andronesi[1,2], Brian Nahed[1], William Curry[1], Daniel Cahill[1], Tracy Batchelor[1], Jayashree Kalpathy-Cramer[1,2], Bruce Rosen[1,2], Susie Huang[1,2], and Elizabeth Gerstner[1]
		[1]Massachusetts General Hospital, Boston, MA, United States, [2]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [3]Computer Assisted Clinical Medicine, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany
		The lack of a sensitive imaging method capable of capturing the full extent of glioma cell infiltration represents a significant challenge to accurate treatment planning and monitoring of therapeutic response. Here, using a recently developed diffusion MRI method (Linear Multi-Scale Model; LMM), we estimated the changes in restricted, hindered, and free water in six glioma patients pre- and post-treatment. We found scan-to-scan reproducibility of diffusion profiles in normal brain and identified distinct diffusion profiles in the tumor and peritumoral regions at different time points, thus highlighting the robustness of the LMM and its feasibility in the clinical setting.

5253	Computer 55	Brain Microstructure Characterization: Initial Experience and Optimization of protocols for the Siemens Terra 7T System
		Maria Roxana Stefanescu[1], David Lohr[1], Aleksander Kosmala[1], Maxim Terekhov[1], and Laura Maria Schreiber[1]
		[1]Chair of Cellular and Molecular Imaging, Comprehensive Heart Failure Center (CHFC), University Hospital, Wuerzburg, Germany

		Recent technological advances have brought new ultrahigh-field MRI (UHF) systems to the market, which nourish the expectation of better image quality with vendor-supplied sequences than with older systems. This would be an important factor for a wider distribution of UHF system and, thus, for moving UHF technology forward from a research tool to a clinical application. Therefore, the aim of this study was to perform a pilot study to assess the new Siemens Magnetom Terra 7T system with regard to typical clinical applications of 7T MRI in the brain.

5254	Computer 56	Characterization of white matter structures growth in common marmosets
		Fumiko Seki[1,2,3], Keigo Hikishima[1,2,4], Yuji Komaki[1,2], Marin Nishio[1,2,5], Junichi Hata[1,2,3], Akiko Uematsu[1,2,3], Norio Okahara[2], Erika Sasaki[1,2], and Hideyuki Okano[1,3]
		[1]Department of Physiology, Keio University, Tokyo, Japan, [2]Central Institute for Experimental Animals, Kawasaki, Japan, [3]Laboratory for Marmoset Neural Architecture, Brain Science Institute RIKEN, Saitama, Japan, [4]Okinawa Institute of Science and Technology Graduate University, Okinawa, Japan, [5]Department of Radiological Sciences, Tokyo Metropolitan University, Tokyo, Japan
		This study investigated developmental patterns of white matter structures in common marmosets using DTI and MTR. Longitudinal MRI was performed to 23 marmosets at the age of 1-34 months. Tract-based ROIs were created for assessment of major fiber bundles. Population growth trajectories of association fibers estimated using Gompertz function showed different developmental patterns. As previously reported, inferior longitudinal fasciculus (ILF) showed earlier maturation with slow speed, whereas inferior fronto-occipital fasciculus (IFOF) showed slower maturation with fast speed observed in MTR, RD and FA. It indicates ILF might mature compared with IFOF at birth, which was consistent with human studies.

5255	Computer 57	Non-invasive assessment of glioma microstructure using VERDICT MRI with comparison to histopathology
		Fulvio Zaccagna[1], Frank Riemer[1], Andrew N. Priest[2], Kieren S. J. Allinson[3], Mary A. McLean[4], James T. Grist[1], Tomasz Matys[1], Jonathan H. Gillard[1], Colin Watts[5], Stephen J. Price[5], Martin J. Graves[1], and Ferdia A. Gallagher[1]
		[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]Department of Radiology, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom, [3]Department of Pathology, Cambridge University Hospitals NHS Foundation Trust, Cambridge, United Kingdom, [4]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [5]Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom

		Gliomas are characterized by diffuse infiltration, high heterogeneity and poor prognosis. Imaging tumor heterogeneity may improve diagnosis and therapy planning. The Vascular, Extracellular and Restricted Diffusion for Cytometry in Tumors (VERDICT) MRI technique is a multi-compartmental model that exploits tissue microstructure. This preliminary study demonstrated the feasibility of translating VERDICT MRI in human brain imaging to investigate the microstructure of glioma with an abbreviated protocol. We demonstrated that VERDICT-derived cell size does not differ from the measured size on pathological slides and we found clear trends in LGG and HGG that may be useful to better differentiate types of glioma.

5256	Computer 58	Microstructure-mesh projection: Combining shape analysis with diffusion MRI models
		Kirsten Lynch[1], Yonggang Shi[1], Arthur Toga[1], and Kristi Clark[1]
		[1]USC Mark and Mary Stevens Neuroimaging and Informatics Institute, University of Southern California, Los Angeles, CA, United States
		The hippocampus is a heterogeneous structure consisting of subfields with distinct cytoarchitectonic and connectivity patterns. In order to capture the complexity of hippocampal structure, we propose a framework that combines the localized specificity of shape analysis with the microstructural sensitivity obtained with diffusion MRI models. The microstructure-mesh projection pipeline projects local model parameters within the hippocampus onto the surface to enable visualization and analysis of regional microstructural features. In a pediatric dataset, regional patterns of microstructural maturation within the hippocampus were observed.

5257	Computer 59	Diffusion Tensor Imaging to Investigate Diet-induced Changes in Neuronal Tissue Microstructure and Organization
		Maribel Torres Velazquez[1], M. Elizabeth Meyerand[1,2,3], and John-Paul J. Yu[1,3,4,5]
		[1]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [4]Neuroscience, University of Wisconsin-Madison, Madison, WI, United States, [5]Psychiatry, University of Wisconsin-Madison, Madison, WI, United States
		Altered gut microbiome populations are associated with a broad range of neurodevelopmental disorders. Disruption of the gut microbiome via dietary intake has been shown to influence brain function and behavior in animal models. Utilizing diffusion tensor imaging we identified global changes in white matter structural integrity occurring in a diet-dependent manner. Subsequent diet-crossover experiments demonstrate the varying permanence of these diet-induced changes and the degree of plasticity associated with these changes. These studies allow us to further explore our understanding of the gut-brain-microbiota axis by revealing possible links between altered and dysbiotic gut microbiome populations and changes in brain structure.

5258	Computer 60	ASSOCIATION OF MID-LIFE VASCULAR RISK FACTORS AND LATE-LIFE WHITE MATTER MICROSTRUCTURE IN COGNITIVELY NORMAL OLDER WOMEN Vijay Venkatraman[1], Christopher Steward[1], Cassandra Szoeke[1], Rowa Aljondi[1], and Patricia Desmond[1] [1]*Department of Medicine and Radiology, University of Melbourne, Royal Melbourne Hospital, Parkville, Australia* In this study, we explored the use of diffusion imaging measures, as possible biomarkers in clinical trials. We examined the association between vascular risk factors and white matter microstructure in normal aging. Consequently, we studied the relationship between composite and individual mid-life vascular risk factors with late-life white matter microstructure in a cohort of cognitively normal women. The results showed no association between composite score and microstructure. However, there was a significant association between systolic blood pressure and white matter microstructure such as the corpus callosum. Future work is needed to understand this relationship and its effect on cognition.

5259	Computer 61	Brain microstructure alterations associated to Alzheimer's disease assessed by diffusion tensor and neurite orientation dispersion and density imaging. Emma Muñoz-Moreno[1], Laura Obrado[2], Raúl Tudela[3], Xavier López-Gil[1], Gemma Piella[2], and Guadalupe Soria[1] [1]*Experimental 7T MRI Unit, Institut d'Investigacions Biòmediques August Pi i Sunyer (IDIBAPS), Barcelona, Spain,* [2]*Dept. of Information and Communication Technologies, Universitat Pompeu Fabra, Barcelona, Spain,* [3]*CIBER de Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN) Group of Biomedical Imaging of the University of Barcelona, Barcelona, Spain* NODDI characterizes neurite orientation dispersion (ODI) and intracellular volume fraction (ICVF), related to neurite density, based on diffusion magnetic resonance imaging. In this study, we have applied NODDI to evaluate excised brains of TgF344-AD, a transgenic rat model of Alzheimer’s disease (AD) and compared them with brains from control rats. Specific brain regions were evaluated: amygdala, caudate putamen, insular cortex and antero-dorsal and posterior hipppocampi. ODI and ICVF shown a different distribution in AD and control rats, with a tendency to higher values in AD, that could not be observed by standard diffusion parameters such as fractional anisotropy (FA).

5260	Computer 62	Characterisation of microstructural alterations in a weight drop mTBI rat model: a longitudinal diffusion MRI and histological analysis Kim Braeckman[1], Benedicte Descamps[1], Leen Pieters[2], Karen Caeyenberghs[3], and Christian Vanhove[1] [1]*Medical Imaging and Signal Processing group, UGent, Ghent, Belgium,* [2]*Department of Basic Medical Sciences, UGent, Ghent, Belgium,* [3]*The Centre of Disability and Development Research, Australian Catholic University, Melbourne, Australia*

		TBI is the leading cause of acquired disability of young adults and due to the subtle nature, conventional scans show no evidence of injury. In this multi-shell longitudinal diffusion MRI study of mTBI in rat brain we found that DKI and white matter metrics can be used to follow up recovery in the brain at least until one week after injury. Moreover, histological analysis showed that changes in the metrics could be explained by inflammation and neurofilament compaction. On the other hand, DTI metrics could not differentiate between the sham and TBI group and were comparable in the two groups.

5261	Computer 63	The contribution of astrocytic aquaporin-4 to gray and white matter diffusion ansiotropy
		Andre Obenaus[1,2], Jacqueline Coats[2], Andrew Fukada[2], Wei Sun[2], and Jerome Badaut[2,3]
		[1]Pediatrics, University of California Irvine, Irvine, CA, United States, [2]Basic Sciences, Loma Linda University, Loma Linda, CA, United States, [3]UMR 5287-Institut de Neurosciences Cognitives et Intégratives d'Aquitaine, Université de Bordeaux, Bordeaux, France
		We investigated the impact of water channels (aquaporin 4; AQP4) on DTI metrics after silencing expression of AQP4 in the juvenile brain. We observed a significant reduction in AQP4 expression after RNA silencing of AQP4 (siAQP4) along with significantly altered DTI metrics in the cortex but not the corpus callosum (CC). No changes in cellular constituents were found. Histological studies have reported decreased AQP4 expression in acquired brain injuries. Thus, our novel findings suggest that reductions in AQP4 expression may underlie the changes in DTI metrics that are often reported in DTI studies of stroke, traumatic brain injury and others.

5262	Computer 64	Diffusion tensor changes in acute neuroinflammation in rats
		Eugene Kim[1], Camilla Simmons[1,2], Karen Randall[1], Brigida Ranieri[1,3], Paula Sureda-Gibert[1], Tobias Wood[1,2], Carmine Pariante[2,4], Federico Turkheimer[1,2], and Diana Cash[1,2]
		[1]Department of Neuroimaging, King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom, [2]Wellcome Trust Consortium for Neuroimmunology of Mood Disorders and Alzheimer's Disease, London, United Kingdom, [3]Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy, [4]Department of Psychological Medicine, King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom
		Many neurodegenerative and psychiatric disorders feature low level neuroinflammation that is insidious yet difficult to diagnose in vivo. Here we explore the possibility of detecting acute neuroinflammation induced by systemic administration of lipopolysaccharide (LPS) in rats using in vivo diffusion tensor imaging (DTI) at 9.4T. Subtle yet widespread decreases in fractional anisotropy and increases in mean diffusivity were found in LPS-treated rats. Our results confirm the notion that DTI metrics are potential sensitive biomarkers of the dynamic inflammatory response in the brain, raising the possibility of utilizing DTI as a non-invasive in vivo assay for therapeutic interventions.

5263	Computer 65	Combining diffusion and perfusion weighted MRI measurements for disease and treatment monitoring in Multiple Sclerosis
		Madalina E Tivarus[1], Xing Qiu[2], Nicole Zizzi[3], and Giovanni Schifitto[4]
		[1]Department of Imaging Sciences, University of Rochester Medical Center, Rochester, NY, United States, [2]Department of Biostatistics and Computational Biology, University of Rochester Medical Center, Rochester, NY, United States, [3]University of Rochester, Rochester, NY, United States, [4]Department of Neurology, University of Rochester Medical Center, Rochester, NY, United States
		In this large sample retrospective study of MS patients with different diagnoses and treatment regimens we investigated interactions between imaging metrics and age, MS phenotype, and types of treatment, and longitudinal changes associated with disease modifying treatments. We assessed WM injury using DTI metrics (FA, MD), and vascular changes (CBF and CBV) using perfusion DSC, in corpus callosum and in its cortical projections. We found significant correlations of perfusion with age, and DTI metrics with disease type and medication, suggesting that advanced neuroimaging methods such as DTI should become integrated into the clinical evaluation of MS patients for improved management.

5264	Computer 66	Free-Water Elimination Diffusion Tensor Imaging to Assess Nerve Recovery in Excised Rat Nerve
		Shashank Manjunath[1], Isaac V. Manzanera-Esteve[1], Wesley P. Thayer[2], Mark D. Does[1], and Richard D. Dortch[1]
		[1]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States, [2]Vanderbilt University School of Medicine, Nashville, TN, United States
		We present our findings using a free water elimination model, which allows for the characterization of edema signal in diffusion measurements. We validate this model on ex vivo rat nerve data after sham surgeries on the sciatic nerve. The free water model effectively accounts for inflammation following sham surgeries, leading to increased accuracy in fractional anisotropy measurements throughout the recovery process. This model will be applied in other injury models (crush, transection/surgical repair) to test its ability to independently monitor inflammation/edema and nerve degeneration/regeneration.

5265	Computer 67	Diffusion tensor imaging in a rat model of brain stem ischemia reveals structural remodeling contralateral to the ischemic lesion
		Lydia Wachsmuth[1], Jens Minnerup[2], Jan-Kolja Strecker[2], Kai Diederich[2], and Cornelius Faber[1]
		[1]Clinical Radiology, Experimental NMR, University of Muenster, Muenster, Germany, [2]Neurology, University of Muenster, Muenster, Germany

		Ischemic stroke of the brain stem affects a considerable number of human patients. However, mechanisms of degeneration and recovery are not well understood and animal models of brain stem ischemia are rare compared to models of cortical stroke. Here we implemented a rat model of brain stem ischemia and applied diffusion tensor MR imaging as a noninvasive means to assess structural connectivity. Probabilistic mapping and histology indicate structural remodeling at the level of thalamus. These results add evidence for a potential compensatory mechanism for the observed partial recovery after brain stem stroke.

5266	Computer 68	Diffusion Changes in Normal-Appearing White Matter in Tracts Affected by White Matter Hyperintensities
		Rozanna Meijboom[1,2], Susana Muñoz Maniega[1,2], Maria Valdés Hernández[1,2], Nathalie Royle[1], Zoe Morris[1], John Starr[3], Mark Bastin[1,2], Ian Deary[4], and Joanna Wardlaw[1,2]
		[1]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom, [2]UK Dementia Research Institute, University of Edinburgh, Edinburgh, United Kingdom, [3]Alzheimer Scotland Dementia Research Centre, University of Edinburgh, Edinburgh, United Kingdom, [4]Department of Psychology, University of Edinburgh, Edinburgh, United Kingdom
		White matter hyperintensities (WMH) are common in older brains. We analyzed how WMH affect white matter (WM) tracts and particularly their normal-appearing WM (NAWM). We used MRI of 52 participants (72.2±0.7y) to quantify diffusion parameters of WMH-affected tracts. The intersections of tracts with WMH were identified and volumes quantified. Diffusion parameters were measured for tract-WMH, tract-NAWM, and for tract-NAWM at different distances from the tract-WMH edge, and from the edge of nearby—non-intersecting—WMH. Tract-NAWM showed a gradient of diffusion abnormalities away from tract-WMH, and nearby-WMH. Tract-WMH diffusion, and either tract-WMH volume or whole-brain WMH load, predicted tract-NAWM diffusion.

5267	Computer 69	Evaluating the effect of 3-n-butylphthalide on expression of aquaporin-4 by ultra-high b value diffusion weighted imaging in animal model with focal cerebral ischemia
		Baohong Wen[1], Dandan Zheng[2], and Jingliang Cheng[1]
		[1]Department of MRI, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China, [2]GE Healthcare, China, Beijing, China
		Previous studies have reported that 3-n-butylphthalide (NBP) had beneficial effects on stroke through multiple aspects, including decreasing the area of cerebral infarct, improving energy metabolism , inhibiting the inflammatory response and improving cerebral microvessels . Although the positive effects of NBP on cerebral ischemia and cerebral infarct have been verified in ischemic patients and animal models, the effects of NBP in aquaporin-4 (AQP-4) are still unclear. Recently, ultra-high diffusion weighted imaging was reported to be able to reflect AQP-4 changes . This study would like to evaluate the effect of 3-n-butylphthalide on expression of aquaporin-4 by ultra-high b value diffusion weighted imaging in animal model of focal cerebral ischemia at different time points.

5268	Computer 70	Early Apparent Diffusion Coefficient Deficit Correlates to Final Outcome in Experimental Neonatal Hypoxic Ischemia
		Yu-Chieh Jill Kao[1,2], Chia-Feng Lu[1,3], Chao-Ching Huang[4,5], and Cheng-Yu Chen[1,2]
		[1]Research Center of Translational Image, Teipei Medical University, Taipei, Taiwan, [2]Department of Radiology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [3]Department of Anatomy and Cell Biology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [4]Department of Pediatrics, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [5]Department of Pediatrics, College of Medicine, National Cheng Kung University, Tainan, Taiwan
		Changes in apparent diffusion coefficient (ADC) at 2 h after hypoxic ischemia (HI) in neonatal rats showed the significant correlation to the final lesion severity. The early ADC deficit appeared within 6 h after HI injury may serve as an index for outcome prediction and the translational evidence to stratify neonates for hypothermia treatment.

5269	Computer 71	Diffusion Tensor Imaging of Excised Rat Nerve Following Transection and Surgical Repair
		Isaac Vicente Manzanera Esteve[1], Angel F Farinas Chopite[2], Marlieke C Nussenbaum[2], Alonda C Pollins[2], Wes P Thayer[2], Mark D Does[3], and Dortch D Richard[1]
		[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Plastic Surgery, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Biomedical Engineering - School of Engineering, Vanderbilt University Medical Center, Nashville, TN, United States
		Traumatic peripheral nerve injury (TPNI) from crushing and/or transection can lead to nerve degeneration distal to the site of injury and a temporary loss in sensorimotor function. In this study, we present our findings showing how high-resolution DTI and Tractography measurements of traumatic nerve injury in the sciatic nerve region are capable to identify and characterize nerve injury degeneration/regeneration and injury type in rats. Our findings suggest that DTI and Tractography are viable biomarkers of nerve regeneration and can provide with valuable information in the evaluation of therapeutic interventions

5270	Computer 72	Spinal cord cross section and DTI by vertebral level correlate superior and inferior to injury
		Devon M Middleton[1], Shiva Shahrampour[2], Chris J Conklin[1], Mahdi Alizadeh[1], Scott H Faro[3], Laura Krisa[1], MJ Mulcahey[1], and Feroze B Mohamed[1]

		[1]Radiology, Thomas Jefferson University, Philadelphia, PA, United States, [2]Bioengineering, Temple University, Philadelphia, PA, United States, [3]Radiology, Johns Hopkins University, Baltimore, MD, United States
		Examination of diffusion and cord cross section by vertebral level in pediatric subjects has the potential to show useful information in injury diagnosis and prognosis. Correlations between DTI and cord cross section by vertebral level are shown superior and inferior to the injury site.

Electronic Poster

Multiple Sclerosis: Brain & Spinal Cord Applications

Exhibition Hall	Thursday 8:00 - 9:00

5271	Computer 73	Gray Matter Myelin Alterations in Early and Late Relapsing-Remitting Multiple Sclerosis Evaluated with Quantitative Synthetic Magnetic Resonance Imaging: A Gray-Matter Based Spatial Statistics Analysis
		Christina Andica[1], Akifumi Hagiwara[1,2], Keigo Shimoji[3], Koji Kamagata[1], Asami Saito[1], Yuki Takenaka[1,4], Tomoko Maekawa[1,2], Saori Koshino[1,2], Ryusuke Irie[1,2], Akihiko Wada[1], Masaaki Hori[1], Kanako K Kumamaru[1], Kanako Sato[1], Kazumasa Yokoyama[5], Nobutaka Hattori[5], and Shigeki Aoki[1]
		[1]Department of Radiology, Juntendo University Graduate School of Medicine, Tokyo, Japan, [2]Department of Radiology, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan, [3]Department of Radiology, Tokyo Metropolitan Geriatric Hospital and Institute of Gerontology, Tokyo, Japan, [4]Department of Radiological Sciences, Graduate School of Human Health Sciences, Tokyo Metropolitan University, Tokyo, Japan, [5]Department of Neurology, Juntendo University School of Medicine, Tokyo, Japan
		Our study demonstrated that myelin volume fraction (MVF) and myelin volume (MyV) obtained by a multi-parametric quantitative synthetic MRI might be useful for evaluating gray matter (GM) myelin alterations and for monitoring disease progression in relapsing-remitting multiple sclerosis (RRMS) patients. GM-based spatial statistics analysis demonstrated decreased MVF in limbic, paralimbic, and deep GM areas in the early-RRMS, and in extensive areas of GM in the late-RRMS. In the meanwhile, MyV was found to be decreased in both RRMS groups compared to healthy subjects, with late-RRMS showing the lowest value, and significantly correlated with disease duration.

5272	Computer 74	Discriminative Analysis of Regional Evolution of Iron and Myelin/Calcium in Deep Gray Matter of Multiple Sclerosis and Healthy Subjects
		Ahmed M. Elkady[1], Dana Cobzas[1], Hongfu Sun[1], Gregg Blevins[2], and Alan H Wilman[1]

		[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada, [2]Division of Neurology, University of Alberta, Edmonton, AB, Canada
		We introduce Discriminative Analysis of Regional Evolution (DARE) of iron and myelin/calcium to assess specific changes in Deep Gray Matter (DGM) of Relapsing-Remitting Multiple Sclerosis (RRMS), Progressive MS (PMS) and corresponding age-matched healthy subjects, which we regress with disease severity. DARE enabled discriminative assessment of longitudinal changes in MS, and demonstrated superior performance compared to conventional bulk analysis. Iron decrease and myelin/calcium increase, and myelin/calcium changes, were the primary drivers of observed MRI longitudinal changes in RRMS and PMS DGM, respectively. Specific DARE measures of MS DGM can be used to predict MS Severity Score, and may reflect complex disease pathology.

5273	Computer 75	Surface-based Quantitative Susceptibility Mapping of Cortical Pathology in Multiple Sclerosis
		Marco Castellaro[1,2], Roberta Magliozzi[2,3], Alessandro Palombit[1], Stefania Montemezzi[4], Francesca Benedetta Pizzini[4], Alessandra Bertoldo[1], and Massimiliano Calabrese[2]
		[1]Department of Information Engineering, University of Padova, Padova, Italy, [2]Department of Neurological, Biomedical and Movement Sciences, University of Verona, Verona, Italy, [3]Faculty of Medicine, Imperial College London, London, United Kingdom, [4]University of Verona, Verona, Italy
		Multiple Sclerosis has been showed to be characterized by extent cortical sub-pial demyelination and iron alterations. Moreover, a “surface-in” gradient of pathology has been showed to be present in MS. In this study, we used QSM to investigate iron and/or myelin changes in the whole cortex. Moreover, we exploit surface-based methods to clarify the presence of a laminar specific changes in cortical susceptibility of Relapsing-Remitting MS patients.

5274	Computer 76	Optimization of CEST MRI at 7 Tesla for Detection of Cortical Gray Matter Pathology in Multiple Sclerosis
		Kristin Poole O'Grady[1,2], Samantha By[3], Bailey A. Box[1,2], Quinn R. Weinberg[1,2], Siddharama Pawate[4], Francesca R. Bagnato[4], and Seth A. Smith[1,2,5]
		[1]Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Philips Healthcare, Baltimore, MD, United States, [4]Department of Neurology, Vanderbilt University Medical Center, Nashville, TN, United States, [5]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States

		Glutamate-sensitive chemical exchange saturation transfer (CEST) MRI has been applied in the human brain and shows promise for detecting pathology related to dysfunctional glutamate regulation. Glutamate abnormalities are linked to cortical gray matter (GM) pathology and cognitive impairment in multiple sclerosis (MS), but quantitative assessment techniques are lacking. We optimized and applied CEST MRI at 7.0T in phantoms and *in vivo* to evaluate sensitivity to glutamate and the effect of saturation pulse duration. Our results show increased CEST contrast in cortical GM of MS patients relative to controls and demonstrate the potential of CEST in characterizing GM damage in MS.

5275	Computer 77	MR Microscopy of Cortical Lesions Reveal Iron Loss in Individual Oligodendrocytes
		Stephen Dodd[1], Govind Nair[2], Seung-Kwon Ha[3], Daniel Reich[3], and Alan Koretsky[1]
		[1]Laboratory of Functional and Molecular Imaging, NINDS, National Institutes of Health, Bethesda, MD, United States, [2]Neuroimmunology Clinic, NINDS, National Institutes of Health, Bethesda, MD, United States, [3]Translational Neuroradiology Section, NINDS, National Institutes of Health, Bethesda, MD, United States
		Imaging of cortical demyelination in chronic multiple sclerosis, has been challenging. Previous MRI studies have detecting signal changes in cortical lesions have been attributed to myelin loss and the presence of iron-laden microglia. Here we demonstrate, in a case study, that MR microscopy may readily identify individual iron-rich cells (primarily oligodendrocytes) and regions. In addition, MR microscopy is shown to allow detailed examination of the central vein signal in white matter lesions.

5276	Computer 78	Inconsistency in Grey Matter Volume Estimation of MS Patients: A Multi-Vendor Study at 3 Tesla
		Houshang Amiri[1], Stephanie Bosschaert[1], Iman Brouwer[1], Joost P.A. Kuijer[1], Jan C. de Munck[1], Marloes Hagens[2], Joep Killestein[2], Frederik Barkhof[1,3], and Hugo Vrenken[1]
		[1]Radiology & Nuclear Medicine, VU University Medical Center, Amsterdam, Netherlands, [2]Department of Neurology, MS Center Amsterdam, VU University Medical Center, Amsterdam, Netherlands, [3]Institutes of Neurology and Healthcare Engineering, UCL, London, United Kingdom
		MR images are widely used to measure brain atrophy is neurodegenerative diseases. However, reliable evaluation of atrophy is hampered by between- and within-scanner variability and inconsistency. We investigated this in 21 multiple sclerosis patients scanned at three different scanners (twice at each scanner). Volumes of GM, WM and whole brain, as well as deep grey matter structures were assessed using SIENAX and FSL-FIRST, respectively. Voxel-based morphometry was used to localise variabilities in the brain. Our findings suggests that scanner-related factors, and especially between-scanner variability, play a role in inconstancy of brain volume measurements.

5277	Computer 79	Comparison of Methods for Whole-Brain and Grey Matter Atrophy Assessment in Multiple Sclerosis

		Loredana Storelli[1], Maria A. Rocca[1,2], Elisabetta Pagani[1], Wim Van Hecke[3], Mark A. Horsfield[4], Nicola De Stefano[5], Alex Rovira[6], Jaume Sastre-Garriga[7], Jacqueline Palace[8], Diana Sima[3], Dirk Smeets[3], and Massimo Filippi[1,2]
		[1]Neuroimaging Research Unit, INSPE, Division of Neuroscience, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy, [2]Department of Neurology, San Raffaele Scientific Institute, Vita-Salute San Raffaele University, Milan, Italy, [3]Research and Development for Icometrix, KU Leuven, Leuven, Belgium, [4]Xinapse Systems, Colchester, United Kingdom, [5]Department of Medicine, Surgery and Neuroscience, University of Siena, Siena, Italy, [6]Section of Neuroradiology, Department of Radiology, Hospital Universitari Vall d'Hebron, Barcelona, Barcelona, Spain, [7]Unitat de Neuroimmunologia Clinica, CEM-Cat, Hospital Universitari Vall d'Hebron, Barcelona, Spain, [8]Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom
		We compared different methods for whole-brain and grey matter (GM) atrophy estimation (ANTs v1.9, CIVET v2.1, FSL-SIENA(X) v5.0.1, Icometrix-MSmetrix v1.7, and SPM v12) in multiple sclerosis (MS). The accuracy and precision were evaluated for cross-sectional and longitudinal whole-brain and GM atrophy measures. All software showed high accuracy and comparable repeatability for cross-sectional measures. However, since there was poor reproducibility and high variability in cross-sectional and longitudinal atrophy measures, changes of MR scanner should be avoided. This study may help in the selection of a suitable pipeline, depending on the requirements of the application (research center, clinical setting or clinical trial).

5278	Computer 80	1H MRS study of glutamate excitotoxicity in hypothalamus of early multiple sclerosis patients
		Petra Hnilicová[1], Ema Kantorová[2], Hubert Poláček [3], Štefan Sivák[2], Michal Bittšanský[1], Kamil Zeleňák[4], Egon Kurča[2], and Dušan Dobrota [5]
		[1]Division of Neurosciences, Biomedical Center Martin, Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, Martin, Slovakia, [2]Clinic of Neurology, Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, Martin, Slovakia, [3]Clinic of Nuclear Medicine, Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, Martin, Slovakia, [4]Clinic of Radiology, Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, Martin, Slovakia, [5]Department of Medical Biochemistry, Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, Martin, Slovakia
		Multiple sclerosis (MS) is considered as an autoimmune disease with expanding axonal and neuronal degeneration in the spinal cord or cerebral cortex during the acute MS phase. The hypothalamus (HYP) is often overlooked yet controls important homeostatic functions. This ^{1}H MRS study performed on 1.5 T MR scanner using 3D CSI with $10\times10\times12.5$ mm^3 voxels was focused to altered HYP metabolism in early MS. Considering our results, increased Glx ratios with reduced mIns and tNAA ratios in HYP suggested glutamate excitotoxicity associated with glial activity and neuronal damage. This indicated that HYP plays an important role in early disease evolution.

5279	Computer 81	Examining Cortical Thickness Markers in Relapse Remitting Multiple Sclerosis

		Geoffrey Ngo[1] and Ravi S Menon[1,2]
		[1]Medical Biophysics, The University of Western Ontario, London, ON, Canada, [2]Centre of Functional and Metabolic Mapping, London, ON, Canada
		Recent evidence suggests that cortical pathology in Multiple Sclerosis (MS) does not affect all brain regions equally. We aim to investigate regional cortical MS pathology by using cortical thickness measures in a relapsing-remitting group (RRMS). Structural scans from 21 RRMS and 21 controls were processed using Freesurfer to obtain cortical thickness measurements. Group level analysis was performed to investigate the preference of sulcal and gyral thinning. Differences between gyri and sulci thickness between groups were also calculated to see if there was any evidence of cortical-layer specific thinning. Sulcal preference was shown, and no layer specific thinning was observed.

5280	Computer 82	Indirect assessment of cerebral metabolism in deep grey matter areas of progressive multiple sclerosis subjects – preliminary results
		Andrea Horvath[1], Ian Tagge[2], Manoj Sammi[2], Katherine Powers[2], Dennis Bourdette[1], Xin Li[2], Rebecca Spain[1], Charles Springer[2], and William Rooney[2]
		[1]Neurology, OREGON HEALTH & SCIENCE UNIV, Portland, OR, United States, [2]Advanced Imaging Research Center, OREGON HEALTH & SCIENCE UNIV, Portland, OR, United States
		Mitochondrial injury and impaired metabolic capacity are hypothesized to drive neurodegeneration in multiple sclerosis (MS). Here, we investigate a novel putative marker of tissue metabolic activity, trans-capillary water flux, derived from dynamic contrast enhanced MRI. In this study we compared 23 subjects with progressive MS to 19 healthy controls. We find significantly reduced measures on capillary water flux in MS thalami compared to controls. Implications for use of this new biomarker are discussed.

5281	Computer 83	Mismatch Between Cerebral Glucose and Oxygen Metabolisms in Young Adults with Relapsing-Remitting Multiple Sclerosis
		Xiang He[1], Kenneth T Wengler[2], Elizabeth Bartlett[2], Leigh Charvet[3], Tim Q Duong[1], Christine DeLorenzo[4], and Lauren Krupp[3]
		[1]Radiology, Stony Brook University Hospital, Stony Brook, NY, United States, [2]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [3]Neurology, New York University Medical Center, New York, NY, United States, [4]Psychiatry, Stony Brook University Hospital, Stony Brook, NY, United States

		Oxidative stress has been linked to neuroinflammation that leads to demyelination in multiple sclerosis (MS). While most studies focus on older MS patients, the underlying cause of oxidative stress at this stage of the disease may be obscured. In this study, cerebral metabolic rates of oxygen and glucose in young adult relapsing-remitting MS patients were measured with simultaneous PET/MRI. Several brain regions, most associated with the corticostriatal pathway, exhibited increased oxygen metabolism and decreased glucose metabolism in young MS patients when compared to healthy controls. These observations may elucidate the mechanism for mitochondrial dysfunction and neuroinflammation in MS pathophysiology.

5282	Computer 84	Altered Hippocampal GABA and Glutamate Levels and Uncoupling from Functional Connectivity in Multiple Sclerosis
		fei gao[1], xuntao yin[2], weibo chen[3], and guangbin wang[1]
		[1]Shandong Medical Imaging Research Institute, Jinan, China, [2]Southwest Hospital, Third Military Medical University, chongqing, China, [3]Philips Healthcare, shanghai, China
		This study offers a novel combination of methods investigating the complex relationships among excitatory/inhibitory neurotransmitters, brain connectivity and cognitive function in health and disease states. Modulation of Glu and GABA neurotransmission may enable the development of new therapeutic strategies for the early stages of MS.

5283	Computer 85	Quantification of white matter tract integrity in primary-progressive multiple sclerosis
		Maria Petracca[1], Simona Schiavi[2], Catarina Saiote[1], Lazar Fleysher[1], and Matilde Inglese[1]
		[1]Icahn School of Medicine, New York, NY, United States, [2]University of Genoa, Genoa, Italy
		Diffuse white matter (WM) injury is prominent in primary progressive multiple sclerosis (PPMS). Diffusion Kurtosis Imaging (DKI) allows the quantification of non-Gaussian water diffusion, offering the possibility of more detailed characterization of WM damage, in comparison with that provided by diffusion tensor imaging metrics. Here we present application of DKI metrics in PPMS using a Tract-Based Spatial Statistics approach. We observed a diffuse WM microstructural damage, manifested as axonal water fraction, mean kurtosis and fractional anisotropy decrease. In line with histopathological studies, our results suggest the prevalence of axonal damage over demyelination in progressive MS.

5284	Computer 86	Multi-dimensional microstructural imaging offers novel in vivo insights into brain pathology: an application to multiple sclerosis

		Kasper Winther Andersen[1], Samo Lasič[1,2], Henrik Lundell[1], Markus Nilsson[3], Daniel Topgaard[4], Filip Szczepankiewicz[2,3], Lars G. Hanson[1,5], Hartwig Roman Siebner[1,6], Morten Blinkenberg[7], and Tim B. Dyrby[1,8]
		[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital Hvidovre, Copenhagen, Denmark, [2]Random Walk Imaging, AB, Lund, Sweden, [3]Clinical Sciences, Lund, Department of Radiology, Lund University, Lund, Sweden, [4]Division of Physical Chemistry, Department of Chemistry, Lund University, Lund, Sweden, [5]Center for Magnetic Resonance, DTU Electrical Engineering, Technical University of Denmark, Kgs. Lyngby, Denmark, [6]Department of Neurology, Copenhagen University Hospital Bispebjerg, Copenhagen, Denmark, [7]Danish Multiple Sclerosis Center, Copenhagen University Hospital Rigshospitalet, Copenhagen, Denmark, [8]Department of Applied Mathematics and Computer Science, Technical University of Denmark, Kgs. Lyngby, Denmark
		Magnetic resonance imaging is today the most versatile imaging method for characterization of multiple sclerosis (MS) in vivo, but clinical examinations lack sensitivity to capture changes in the tissue microstructure. Using a multi-dimensional microstructural imaging approach, we demonstrate how it is possible to obtain more specific and broader microstructural insights about the underlying pathology of MS. For this we use a comprehensive battery of conventional and novel diffusion weighted imaging and quantitative MRI sequences each capable of explaining different and complementary microstructural properties. This allows us to explore the underlying pathology of MS, which is normally only accessible with histology.

5285	Computer 87	Does the presence of diffusely abnormal white matter in MS affect cognitive function?
		James Cairns[1,2], Irene Vavasour[1], Guojun Zhao[2,3], Roger Tam[1,3], Sarah Morrow[4], Andrew Riddehough[2,3], Alex MacKay[1,5], Anthony Traboulsee[2,3], Martin McKeown[2], Wayne Moore[2,6,7], David Li[1,2,3], and Cornelia Laule[1,5,6,7]
		[1]Radiology, University of British Columbia, Vancouver, BC, Canada, [2]Medicine, University of British Columbia, Vancouver, BC, Canada, [3]UBC MS/MRI Research Group, University of British Columbia, Vancouver, BC, Canada, [4]Neurology, University of Western Ontario, London, ON, Canada, [5]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [6]Pathology and Laboratory Medicine, University of British Columbia, Vancouver, BC, Canada, [7]International Collaboration on Repair Discoveries, University of British Columbia, Vancouver, BC, Canada, University of British Columbia, Vancouver, BC, Canada
		Multiple sclerosis (MS) subjects with diffusely abnormal white matter (DAWM) typically progress faster on physical disability scores. The impact of DAWM on cognitive measures is unknown. 50 MS participants had conventional MRI and cognitive tests of Trails Making Test, Working Memory, and Processing Speed. The presence of DAWM was not associated with worse cognitive performance. As DAWM is most commonly present in posterior regions of the brain, it may be that these cognitive tests were not sensitive to DAWM-associated pathology.

5286	Computer 88	Advanced diffusion MRI characterization of microstructure changes associated with increasing T1 hypointensity in the white matter lesions of relapsing-remitting multiple sclerosis patients.
		Timothy M. Shepherd[1], Benjamin Ades-aron[1], Bettina Conti[1], Yvonne Lui[1], Dmitry S Novikov[1], and Els Fieremans[1]
		[1]New York University, New York, NY, United States
		Autopsy studies of white matter lesions in relapsing-remitting multiple sclerosis demonstrate that FLAIR-bright lesions represent a juxtaposition of inflammation, demyelination, axonal injury and gliosis, whereas T1 hypointense lesions represent more severe confluent injury and axonal loss. We used a white matter tract integrity (WMTI) previously validated in cuprizone animal models of demyelination to better characterize specific in vivo microstructure changes associated with graded T1 signal intensity changes in multiple sclerosis lesions.

5287	Computer 89	DTI Analysis in FLAIR-positive Lesions and Normal-Appearing White Matter in Young Adult Multiple Sclerosis Patients
		Tao Wang[1], Sindhuja Govindarajan[2], M. Andrea Parra[1], Patricia Stefancin[1], Andrew Labella[2], Kenneth Wengler[2], Chuan Huang[1], Xiang He[1], Leigh Charvet[3], Lauren Krupp[3], and Tim Q Duong[1]
		[1]Radiology, Stony Brook Medicine, Stony Brook, NY, United States, [2]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [3]New York University, New York, NY, United States
		Neuroimaging studies showed that there is abundant diffusion tensor imaging (DTI) research that has been done on older multiple sclerosis (MS) patients. By contrast, similar research is relatively sparse in young/pediatric MS patients. Our study is interested in discovering the effects of MS on young adult patients to see whether the same pattern as in older patients appears. Our results suggest that DTI diffusivity data provides insights in the pathophysiology of MS in young adults. Diffusivity data may serve as an imaging biomarker of early disease pathophysiology in MS.

5288	Computer 90	Utility of Combination Image of T2-weighted and FLAIR using Synthetic MRI for Improved Lesion Contrast in Multiple Sclerosis
		Yasuhiro Fujiwara[1], Yumi Inoue[2], Masayuki Kanamoto[3], Shota Ishida[3], Toshiki Adachi[3], and Hirohiko Kimura[4]
		[1]Department of Medical Imaging, Faculty of Life Sciences, Kumamoto University, Kumamoto, Japan, [2]Schoo of Health Sciences, Kumamoto University, Kumamoto, Japan, [3]Radiological Center, University of Fukui Hospital, Fukui, Japan, [4]Department of Radiology, University of Fukui, Fukui, Japan

		To improve multiple sclerosis plaque, we attempted to produce Synthetic FLAIR3 (SyFLAIR3) combined from FLAIR and T2WI using Synthetic MRI. The purpose of this study was to determine optimal contrast weighting for SyFLAIR3 and to evaluate whether the SyFLAIR3 can improve the T2 contrast on WM. To effectively suppress CSF signal for SyFLAIR3, it was necessary to optimize the combination of TE for T2WI and FLAIR. The optimized SyFLAIR3 using Synthetic MRI makes it possible to improve contrast in MS lesion.

5289	Computer 91	Accelerated Isotropic Sub-Millimeter Whole-Brain Susceptibility Imaging at 3T: Application to Multiple Sclerosis
		Sunil Patil[1], Henrik Odéen[2], J. Andrew Derbyshire[3], Gunnar Krueger[4], Dennis L. Parker[2], Himanshu Bhat[5], Daniel S. Reich[6], and Pascal Sati[6]
		[1]Siemens Medical Solutions USA, Inc, Baltimore, MD, United States, [2]Radiology and Imaging Sciences, University Of Utah, Salt Lake City, UT, United States, [3]Section of Functional Imaging Methods, Laboratory of Brain and Cognition, National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States, [4]Siemens Healthcare, Zurich, Switzerland, [5]Siemens Medical Solutions USA, Inc, Boston, MA, United States, [6]Translational Neuroradiology Section, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States
		High-resolution susceptibility-weighted MRI has recently gained attention as a novel imaging biomarker in multiple sclerosis (MS) such as the ‘central vein sign’ and ‘phase rims’. This preliminary study demonstrates the feasibility of an accelerated volumetric (3D) segmented echo-planar-imaging (EPI) sequence, which allows acquiring whole brain images at 0.65 mm isotropic resolution in approximately 3 minutes. Both magnitude ($T2^*$-weighted) and phase (QSM) information were interpretable and displayed characteristic features of MS lesions. This accelerated 3D EPI anatomical acquisition shows potential to open the door to routine high-resolution susceptibility-weighted imaging to better support diagnosis and therapy monitoring in MS patients.

5290	Computer 92	Quantitative MT (qMT) imaging of the Whole Brain: Conventional 3D MT vs. 3D EP-vfMT methods
		Se-Hong Oh[1,2], Dongmyung Shin[3], Ken Sakaie[2], Daniel Ontaneda[4], and Mark J. Lowe[2]
		[1]Department of Biomedical Engineering, Hankuk University of Foreign Studies, Yong-In, Republic of Korea, [2]Imaging Institute, Cleveland Clinic Foundation, Cleveland, OH, United States, [3]Department of Electrical and computer engineering, Seoul National University, Seoul, Republic of Korea, [4]Mellen Center, Cleveland Clinic Foundation, Cleveland, OH, United States

		In this study, the whole brain qMT map from conventional MT imaging was compared with that from a newly proposed method, Segmented EPI readout Variable Flip angle Magnetization Transfer (EP-vfMT). The voxel-wise correlation shows a high correlation between the two maps. Compared to the conventional MT method, EP-vfMT provides similar image quality with good reproducibility. It also covers a whole brain volume in a much reduced scan time.

5291	Computer 93	Multicenter assessment of focal and diffuse cervical cord MTR abnormalities in early relapsing-remitting multiple sclerosis
		Benoit Combès[1], Anne Kerbrat[1,2], Laureline Monteau[3], Jean-Christophe Ferré[1,3], Emmanuelle Le Page[2], Josefina Maranzano[4], Virginie Callot[5], Pierre Labauge[6], Xavier Ayrignac[6], Clarisse Carra Dallière[6], Nicolas Menjot de Champfleur[6], Jean Pelletier[7], Adil Maarouf[7], David Brassat[8], Jérome de Seze[9], Nicolas Collongues[9], Francoise Durand Dubief [10], Christian Barillot[1], Gilles Edan[2], and Elise Bannier[1,3]
		[1]Univ Rennes, Inria, CNRS, Inserm, IRISA UMR 6074, VISAGES ERL U-1228, F-35000, Rennes, France, [2]Neurology department, Rennes University Hospital, Rennes, France, [3]Radiology department, Rennes University hospital, Rennes, France, [4]MNI, Montréal, Canada, Montreal, QC, Canada, [5]CRMBM UMR7339, Aix-Marseille University, CNRS, Marseille, France, [6]Montpellier University Hospital, Montpellier, France, [7]APHM, La Timone Hospital, Marseille, France, [8]Toulouse University Hospital, Toulouse, France, [9]Strasbourg University Hospital, Strasbourg, France, [10]Lyon University Hospital, Lyon, France
		The purpose of this work was to assess the ability of magnetization transfer ratio imaging of the cervical spinal cord to capture relevant differences in the first stage of multiple sclerosis in a multicenter context. For this purpose, we analyzed the MTR values in the lesions, the whole cord and normal-appearing cord from 52 patients in the first 18 months of the disease and from 17 controls. Images were acquired in 5 centers. We showed such measurements were able to capture relevant group differences and displayed slightly higher correlations with patients clinical status than lesion volume.

5292	Computer 94	Assessing the Role of Cord Atrophy Toward Disease Progression in Multiple Sclerosis
		Govind Nair[1], Shila Azodi[1], Yoshimi Akahata[1], Daniel S Reich[1], and Steven Jacobson[1]
		[1]NIH, Bethesda, MD, United States

		Plot of spinal cord cross-sectional area (SCCSA) from C1 to T10 reveals distinct patterns in various multiple sclerosis subtypes. While the relapsing remitting subtype revealed thinner cord in the cervical region, progressive subtypes had thinner c- and t-spines compared to healthy subjects. SCCSA measures were related to clinical outcomes, and revealed that up to 10-15% of disability can be explained by differences in SCCSA alone. Furthermore, segregating patients based on the SCCSA seems to give a better stratification of their clinical disability. This study suggests SCCSA can be used as an outcome measure in clinical trials.

5293	Computer 95	A fully unsupervised method for spinal cord lesion segmentation in Multiple Sclerosis
		Carole Hélène Sudre[1,2], Ferran Prados[1,3], Rosanna Cortese[3], Marios Yiannakas[3], Hugh Kearney[3], Olga Ciccarelli[3], Sébastien Ourselin[1,2], Claudia Angela Gandini Wheeler-Kingshott[3,4,5], and M. Jorge Cardoso[1,2]
		[1]Translational Imaging Group, CMIC, Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]UCL Institute of Neurology, Dementia Research Centre, University College London, London, United Kingdom, [3]Queen Square MS Centre, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [4]Department of Brain and Behavioural Sciences, University of Pavia, Pavia, Italy, [5]Brain MRI 3T Research Centre, C. Mondino National Neurological Institute, Pavia, Italy
		The presence of focal lesions in the spinal cord is an important diagnostic criteria for Multiple Sclerosis (MS). Accurate estimation of lesion volume is important for monitoring disease progression over time. However, manual and automated lesion segmentation for volume estimation remain challenging, since they rely respectively on the skills of the rater or on the automated criteria set within the algorithms. In this work, we present an adaptation to the spinal cord, of a fully unsupervised hierarchical model selection framework that automatically detects abnormality tissue patterns without any a priori knowledge on pathology location.

5294	Computer 96	Relationship of spinal cord volume, total and regional brain volumes to disability in a large cohort of multiple sclerosis patients
		Michaela Andelova[1], Jan Krasensky[2], Lukas Sobisek[3], Zdenek Seidl[2], Eliska Kusova[2], Tomas Uher[1], Eva Havrdova[1], Barbora Benova[1], Bénédicte Maréchal[4,5,6], Tobias Kober[4,5,6], Dana Horakova[1], and Manuela Vaneckova[2]
		[1]Department of Neurology and Center of Clinical Neuroscience, 1st Faculty of Medicine, Charles University and General University Hospital, Prague, Czech Republic, [2]Department of Radiology, 1st Faculty of Medicine, Charles University and General University Hospital, Prague, Czech Republic, [3]Department of Statistics and Probability, University of Economics, Prague, Czech Republic, [4]Advanced Clinical Imaging Technology, Siemens Healthcare AG, Lausanne, Switzerland, [5]Department of Radiology, University Hospital Lausanne (CHUV), Lausanne, Switzerland, [6]Signal Processing Laboratory (LTS 5), École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

Identification of MRI biomarkers that predict permanent neurological disability in multiple sclerosis is crucial for assigning patients to correct treatment and for appropriate recruitment of patients for clinical trials. A variety of brain structures and spinal cord have been investigated; however, neither a single structure nor combinations of structures have been routinely used as stable, specific and sensitive biomarkers. Small sample sizes, different MR protocols and segmentation approaches across studies may hamper the identification of such a biomarker. We evaluated global and regional brain volumes and cervical spinal cord volume in a large single-center cohort of multiple sclerosis patients.

Electronic Poster

Psychoradiology

Exhibition Hall	Thursday 8:00 - 9:00

5295 Computer 97

Hypersynchronicity in the default mode-like network and altered NMDA receptor function in a maternal immune activation model

Stephan Missault[1,2], Cynthia Anckaerts[2], Soumaya Ahmadoun[1], Ines Blockx[2,3], Kenny Bielen[4], Disha Shah[2], Samir Kumar-Singh[4], Annemie Van der Linden[2], Stefanie Dedeurwaerdere[1], and Marleen Verhoye[2]

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Maternal immune activation (MIA) is an important risk factor for schizophrenia, which supports the neurodevelopmental hypothesis of this disorder. Two major hypotheses of schizophrenia are the aberrant connectivity hypothesis and the NMDA receptor hypofunction hypothesis. The goal of our study was to investigate functional and structural connectivity, as well as NMDA receptor function in a MIA model using resting-state functional MRI, diffusion tensor imaging and pharmacological MRI. We observed increased functional connectivity in the default mode-like network, as well as a decreased response to the NMDA receptor antagonist in adult rats that were exposed to prenatal immune challenge.

5296 Computer 98

Brain Metabolism in Schizophrenia and First-Degree Relatives: a 7T MRS study

Anna Min Wang[1,2], Subechhya Pradhan[1,2], Stephanie Korenic[3], S. Andrea Wijtenburg[3], Laura M. Rowland[3], and Peter B. Barker[1,2]

[1]Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Kennedy Krieger Institute, Baltimore, MD, United States, [3]Maryland Psychiatric Research Center, Department of Psychiatry, University of Maryland School of Medicine, Baltimore, MD, United States

		Brain metabolism was investigated in 38 patients with schizophrenia (SZ), 38 healthy control (HC) subjects, and 11 first degree relatives of SZ patients using 7T MRS in 5 brain regions. Multiple metabolic abnormalities were found in SZ patients, including increases in the ratio of glutamine to glutamate, increased levels of brain lactate, and decreased levels of γ-aminobuytric acid (GABA) and N-acetylaspartate-glutamate (NAAG). Many of these changes also correlated with measures of cognitive performance and negative symptom severity. 7T MRS is an excellent tool for the non-invasive investigation of brain pathophysiology in SZ.

5297	Computer 99	Ex-vivo diffusion MRI reveals microstructural alterations in stress-sensitive brain regions: A chronic mild stress recovery study
		Ahmad Raza Khan[1], Brian Hansen[1], Ove Wiborg[1], Christopher D Kroenke[2], and Sune Nørhøj Jespersen[1,3]
		[1]Clinical Medicine, Aarhus University, Aarhus C, Denmark, [2]Oregon Health and Science University, Portland, OR, United States, [3]Dept. of Physics and Astronomy, Aarhus University, Aarhus, Denmark
		Depression is a leading cause of disability worldwide and causes significant microstructural alterations in stress-sensitive brain regions. However, the potential recovery of these microstructural alterations has not previously been investigated, which we, therefore, set out to do using diffusion MRI (d-MRI) in the chronic mild stress (CMS) rat model of depression. This study reveals significant microstructural alterations after 8 weeks of recovery, in the opposite direction to change induced by stress in the acute phase of the experiment. Such findings may be useful in the prognosis of depression or for monitoring treatment response.

5298	Computer 100	Analysis of resting-state networks alterations of first-episode obsessive–compulsive disorder by ICA - based fMRI
		Junhong Liu[1], Dandan Zheng[2], and Jingliang Cheng[3]
		[1]Magnetic resonance imaging Department, The First Affiliated Hospital of Zhengzhou University, Zhengzhou City, China, [2]GE Healthcare, MR Research China, Zhengzhou, China, [3]The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China
		Whole brain resting-state functional connectivity was analyzed using independent component analysis in 47 subjects including 23 first-episode and treatment-naïve patients with obsessive-compulsive disorder（OCD） and 24 health controls. Three abnormal resting-state networks, pDMN, RFP and IVN, have been found in OCD patients. In addition, OCD patients showed increased functional connection in Bilateral cuneus（T=3.8222，P=0.005）, Right inferior parietal lobule（T=5.291，P=0.005）and Right middle occipital lobule(T=4.614，P=0.005） compared with controls. It’s considered that changes of abnormal resting-state networks might be associated with emotional and cognitive dysfunction in OCD patients.

5299	Computer 101	Disrupted reward and cognitive control networks contribute to anhedonia in depression Liang Gong[1], Chunming Xie[2], Hongxing Zhang[3], and Zhijun Zhang[4] *[1]Neurology, Southeast Uninversity, Nanjing, China, [2]Neurology, Southeast University, Nanjing, China, [3]Xinxiang Medical Colleage, Xinxiang, China, [4]Southeast University, Nanjing, China* In the present study, we investigate the association between intrinsic reward network (β-network) and cognitive control network (δ-network) and anhedonia in depression patient. We found that depression patients showed decreased functional connectivity (FC) in intra- and inter- β- and δ-networks and the FC in both β- and δ-networks were significantly correlated with anhedonic severity in depression patients. Importantly, the integrated neural features of β- and δ-networks would more precisely predict anhedonia symptom. These findings indicated that the neural features in both β- and δ-networks would represent a fundamental mechanism underlying anhedonia in the MDD patients.

5300	Computer 102	Subcortical and medial temporal lobe shape changes following electroconvulsive therapy Filip Bouckaert[1,2,3], Jurgen Germann[4], Mallar Chakravarty[4], Annemieke Dols[5,6], François-Laurent De Winter[1,3], Lies Van Assche[1,3], Jan Van den Stock[1,3], Stefan Sunaert[7,8], Max Stek[5,6], Pascal Sienaert[2], Mathieu Vandenbulcke[1,3], and Louise Emsell[1,3,7,8] *[1]Old Age Psychiatry, UPC KU Leuven, Leuven, Belgium, [2]Academisch Centrum voor ECT en Neuromodulatie (AcCENT, UPC KU Leuven, Kortenberg, Belgium, [3]Laboratory for Translational Neuropsychiatry, Dept Neurosciences, KU Leuven, Leuven, Belgium, [4]Douglas Mental Health University Institute, McGill University, Montreal, QC, Canada, [5]Old Age Psychiatry, GGZ in Geest, Amsterdam, Netherlands, [6]Old Age Psychiatry, VU Medical Center, Amsterdam, Netherlands, [7]Translational MRI, Department of Imaging & Pathology, KU Leuven, Leuven, Belgium, [8]Radiology, UZ Leuven, Leuven, Belgium* Electroconvulsive therapy is a safe, rapid-acting antidepressant treatment that has consistently been associated with grey matter (GM) volume increase, primarily in the medial temporal lobe (MTL). Here we replicate and extend previous studies by demonstrating substantial surface area and local displacement changes in subcortical and MTL GM one week following the last ECT treatment in 70 patients with late-life depression. We report new data on ECT induced thalamus shape changes, and demonstrate that whilst the number of ECT treatments correlates positively with the degree of medial temporal GM surface area increase, this is not associated with clinical improvement in mood.

5301	Computer 103	Reduced White Matter Integrity Related with Elevated Inflammatory Cytokine Expression and Cognitive Impairments in First-episode Schizophrenia: A Diffusion Tensor Imaging Study Based on Tract-Based Spatial Statistics Jie Gao[1], Yajuan Fan[2], Lei Wang[3], Yarong Wang[3], Feng Zhu[2], Min Tang[1], Dongsheng Zhang[1], Xia Zhe[1], Xuejiao Yan[1], Xin Zhang[1], Zhizheng Zhuo[4], and Xiaoling Zhang[1]

		[1]Department of MRI Diagnosis, Shannxi Provincial People's Hospital, Xi'an, China, [2]Department of Psychiatry, The First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China, [3]Department of Diagnostic Radiology, The First Affiliated Hospital, Xi'an Jiaotong University, Xi'an, China, [4]Philips Healthcare, Beijing, China
		This study aimed to investigate whether elevated inflammatory cytokine expression induced white matter integrity changes and cognitive impairments in first-episode schizophrenia patients. 27 first-episode schizophrenia patients and 16 healthy controls who underwent diffusion tensor imaging were enrolled. Tract-based spatial statistics analysis exhibited significantly decreased fractional anisotropy and increased radial diffusivity in widespread white matter tracts in patients. Of these tracts, anterior corona radiata (ACR), superior corona radiata, superior longitudinal fasciculus, the body of the corpus callosum, the splenium of the corpus callosum and fornix showed significant correlations with higher inflammatory cytokine expression. Moreover, ACR and fornix simultaneously showed reduced white matter integrity related to cognitive impairments in working memory and problem solving. These findings provides more evidence for supporting the role of neuroinflammation in the pathophysiology of schizophrenia.

5302	Computer 104	Disrupted functional connectivity of occipital lobe with frontal and parietal regions in subjects with Cocaine addiction.
		Jaspreet Kaur[1], Divya Gautam[1], and Rahul Garg[1]
		[1]Computer Science and Engineering, Indian Institute of Technology Delhi, Delhi, India
		The study aims at exploring a data driven method to analyse connectivity differences between two populations - subjects with cocaine addiction and healthy controls. Sufficient indications of previously undiscovered hypo- and hyper-connectivity was observed in cocaine addicts spanning different lobes of brain suggesting that hypothesis driven approaches are insufficient.

5303	Computer 105	Investigation of Schizophrenia Patients with Clozapine-Induced Obsessive Compulsive Symptoms by Advanced MR Imaging
		Arzu Ceylan Has[1], Sule Bicakci[2], Elif Bulut[3], Aygun Ertugrul[2], and Kader K. Oguz[3]
		[1]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey, [2]Department of Neurological Sciences and Psychiatry, Hacettepe University, Ankara, Turkey, [3]Department of Radiology, Hacettepe University, Ankara, Turkey

		We aimed to investigate white matter (WM) integrity and structural differences in schizophrenia patients with clozapine-induced obsessive compulsive symptoms (S-OCS) comparing them those without symptoms (S) and healthy controls (HC). Tract-based-spatial-statistic/diffusion-tensor-imaging, voxel-based morphometry, and caudate volume measurements were performed to reveal underlying WM and gray matter (GM) alterations. S-OCS showed less fractional anisotropy (FA) reductions in WM and less areas of reduced GM density than S when compared to HC. FA elevations and increased GM density were observed in S-OCS compared with S. The results may suggest differential effect of clozapine, and/or different baseline pathophysiology in a subgroup of patients.

5304	Computer 106	Whole brain effect of real-time fMRI amygdala neurofeedback emotional training and its association with PTSD symptom reduction
		Masaya Misaki[1], Vadim Zotev[1], Raquel Phillips[1], Chung-Ki Wong[1], Brent Wurfel[1,2], Frank Krueger[3], Matthew Feldner[4], and Jerzy Bodurka[1,5]
		[1]Laureate Institute for Brain Research, Tulsa, OK, United States, [2]Laureate Psychiatric Clinic and Hospital, Tulsa, OK, United States, [3]George Mason University, Fairfax, VA, United States, [4]University of Arkansas, Fayetteville, AR, United States, [5]University of Oklahoma, Norman, OK, United States
		The effect of real-time fMRI neurofeedback (rtfMRI-nf) training with the left amygdala activity on whole brain regions and their association with symptom reduction was investigated in veterans with combat-related PTSD. The main effect of training was seen in the salience network regions including anterior insula and the anterior cingulate cortex (ACC). The decrease in ACC response was significantly correlated with a decrease in PTSD symptoms. These results indicated that the effect of rtfMRI-nf training was not limited to the left amygdala but other emotion-related regions were co-modulated during the training. The treatment response could be meditated by those regions.

5305	Computer 107	Multivariate pattern analysis of DTI reveals differential white matter in depressive patients with and without suicidal ideation.
		Huawei Zhang[1] and Zhiyun Jia[2]
		[1]Radiology, Huaxi MR Research Center (HMRRC), West China Hospital of Sichuan University, Chengdu, China, [2]Nuclear Medicine, Huaxi MR Research Center (HMRRC), West China Hospital of Sichuan University, Chengdu, China

		At present there are no objective biological markers that can be used to reliably identify depressive individuals with and without suicidal ideation (SI). DTI data were obtained from 20 depressive patients with SI and 20 depressive patients without SI, scanned using a 3T MRI system. Fractional anisotropy (FA) values of white matter between patients were examined using multivariate support vector machine (SVM). SVM applied to FA images correctly discriminated two groups of patients with a sensitivity of 75% and a specificity of 85% resulting in a statistically significant accuracy of 80% ($p \leq 0.001$). The discriminating regions contain the bilateral occipital lobes and parietal lobes, right temporal lobe and splenium of corpus callosum. These results reveal patterns of neuroanatomical alterations that could be used to inform the identification of depressive patients with and without SI at the individual level.

5306	Computer 108	EEG Correlates of Real-time fMRI Neurofeedback of the Amygdala in Combat-related PTSD Evaluated Using eLORETA
		Vadim Zotev[1], Raquel Phillips[1], Masaya Misaki[1], Chung Ki Wong[1], Brent Wurfel[1], Matthew Meyer[1,2], Frank Krueger[1,3], Matthew Feldner[1,4], and Jerzy Bodurka[1,5]
		[1]Laureate Institute for Brain Research, Tulsa, OK, United States, [2]Laureate Psychiatric Clinic and Hospital, Tulsa, OK, United States, [3]Neuroscience Dept., George Mason University, Fairfax, VA, United States, [4]Dept. of Psychological Science, University of Arkansas, Fayetteville, AR, United States, [5]College of Engineering, Stephenson School of Biomedical Engineering, University of Oklahoma, Tulsa, OK, United States
		We have performed a study of emotion regulation training in veterans with combat-related PTSD using real-time fMRI neurofeedback (rtfMRI-nf) with simultaneous EEG. Eighteen PTSD patients learned to upregulate their left amygdala activity using rtfMRI-nf during a positive emotion induction task based on retrieval of happy autobiographical memories. EEG source analysis with eLORETA revealed task-specific changes in the current source densities in the upper alpha and delta EEG bands that significantly correlated with PTSD severity. These results suggest that the rtfMRI-nf training in combination with EEG source analysis provides new insights into the neurobiology of PTSD.

5307	Computer 109	Multimodal metabolic imaging using single voxel MRS and [11C]ABP688 PET in Schizophrenic Patients
		Linda Orth[1,2], Ravichandran Rajkumar[1,2,3,4], Cláudia Régio Brambilla [1], Ezequiel Farrher[1], Andreas Matusch[5], Shukti Ramkiran[1], Andrej Ruch [2], Jörg Mauler[1], Elena Rota Kops[1], Lutz Tellmann[1], Jürgen Scheins[1,4], Bernd Neumaier[6], Markus Lang[6], Johannes Ermert[6], Hans Herzog[1], Karl-Josef Langen[1,3,7], Christoph Lerche[1,4], N. Jon Shah[1,3,4,8,9,10], and Irene Neuner[1,2,3,4]

		[1]Institute of Neuroscience and Medicine 4, INM-4, Forschungszentrum Jülich, Jülich, Germany, [2]Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH Aachen University, Aachen, Germany, [3]JARA – BRAIN – Translational Medicine, Jülich, Germany, [4]TRIMAGE – consortium (http://www.trimage.eu/), Jülich, Germany, [5]Institute of Neuroscience and Medicine 2, INM-2, Forschungszentrum Jülich, Jülich, Germany, [6]Institute of Neuroscience and Medicine 5, INM-5, Forschungszentrum Jülich, Jülich, Germany, [7]Department of Nuclear Medicine, RWTH Aachen University, Aachen, Germany, [8]Institute of Neuroscience and Medicine 11, INM-11, Forschungszentrum Jülich, Jülich, Germany, [9]Department of Neurology, RWTH Aachen University, Aachen, Germany, [10]Monash Biomedical Imaging, School of Psychological Sciences, Monash University, Melbourne, Australia
		By utilizing a multimodal imaging approach, the levels of glutamate and other metabolites in the anterior cingulate and the posterior cingulate cortex were assessed by MRS and compared to the metabotropic glutamate receptor 5 (mGluR5) binding potential using [^{11}C]ABP688 PET in schizophrenic patients and healthy controls. Glutamate levels seem to be elevated in schizophrenic patients. PET analysis revealed no differences in binding potential (BP_{ND}) in both diagnostic groups. However, adding smoking status to analysis, there is a significant reduction in BP_{ND} in smokers compared to non-smokers, suggesting a connection between mGluR5 binding potential and nicotine dependence.

5308	Computer 110	A multi-methodological fMRI resting state voxel-wise analysis to assess brain abnormalities of children with ADHD
		Yingxue Gao[1], Hailong Li[1], Xuan Bu[1], Lianqing Zhang[1], Xinyu Hu[1], Peiran Hu[2], Xiaoxiao Hu[1], and Xiaoqi Huang[1]
		[1]Huaxi Magnetic Resonance Research Centre (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, China, [2]West China Hospital / West China School of Medicine Sichuan University, Chengdu, China
		We used three different measurements including regional homogeneity (ReHo), voxel-mirrored homotopic connectivity (VMHC) and functional connectivity strength (FCS) to explore local and interhemispheric FC in drug naïve ADHD children. And we found lower ReHo and FCS in ADHD located in almost identical region of right middle frontal gyrus and correlated with each other. In addition, we also found lower VMHC in the bilateral occipital lobe, which was related with characteristics of WCST and CPRS-R. This finding may provide new insights into functional connectivity changes in ADHD and promote the exploration of functional network in the future.

5309	Computer 111	Quantative Tractography Reveals Alteration in Corticospinal Tract Associated with Motor Abnormalies in Medication-Naive Attention-Deficit /Hyperactivity Disorder Children
		Xuan Bu[1], Qingxia Lin[2], Lu Lu[1], Lianqing Zhang[1], Xiaoxiao Hu[1], Hailong Li[1], Xinyu Hu[1], Chuang Yang[2], and Xiaoqi Huang[1]

		[1]Huaxi MR Research Center(HMRRC), Radiology Department, West China Hospital, Sichuan University, Chengdu, China, [2]Department of Psychiatry, The First Affiliated Hospital of Wenzhou Medical University, Wenzhou Medical University, Wenzhou, China
		In the current study, we aim to quantify diffusion measures at multiple nodes along the trajectory of corticospinal tract in ADHD children. We found altered FA and RD in distinctive CST regions. Besides, significant correlations between neuropsychological measurements and abnormal white matter microstructure implicated critical role the disturbed CST played in the pathology of motor deficits in ADHD.

5310	Computer 112	The effects of relapse on gray matter volume changes in patients with Major Depression – a longitudinal VBM study
		Harald Kugel[1], Dario Zaremba[2], Katharina Dohm[2], Ronny Redlich[2], Dominik Grotegerd[2], Robert Strojny[2], Susanne Meinert[2], Christian Buerger[2], Verena Enneking[2], Katharina Foerster[2], Jonathan Repple[2], Nils Opel[2], Bernhard T Baune[3], Pienie Zwitserlood[4], Walter Heindel[1], Volker Arolt[2], and Udo Dannlowski[2]
		[1]Department of Clinical Radiology, University of Muenster, Muenster, Germany, [2]Department of Psychiatry, University of Muenster, Muenster, Germany, [3]Discipline of Psychiatry, University of Adelaide, Adelaide, Australia, [4]Department of Psychology, University of Muenster, Muenster, Germany
		Structural brain alterations in major depressive disorder (MDD) are associated with patients' course of illness, especially in progressive and recurrent MDD. Here, a longitudinal study investigated the influence of relapse on gray matter volume. As a result, Voxel based morphometry showed a decrease of insular and DLPF gray matter volume in patients with at least one relapse, while volume in patients without relapse was stable. This illustrates the negative effect of relapse on structural brain alterations.

5311	Computer 113	Characteristic Changes of Shape in Subcortical Nuclei in Major Depressive Disorder
		Lianqing Zhang[1], Naici Liu[2], Lu Li[3], Lu Lu[1], Xiaoxiao Hu[1], Hailong Li[1], Xuan Bu[1], Xinyu Hu[1], Qiyong Gong[1], and Xiaoqi Huang[1]
		[1]Department of Radiology, West China Hospital of Sichuan University, Huaxi MR Research Center (HMRRC), Chengdu, China, [2]Sichuan University, West China School of Clinical Medicine, Chengdu, China, [3]Sichuan University, West China School of Public Health, Chengdu, China

		We analysis alterations of volume and shape of subcortical nuclei in a relatively large sample of adult patients with Major Depressive Disorder (MDD) using an automatically segmentation and vertex-based shape analysis protocol. We found that hippocampus, putamen and accumbens were impaired in patients with MDD and subregional shape of hippocampus, accumbens and pallidum may have potential predictive value of treatment response in patients with MDD. Shape analysis may provide more evidence of neuropathology related to depression from a different perspective. Future study should consider shape and volume analysis simultaneously.

5312	Computer 114	Alterations in functional brain network topology in Tourette's syndrome
		Shukti Ramkiran[1], Larissa Heidemeyer[2], Ravichandran Rajkumar[1,2,3,4], N Jon Shah[1,3,4,5,6,7], and Irene Neuner[1,2,3,4]
		[1]Institute of Neuroscience and Medicine - 4, INM-4, Forschungszentrum Juelich, Juelich, Germany, [2]Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH Aachen University, Aachen, Germany, [3]JARA-BRAIN Translational Medicine, Aachen, Germany, [4]TRIMAGE – consortium, Aachen, Germany, [5]Institute of Neuroscience and Medicine - 11, INM-11, Forschungszentrum Juelich, Juelich, Germany, [6]Department of Neurology, RWTH Aachen University, Aachen, Germany, [7]Department of Electrical and Computer Systems Engineering, and Monash Biomedical Imaging, School of Psychological Sciences, Monash Institute of Medical Engineering, Monash University, Melbourne, Australia
		Tourette syndrome (TS) is a neurodevelopmental disorder with typical onset in childhood. Its characteristic motor tics are said to be attributed to dysfunction in the cortico-striato-thalamo-cortical circuit and cerebellar communication. Brain functional connectivity along with network topology analysis provides a useful tool to understand communication strategies in the brain. Hence we aim to investigate alterations in functional and effective connectivity in brains of patients with TS. Based on prior results[1,2], we hypothesize that connectivity of basal ganglia, thalamus and cerebellum with other regions will be altered.

5313	Computer 115	Altered Brain Activity in Jet Lag by Regional Homogeneity (ReHo): A resting state fMRI study
		Feifei Zhang[1], Zhiyun Jia[2], and Qiyong Gong[2]
		[1]West China Hospital of Sichuan University, Chengdu, China, [2]West China Hospital, Sichuan University, Chengdu, China
		To identify how jet lag influence brain activity in rest we calculate ReHo values of 23 adult participants who were on a transmeridian flight across eight-time zones from west to east .Participants in 'Jet Lag' state compare to recovered state showed decreased ReHo value in the right inferior parietal lobule (BA40, BA7) and the right angular gyrus and increased in the bilateral occipital lobe. Acute circadian disruption caused by jet lag can lead to mild temporary visual cognitive dysfunction.

5314	Computer 116	Meta-analytic investigations of grey matter alterations in patients with anorexia nervosa. Simin Zhang[1], Weina Wang[1], Xiaorui Su[1], Qiyong Gong[1], and Qiang yue[1] *[1]HMRRC,Department of Radiology,West China Medical School of Sichuan University, Chengdu, China* The purpose of the present Meta-analytic study was to summarize the grey matter volumetric alterations and elucidate how the changes were associated with symptoms and pathophysiology in anorexia nervosa(AN). We use effect-size signed differential mapping (ES-SDM) to conduct meta-analytical whole brain volumetric differences between patients AN and healthy controls (HCs). The studies showed volume reduction in bilateral median cingulate cortex(MCC), posterior cingulate cortex (PCC), precuneus, supplementary motor area(SMA) and left cerebellum, which provide evidence for abnormalities in emotion regulation, behavior regulation and sensorimotor area in nervosa anorexia.

5315	Computer 117	Meta-analysis of Resting-State Functional Connectivity in Major Depressive Disorder Shi Tang[1], Xinyu Hu[1], Lianqing Zhang[1], Lu Lu[1], Xuan Bu[1], Xiaoxiao Hu[1], Hailong Li[1], Qiyong Gong[1], and Xiaoqi Huang[1] *[1]37#Guoxue lane, Huaxi Magnet Resonance Imaging(HMRRC),Department of Radiology,West China Medical School of Sichuan University, Chengdu, China* To investigate the most reliable resting-state functional connectivity(rsFC) abnormalities in adult dignosed as having major depressive disorder(MDD) with existing studies.After a comprehensive literature search of studies, meta analysis was conducted using Signed Differential Mapping(SDM) software package. We found dysfunction in large-scale brain regions in MDD patients, including hyperconnectivity in fronto-cingulate-parietal area and hypoconnectivity in bilateral superior temporal gyrus(STG). These findings paralleled to the core feature of MDD patients and may underlie the cognitive and affective abnormalities in depressive disorder.

5316	Computer 118	The morphometric brain alteration in current and remitted major depressive disorder: a meta-analysis Xin Xu[1], Zhiyun Jia[2], and Qiyong Gong[1] *[1]Huaxi MR Research Center (HMRRC), West China Hospital of Sichuan University, Chengdu, China, [2]Department of Nuclear Medicine, West China Hospital of Sichuan University, Chengdu, China*

		To investigate the gray matter volume (GMV) alteration in major depressive disorder (MDD) patients at different episode state, here we conducted a meta-analysis which tried to integrate the Voxel-based morphometry (VBM) studies by using Seed-based d Mapping. This study detected that lower GMV in the left insula in both current and remitted MDD patients compared to HC. And the current conjunction meta-analysis indicated that GMV in bilateral anterior cingulate (ACC) were decreased in current MDD patients but increased in remitted MDD patients. Our findings here motivate a morphological alteration pattern of MDD linked to dynamic mood dysfunction state.

5317	Computer 119	The effects of illness duration on white matter connectivity in drug-naive schizophrenia
		Fei Li[1], Su Lui[1], Li Yao[1], Wei Liao[2], Gongjun Ji[3], Xiaoqi Huang[1], and Qiyong Gong[1]
		[1]Huaxi MR Research Center (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, China, [2]Center for Information in BioMedicine, Key Laboratory for Neuroinformation of Ministry of Education, School of Life Science and Technology, University of Electronic Science and Technology of China, Chengdu, China, [3]Laboratory of Cognitive Neuropsychology, Department of Medical Psychology, Anhui Medical University, Hefei, China
		This study investigated the topological alterations of white matter connectivity in schizophrenia patients with a long illness duration by using diffusion tensor imaging and graph theoretical analysis and explored the relationship of such characteristics with the duration. We recruited three groups including the healthy controls, drug-naive schizophrenia patients with a short illness duration (0.1 to 10 months) and a long duration (12 to 36 months), and found that only the patients with a long illness duration exhibited decreased connection strength than the controls and a correlation between the nodal degree of rolandic operculum and the duration, suggesting a neuroprogressive process.

5318	Computer 120	Functional Connectivity as a Potential Predictor of Treatment Response in Patients With Major Depressive Disorder
		Hailong Li[1], Xinyu Hu[1], Lianqing Zhang[1], Lu Lu[1], Xiaoxiao Hu[1], Xuan Bu[1], Shi Tang[1], Qiyong Gong[1], and Xiaoqi Huang[1]
		[1]Huaxi Magnetic Resonance Research Centre (HMRRC) Department of Radiology West China Hospital, Chengdu, China
		Resting-state functional connectivity(FC) analyses using a subcallosal cingulate cortex(SCC) seed was applied to major depressive disorder(MDD) patients to characterize a potential neuro-imaging biomarker that identifies the treatment outcome. MDD patients were divided into refractory and non-refractory group according to the treatment response. We found distinguished FC alterations between the three groups especially the lack of FC between SCC and Anterior Cingulate Cortex in the refractory MDD patients. In addition, the alterations in FC correlated with clinical symptoms in different ways in two MDD groups.

Electronic Poster

Diffusion MRI: Acquisition & Reconstruction

Exhibition Hall	Thursday 9:00 - 10:00

5319	Computer 1	Distortion-free diffusion imaging with SMS PROPELLER DUO
		Ali Ersoz[1] and Graeme C McKinnon[1]
		[1]GE Healthcare, Waukesha, WI, United States
		Although fast spin echo based diffusion-weighted imaging methods provide distortion-free images, they suffer from prolonged scan times. In this work, we incorporated simultaneous multi-slice (SMS) techniques into PROPELLER DUO for accelerated distortion-free diffusion imaging. Results show that SMS PROPELLER DUO can reduce scan time dramatically which can make it a feasible option for clinical applications.

5320	Computer 2	Non-CPMG PROPELLER diffusion imaging: comparison of phase insensitive preparation with split acquisition
		Kun Zhou[1], Wei Liu[1], and Shi Cheng[1]
		[1]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China
		Turbo spin echo (TSE) based diffusion weighted (DW) PROPELLER imaging has the advantage of reduced sensitivity to B0 inhomogeneity and T2 decay caused image blurring, comparing to DW-EPI sequence. However, the violation of CPMG condition is a challenge for DW-PROPELLER sequences. Phase insensitive preparation and split acquisition methods can be used to handle the non-CPMG problem. A comparison study of these two methods was performed and the results show that the phase insensitive method has superior image quality while split acquisition method has the advantage of speed and lower SAR.

5321	Computer 3	Multiband Diffusion-Weighted MRI of the Eye and Orbit Free of Geometric Distortions Using a RARE-EPI Hybrid
		Katharina Paul[1], Till Huelnhagen[1], Sebastian Schmitter[2], Oliver Stachs[3], and Thoralf Niendorf[1,4]

		[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [2]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, [3]Department of Ophthalmology, University of Rostock, Rostock, Germany, [4]Experimental and Clinical Research Center (ECRC), a joint cooperation between the Charité Medical Faculty and the Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany
		This study shows that multiband diffusion-weighted RARE-EPI has the capability to acquire distortion-free images of the eye and orbit with ample diffusion contrast for slices in close proximity. The results underpin the challenges of ocular imaging at 3.0 T and 7.0 T for echo planar imaging and demonstrate that these issues can be offset by using accelerated RARE based approaches. This benefit can be exploited for the assessment of spatial arrangements of the eye segments and their masses with the goal to provide guidance in diagnostic assessment and treatment of ophthalmological diseases.

5322	Computer 4	Distortion-Free High-Resolution Diffusion MRI with RPG-MUSE
		Iain P Bruce[1], Christopher Petty[1], and Allen W Song[1]
		[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States
		Diffusion-weighted images acquired with multi-shot EPI at high-resolution are susceptible to inter-shot motion artifacts and geometric distortions resulting from magnetic-field inhomogeneities. This study presents an efficient means of inherently accounting for both motion and distortion artifacts by alternating the phase encoding gradient polarities in odd/even shots of multi-shot EPI. When acquired in this fashion, the proposed RPG-MUSE model simultaneously accounts for both shot-to-shot motion induced artifacts and geometric distortions during the reconstruction of multi-shot diffusion weighted images. This technique requires no additional scan time, and accounts for B_0 and eddy current induced distortions specific to each diffusion-weighted volume.

5323	Computer 5	Diffusion-weighted MRI of the prostate without susceptibility artifacts: Multi-shot STEAM with radial undersampling
		Andreas Merrem[1], Klaus-Dietmar Merboldt[1], Jakob Klosowski[1], and Jens Frahm[1]
		[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institute for Biophysical Chemistry, Göttingen, Germany

		Undersampled radial STEAM MRI allows for diffusion-weighed imaging without susceptibility artifacts. Here, this technique was developed for applications to the prostate by moving to a multi-shot acquisition and reconstruction method to optimally process data with limited SNR. Numerical simulations defined the conditions for accurate ADC measurements. In vivo studies of healthy subjects resulted in ADC values in the central gland of the prostate which are consistent and in agreement with previous literature values. A comparison of DW STEAM and DW EPI of the prostate confirmed the major benefit of STEAM sequences which are free of susceptibility-induced distortions.

5324	Computer 6	Improved signal-to-noise ratio with highly asymmetric STEAM-EPI (HASTEAM-EPI)
		Manoj Shrestha[1], Ulrike Nöth[1], and Ralf Deichmann[1]
		[1]Brain Imaging Center (BIC), Goethe University Frankfurt, Frankfurt am Main, Germany
		Several methods exist for increasing the signal-to-noise ratio (SNR) in high spatial resolution imaging, e.g., by using reduced field-of-view techniques or reduced echo-times (*TE*). Here, a novel module dubbed “highly asymmetric STEAM" (HASTEAM) is proposed, where the stimulated echo (STE) occurs prior to the EPI readout and thus maintains a constant duration of STE preparation, independent of the acquisition matrix-size. This shortens *TE* and allows for higher SNR, in particular for high spatial resolutions. SNR gain of HASTEAM over the standard STEAM is simulated and compared to in vivo results for different resolutions in structural and diffusion-weighted imaging.

5325	Computer 7	Comparison of Different Methods for Motion-induced Data Corruption Detection Using k-space Information in Diffusion Imaging
		Zhe Zhang[1,2], Hua Guo[2], Zhangxuan Hu[2], Yaou Liu[1,3], Yilong Wang[4,5], and Chun Yuan[1,2,6]
		[1]Tiantan Image Research Center, China National Clinical Research Center for Neurological Diseases, Beijing, China, [2]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [3]Department of Radiology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China, [4]Department of Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China, [5]China National Clinical Research Center for Neurological Diseases, Beijing, China, [6]Department of Radiology, University of Washington, Seattle, WA, United States
		In diffusion imaging, subject motion together with diffusion encoding gradient may introduce data corruption. Several methods for corrupted data detection using k-space information such as DC peak amplitude, entropy and signal distribution metric have been proposed, and the detection directly from acquired k-space enables instant data rejection and re-acquisition. This work compared and evaluated these methods using the same single-shot data set. The results show that all methods can successfully detect corrupted shots, and demonstrate good detection consistency with each other and also with ADC measurement.

5326	Computer 8	Highly efficient diffusion MRI by Slice-interleaved Free-waveform Imaging (SIFI)
		Jana Hutter[1], Markus Nilsson[2], Daan Christiaens[1], Torben Schneider[3], Anthony N Price[1], Joseph V Hajnal[1], and Filip Szczepankiewicz[2,4]
		[1]Biomedical Engineering, King's College London, London, United Kingdom, [2]Clinical Sciences, Lund University, Lund, Sweden, [3]Philips Healthcare, Guilford, United Kingdom, [4]Random Walk Imaging AB, Lund, Sweden
		Diffusion encoding along multiple directions in a single shot facilitates probing of tissue microstructure that is not accessible with conventional (linear) tensor encoding. However, it tends to engage gradients on multiple axes in a pattern that yields higher energy consumption, which can become a critical limiting factor for gradient system performance. Here, we show that Slice Interleaved Free-waveform Imaging (SIFI) of b-tensor size, orientation, and shape reduces peak power consumption and heating, which translates to markedly reduced repetition time, shorter examination times and higher temporal SNR.

5327	Computer 9	Efficient mutli-slice reduced field of view cardiac T2-ADC mapping with a restore pulse
		Kévin Moulin[1], Eric Aliotta[1,2], and Daniel B Ennis[1,2]
		[1]Department of Radiological Sciences, University of California, Los Angeles, CA, Los Angeles, CA, United States, [2]Biomedical Physics Interdepartmental Program, University of California, Los Angeles, CA., Los Angeles, CA, United States
		Slice-following significantly reduces the scan time in cardiac diffusion weighting imaging by enabling free-breathing acquisition compatible with multi-slice coverage. However reduced field of view techniques result in a significant SNR penalty when combined with this multi-slice strategy. The objective of this work was to develop and evaluate a reduce field of view T2+ADC protocol compatible with multi-slice acquisition by using a “restore” pulse to improve higher SNR-efficiency.

5328	Computer 10	Combined Crushers: Omitting Separate Crusher Gradients in the Twice-Refocused Spin Echo Diffusion MRI Sequence
		Richard Buschbeck[1], Seong Dae Yun[1], Markus Zimmermann[1], Ezequiel Farrher[1], and N. Jon Shah[1,2]
		[1]Institute of Neuroscience and Medicine - 4, Jülich Research Centre, Juelich, Germany, [2]RWTH Aachen University, Faculty of Medicine, Department of Neurology, JARA, Aachen, Germany

		A new method is proposed that allows for the omission of crusher gradients in the Twice-Refocused Spin Echo (TRSE) sequence. The proper spoiling of the unwanted signal pathways is achieved by modifying the amplitudes and durations of the diffusion gradients. Both the crusher moment as well as the desired diffusion weighting is eventually provided only by the diffusion gradients. This results in several advantages like shorter minimum TEs and higher SNRs, all of which can be beneficial in diffusion MRI.

5329	Computer 11	Flow-compensated IVIM model: accuracy and precision as function of SNR, b-values and perfusion fraction
		Susanne S. Rauh[1,2], Oliver J. Gurney-Champion[2], Uwe Oelfke[2], Frederik B. Laun[1], and Andreas Wetscherek[2]
		[1]Institute of Radiology, University Hospital Erlangen, Erlangen, Germany, [2]Joint Department of Physics, The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, London, United Kingdom
		To use intravoxel incoherent motion (IVIM) modelling for clinical applications, the model parameters need to be determined accurately and precisely, which was found challenging. We studied the influence of signal-to-noise ratio (SNR), number of b-values and perfusion fraction on the accuracy of the recently introduced flow-compensated IVIM model parameters (tissue diffusivity, perfusion fraction, characteristic timescale and blood flow velocity). Simulations were performed for typical parameters obtained in healthy volunteers for pancreas and kidney and revealed that for an SNR of 20, 9 b-values and a perfusion fraction of more than 15% are needed for reliable parameter estimation in flow-compensated IVIM.

5330	Computer 12	Simultaneous IVIM and kurtosis acquisition in brain tumours: a trace-based protocol validated in a hybrid MR-PET system
		Ricardo Loução[1], Ana-Maria Oros-Peusquens[1], Karl-Josef Langen[1], Hugo Alexandre Ferreira[2], and N. Jon Shah[1]
		[1]INM4 - FZJ, Jülich, Germany, [2]Instituto de Biofísica e Engenharia Biomédica, Sciences Faculty, University of Lisbon, Lisbon, Portugal
		Diffusion weighted imaging such as intravoxel incoherent motion (IVIM) and non-Gaussian diffusion (NG-diff) allow the non-invasive study of tissue perfusion and are able to infer the organisation of the microstructure, respectively. Both are highly relevant in pathology characterisation, but are often acquired separately. Here we propose a unified IVIM/NG-diff protocol and apply it to brain tumour patients undergoing preoperative or follow-up scans in a hybrid MR-PET environment. The results agree well with previously reported values using standard techniques. Furthermore, indication for tumour grading power of IVIM parameters was found.

5331	Computer 13	Randomized-Slice Simultaneous Multi-Slice for Diffusion Kurtosis Imaging
		Daniel V Olson[1], Volkan Emre Arpinar[2], Andrew Nencka[2], and L. Tugan Muftuler[3]
		[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States
		Simultaneous Multi-slice (SMS) techniques excite multiple slices simultaneously to accelerate MRI data acquisition. However, slice separation during image reconstruction is not exact and results in coupling between separated voxels. While this may not be critical for most anatomic imaging methods, small but consistent leakage of information from another slice in a DKI dataset will cause bias in diffusion parameter estimates. Here, we implement a randomized-slice pairing technique to alleviate this problem in diffusion MRI acquisitions.

5332	Computer 14	Multi-Shot Diffusion-Weighted EPI Reconstruction Based on Locally Low-Rank Constraints
		Xin Ma[1,2], Mengye Lyu[1,2], Yilong Liu[1,2], and Ed X. Wu[1,2]
		[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong SAR, China, [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, China
		Based on the locally low rank (LLR) property of multi-shot diffusion-weighted imaging (DWI), a novel reconstruction scheme is proposed to achieve high signal-to-noise ratio (SNR) without explicit estimation of inter-shot phase variation. The results from in vivo DWI data indicate that the proposed method can effectively improve the image quality at various shot numbers when compared with traditional shot-by-shot reconstruction approaches.

5333	Computer 15	SPIRiT-Based Reconstruction of Interleaved Multi-shot EPI (SPECTRA) for Navigator-Free Diffusion Weighted MRI
		Gaojie Zhu[1], Hai Luo[1], Xiang Zhou[1], Meining Chen[1], Chao Wang[1], Wei Bian[2], and Ziyue Wu[1]
		[1]Advanced Application, Alltech Medical Systems, Chengdu, China, [2]Alltech Medical Systems, Chengdu, China

		Multi-shot EPI can achieve a high imaging resolution for Diffusion weighted MRI (DWI) by sampling a large k-space without increasing the degree of T2* blurring. However, its shot-to-shot phase error has to be corrected. Recently, a navigator-free correction method based on SENSE technique has been developed, assuming the phase error is spatially smooth among different DWI shots. In this work, we propose a SPIRiT-based method to correct the phase error and iteratively reconstruct navigator-free multi-shot EPI. Our results suggest it has the advantage of insensitivity to coil map bias and better SNR compared to the SENSE-based method.

5334	Computer 16	Eddy current characterization and correction using field monitoring for diffusion weighted imaging with maximal strength of 250 mT/m
		Yi-Cheng Hsu[1,2], Ying-Hua Chu[1,2], Thomas Witzel[3], Qiuyun Fan[3], and Fa-Hsuan Lin[2]
		[1]Dept. of Radiology, Medical Physics, Medical Center University of Freiburg, Faculty of Medicine, Freiburg, Germany, [2]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [3]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Charlestown, MA, United States
		We used a 24-channel field probe array to characterize the eddy current in a connectome scanner during diffusion weighted imaging with the maximal strength of 250 mT/m. Image distortion can be reduced by field monitoring but noticeable artifact remained after characterizing the eddy by up the 3rd-order spherical harmonics. We also found that eddy current lasted longer than 1 s. Our results suggested that the connectome scanner is not a linear time-invariant system, where concurrent field monitoring and high-order spherical harmonics characterization are desired.

5335	Computer 17	The importance of constraints and spherical sampling in diffusion MRI
		Tom Dela Haije[1] and Aasa Feragen[1]
		[1]Department of Computer Science, University of Copenhagen, Copenhagen, Denmark
		In this work we analyze the incidence of voxels with physically impossible model parameters, reconstructed from diffusion-weighted data that is acquired using different sampling schemes. Our results show that for cumulants up to order $$$4$$$ constrained least squares can be used to compute a reliable reconstruction of the cumulant expansion of the signal from realistic acquisitions, with spherical sampling producing fewer unsatisfied model constraints compared to space-filling sampling. Voxels where reconstruction is likely to fail are shown to be consistently localized near the white matter-gray matter interface and in deep brain structures.

5336	Computer 18	Phase Inconsistency Compensated Multi-shot Diffusion Image Reconstruction with Locally Low-Rank Constraint

		Ziwu Zhou[1], Fei Han[1], Yu Gao[1], Yingli Yang[2], and Peng Hu[1]
		[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Radiation Oncology, University of California, Los Angeles, Los Angeles, CA, United States
		Multi-shot diffusion imaging is a promising technique to achieve high-resolution visualization of the microstructure of the issue. However, phase variations induced by physiological motion among different shots remains to be a challenge. To improve the reconstruction accuracy, we propose a novel reconstruction method that integrates the information of phase variation within a compressed sensing framework, and exploits the data redundancy using locally low-rank constraint after phase inconsistency is taken care of.

5337	Computer 19	Model-Based Iterative Reconstruction for in vivo Diffusion Quantification
		Jannik Marcel Arbogast[1], Anna-Katinka Bracher[2], Meinrad Beer[2], Henning Neubauer[2], and Volker Rasche[1]
		[1]Internal Medicine II, University Ulm Medical Center, Ulm, Germany, [2]Radiology, University Ulm Medical Center, Ulm, Germany
		A model-based iterative reconstruction of the apparent diffusion coefficient (ADC) is introduced enabling the quantification of diffusion properties from undersampled DWI data of human knee joints. The approach uses an underlying model function to synthesize k-space data containing crucial phase information. A NLCG is implemented for ADC reconstruction comparing synthetic and measured k-space data. In vivo data of nine subjects show up to 3.5-fold acceleration of the DWI sequence without losing substantial accuracy of the ADC estimates.

5338	Computer 20	A POCS-Enhanced k-Space Reconstruction for 3D Multi-Slab Diffusion Imaging
		Erpeng Dai[1], Xiaodong Ma[1], Zhe Zhang[2], Yu-hsuan Wu[1], Wenchuan Wu[3], Karla L. Miller[3], Chun Yuan[1,4], and Hua Guo[1]
		[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [2]Tiantan Image Research Center, China National Clinical Research Center for Neurological Diseases, Beijing, China, [3]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [4]Vascular Imaging Laboratory, Department of Radiology, University of Washington, Seattle, WA, United States

		3D multi-slab acquisition is a new technique for high-resolution isotropic diffusion imaging with sufficient SNR maintained. To fill the whole 3D k-space, multi-shot acquisitions are usually needed. However, this can cause the inter-shot phase variations. In this study, we propose a new k-space-based phase correction method for multi-slab diffusion imaging. This proposed method is based on a previous method termed GRAPPA with compact kernel (GRAPPA-CK). Furthermore, POCSMUSE algorithm is subsequently used to enhance the reconstruction of GRAPPA-CK. Finally, the newly proposed method is demonstrated to be compatible with in-plane acceleration in 3D multi-slab imaging.

5339	Computer 21	Novel Image-based Nyquist Ghost Correction of Diffusion-Weighted Echo Planar Imaging using Ghost/Object Minimization
		Jessica A McKay[1], Steen Moeller[2], Sudhir Ramanna[2], Edward J Auerbach[2], Gregory J Metzger[2], Justin R Ryder[3], Kamil Ugurbil[2], Essa Yacoub[2], and Patrick J Bolan[2]
		[1]Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States, [2]Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [3]Department of Pediatrics, University of Minnesota, Minneapolis, MN, United States
		Diffusion weighted imaging (DWI) acquired with SE-EPI is subject to Nyquist ghosts, which are commonly corrected using a three-line navigator. However, several alternative ghost correction strategies do not require any reference acquisition. These methods define a cost function that is minimized when the image is ghost-free. We propose a novel referenceless method called ghost/object minimization by defining the cost function as the summation over the image divided by its ½-FOV-shifted counterpart. In this work, we test noise sensitivity and demonstrate the feasibility of the ghost/object minimization using simulated ghosts and in vivo acquisitions including brain, prostate, breast, and liver DWI.

5340	Computer 22	Accelerating Intravoxel Incoherent Motion Mapping in the Brain using k-bpp PCA
		Georg Ralph Spinner[1], Johannes Frieder Matthias Schmidt[1], and Sebastian Kozerke[1]
		[1]IBT, ETH Zurich, Zurich, Switzerland
		Intravoxel Incoherent Motion (IVIM) parameter mapping yields quantitative information about diffusion and pseudo-perfusion properties. In brain IVIM, parallel imaging with two-fold undersampling has been reported. In order to address noise amplification and unfolding artifacts at undersampling factors greater than two with parallel imaging, reconstruction in spatio-principal component space with data reshuffling (k-b_{pp} PCA) is presented here. Using in-vivo brain data, it is demonstrated that k-b_{pp} PCA allows for significantly increased undersampling factors relative to parallel imaging while maintaining comparable image quality and parameter estimation errors.

5341	Computer 23	Comparison of Navigator-free Multi-shot Diffusion-Weighted Imaging Reconstruction Algorithms for EPI Malte Steinhoff[1,2], Kay Nehrke[3], and Peter Börnert[3,4] *[1]Braunschweig University of Technology, Braunschweig, Germany, [2]University of Lübeck, Lübeck, Germany, [3]Philips Research Europe, Hamburg, Germany, [4]Dept. Radiology, LUMC, Leiden, Netherlands* Multi-shot diffusion-weighted MRI allows for higher spatial resolution than single-shot approaches, but suffers from image artifacts due to motion-induced shot-specific phase variations. Advanced parallel imaging reconstructions can mitigate these effects, but a comparison of these approaches is still missing, especially for the widespread EPI. Following the concept of reproducible research, a number of algorithms were implemented, adapted and refined for EPI, and compared in simulations and in-vivo. Results show different performance and applicability. The iterative feedback and the sharing of joint global information in the reconstruction and appropriate constraints were found to be crucial for high-quality high-resolution DWI.

5342	Computer 24	A diffusion-matched principal component analysis (DM-PCA) based denoising procedure for high-resolution diffusion-weighted MRI Nan-kuei Chen[1], Hing-Chiu Chang[2], Ali Bilgin[3], Adam Bernstein[3], and Theodore P Trouard[3] *[1]Biomedical Engineering, University of Arizona, Tucson, AZ, United States, [2]University of Hong Kong, Hong Kong, Hong Kong, [3]University of Arizona, Tucson, AZ, United States* A concern with high-resolution DWI and DTI is the limited SNR. Here we report a new denoising procedure, termed diffusion-matched principal component analysis (DM-PCA), which comprises 1) identifying a group of voxels with very similar signal variation patterns along the diffusion dimension, 2) performing PCA along the diffusion dimension for those voxels, and 3) suppressing noisy PCA components. The DM-PCA method performs reliably for input data with a range of SNR and different numbers of diffusion encoding scans, without compromising anatomic resolvability, and should prove highly valuable for imaging studies in research and clinical uses.

Electronic Poster

Diffusion MRI: Post-Processing

Exhibition Hall	Thursday 9:00 - 10:00

5343	Computer 25	A framework for b-value optimization in DWI Rick Keesman[1], Leon ter Beek[2], and Uulke van der Heide[1]

		[1]*Department of Radiation Oncology, Netherlands Cancer Institute, Amsterdam, Netherlands,* [2]*Department of Radiology, Netherlands Cancer Institute, Amsterdam, Netherlands*
		Diffusion-weighted imaging is a valuable asset in the diagnosis of a plethora of diseases. General guidelines are available when measuring (mono-exponential) diffusion in several organs of interest, but there is less consensus on optimal acquisition parameters for more complex models (*e.g.*, intravoxel incoherent motion, kurtosis). We provide a general, easy to implement, solution scheme (similar to the Cramér–Rao lower bound approach) that can be used to optimize the acquisition protocol with respect to the $$$b$$$-values. We present mathematical proof, and phantom as well as in-vivo measurements that corroborate the viability of our method.

5344	Computer 26	Investigation of the Effect of Body Posture on Dynamic ADC Change during Cardiac Cycle in Human Brain
		Naoki Ohno[1], Tosiaki Miyati[1], Masatomo Uehara[1], Yuki Hiramatsu[1], Riho Okamoto[1], Mitsuhito Mase[2], Satoshi Kobayashi[1], and Toshifumi Gabata[1]
		[1]*Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan,* [2]*Department of Neurosurgery, Nagoya City University, Nagoya, Japan*
		Intracranial conditions are strongly affected by body posture. Apparent diffusion coefficient (*ADC*) of the brain significantly changes during the cardiac cycle, and this change (*ΔADC*) reflects intracranial condition. However, the effect of body posture on *ΔADC* has yet to be confirmed. Therefore, we evaluated the *ΔADC* and *ADC* of the brain in upright and supine postures using a multi-posture MRI. *ΔADC* and *ADC* of the white matter in the upright posture were significantly higher than those in the supine posture. Multi-posture MRI facilitates the noninvasive evaluation of the effect of gravity on intracranial conditions.

5345	Computer 27	GPU Accelerated Maximum Likelihood Estimation of Diffusion and Kurtosis Tensors with the Rician Noise Model
		Viljami Sairanen[1,2], Jia Liu[3], and Dario Gasbarra[3]
		[1]*Medical Physics, Radiology, Helsinki University Hospital, Helsinki, Finland,* [2]*Department of Physics, University of Helsinki, Helsinki, Finland,* [3]*Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland*

		Diffusion- and kurtosis tensor estimators generally assume independent and a Gaussian distributed noise. While with adequate signal-to-noise ratios (SNR) this assumption can be made without significant bias in the estimated models, this is not true when utilizing high diffusion weighting thus low SNR. In such case, the Rician noise should be considered with maximum likelihood (ML) estimators for example. Moreover, the mathematical properties of ML estimators could unveil novel details of the underlying diffusion process within the brain. In this work, we present super-fast, GPU accelerated ML estimator with Matlab interface to provide a practical tool for such improved estimation.

5346	Computer 28	Rebooting diffusion MRI uncertainty distributions in the presence of outliers with ROBOOT
		Viljami Sairanen[1,2], Derek K Jones[3], Alexander Leemans[4], and Chantal M. W. Tax[3]
		[1]Medical Physics, Radiology, Helsinki University Hospital, Helsinki, Finland, [2]Department of Physics, University of Helsinki, Helsinki, Finland, [3]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, Cardiff, United Kingdom, [4]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands
		Characterizing uncertainty distributions in diffusion MRI derived metrics such as fractional anisotropy or kurtosis anisotropy requires non-parametric approaches, since the correct form of the distribution is rarely known *a priori*. Previously suggested wild bootstrapping methods, however, have not considered the impact of outliers in the data. In this work, we updated the existing wild bootstrap methodology to consider outliers detected by a robust model estimator, adopting a strategy similar to the rejection of the outliers prior to the model estimate. Additionally, we used simulations based on real human data to demonstrate the benefits of our pipeline for recovering uncertainty distributions.

5347	Computer 29	Automated Pattern Recognition Analysis of Intravoxel Incoherent Motion (IVIM)-diffusion to Segment Hypo-perfused Stroke Region
		MinJung Jang[1], SoHyun Han[2], and HyungJoon Cho[1]
		[1]Ulsan National Institute of Science and Technology, Ulsan, Republic of Korea, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Cambridge, MA, United States
		The variation in fitted perfusion factors (*f*) from different fitting models and the necessary parameter thresholdings are one of the challenges in the robust interpretation of intravoxel incoherent motion (IVIM) diffusion data [1-3]. The purpose of this study is to investigate the feasibility of applying constrained nonnegative matrix factorization (cNMF) to IVIM-diffusion data for the automatic segmentation of hypo-perfused stroke region of rat brain without any model-fittings nor thresholdings.

5348	Computer 30	Digital DWI phantoms for non-Gaussian diffusion with Rician noise

		Dariya I Malyarenko[1], Yuxi Pang[1], and Thomas L Chenevert[1]
		[1]Radiology, University of Michigan, Ann Arbor, MI, United States
		Multi-parametric diffusion models describe non-Gaussian diffusivity of tissue observed by quantitative diffusion weighted imaging (qDWI). The ground-truth values for assumed model parameters are useful for both testing the analysis algorithms and optimizing qDWI acquisition. These values can be provided by virtual phantoms, termed digital reference objects (DROs), based on forward modeling. Here we describe a tool to generate DWI DICOM DROs with varying diffusivity model parameters and *b*-values including physical noise. Application examples are shown for Kurtosis, Stretched Exponential and Perfusion-fraction Intra-Voxel Incoherent-Motion DWI DROs to quantify noise-induced bias and variation in derived qDWI parametric maps.

5349	Computer 31	Impact of scan and fitting parameters on the accuracy of parameter maps in IVIM-diffusion-MRI of the knee joint
		Anna-Katinka Bracher[1], Meinrad Beer[1], Volker Rasche[2], and Henning Neubauer[1]
		[1]Departement of Diagnostic and Interventional Radiology, Ulm University Medical Center, Ulm, Germany, [2]Departement of Internal Medicine II, Ulm University Medical Center, Ulm, Germany
		Intravoxel Incoherent Motion (IVIM) imaging has proven its potential for combined diffusion and perfusion imaging of synovitis in the knee joint. In this abstract the impact of the maximum B-value B_{max} and the threshold B-value B_{cutoff} - which separates the B-values for the fitting function in perfusion and non-perfusion part - were investigated. The parameter maps show high dependency on B_{cutoff} and only slight variations on B_{max}.

5350	Computer 32	Diffusion and Perfusion Analysis using Intravoxel Incoherent Motion (IVIM): A Twenty Patient Study with Osteosarcoma
		Esha Baidya Kayal[1], Devasenathipathy Kandasamy[2], Kedar Khare[3], Raju Sharma[2], Sameer Bakhshi[4], and Amit Mehndiratta[1,5]
		[1]Centre for Biomedical Engineering, Indian Institute of Technology, Delhi, New Delhi, India, [2]Radiodiagnosis, All India Institure of Medical Sciences, New Delhi, New Delhi, India, [3]Department of Physics, Indian Institute of Technology, Delhi, New Delhi, India, [4]Department of Medical Oncology, IRCH, All India Institure of Medical Sciences, New Delhi, New Delhi, India, [5]Department of Biomedical Engineering, All India Institute of Medical Sciences, New Delhi, New Delhi, India

		Quantitative analysis of Intravoxel incoherent motion (IVIM) effect of diffusion weighted imaging can assess both diffusion and perfusion component of tissue separately. To the best of our knowledge, IVIM analysis in primary bone tumors has not been reported yet and no reference for IVIM parameter values in bone tumors is available for simulation study. We estimated quantitative IVIM parameters using state-of-the-art IVIM analysis method – Bi-exponential model with adaptive Total Variation penalty function (BE+TV) in a cohort of twenty patients with Osteosarcoma that is useful for IVIM analysis in bone tumors for prognosis and can serve as standard reference for future studies.

5351	Computer 33	Features extracted from diffusion-driven tensor based morphometry can serve as a specific imaging marker for Moebius Syndrome
		Neda Sadeghi[1], Irini Manoli[2], Timothy Wood[3], Francis S. Collins[2], Ethylin Wang Jabs[4], Elizabeth C. Engle[5], Moebius Syndrome Research Consortium[6], and Carlo Pierpaoli[1]
		[1]Quantitative Medical Imaging Section, National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health, Bethesda, MD, United States, [2]Medical Genomics and Metabolic Genetics Branch, National Human Genome Research Institute, National Institutes of Health, Bethesda, MD, United States, [3]Department of Computer Science, University of Maryland: College Park, College Park, MD, United States, [4]Department of Genetics and Genomic Sciences, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [5]Departments of Neurology and Ophthalmology, Boston Children's Hospital and Harvard Medical School, Boston, MA, United States, [6]National Institutes of Health, Bethesda, MD, United States
		Quantitative diffusion derived metrics such as fractional anisotropy (FA), and Trace of diffusion tensor (TR) have been used in many studies to assess differences between a subject group and a control group. In this study, in addition to FA and TR, we also look at morphological differences measured by diffusion-driven tensor based morphometry (DTBM). We use DTBM to extract features for use in classification of Moebius syndrome subjects, a rare birth defect characterized by paralysis or weakness of facial muscles and impairment of ocular abduction.

5352	Computer 34	Brain q-space imaging: Mean displacement measurement by SMS, grid sampling, and multi-shell QSI
		Koji Sakai[1], Hiroyasu Ikeno[2], Hiroshi Imai[3], Kentaro Akazawa[1], Masashi Yasuike[1], Hitomi Nagano[1], and Kei Yamada[1]
		[1]Kyoto Prefectural University of Medicine, Kyoto, Japan, [2]Kyoto Prefectural University of Medicine Hospital, Kyoto, Japan, [3]Siemens Healthcare K. K., Tokyo, Japan

		The comparisons of mean displacement (MD) from multi-shell QSI (msQSI) and grid sampling QSI (gsQSI) were executed by anisotropic diffusion phantom and human brain. In addition, the effect of the number of slices excited and acquired simultaneously (SMS factor) we also investigated. The MDs of msQSI and gsQSI were different. The shorter diffusion time on gsQSI might effect these differences. SMS factors on msQSI showed difference among the acceleration. On contrary, SMS factors on gsQSI did not show any difference among the acceleration.

5353	Computer 35	Physiological noise at low diffusion weighting reduces repeatability of apparent diffusion coefficient independent of underlying diffusion curve characteristics
		Neil Peter Jerome[1,2], Igor Vidic[3], Liv Egnell[2,3], Torill E. Sjøbakk[1], Agnes Østlie[2], Hans E. Fjøsne[4,5], Tone F. Bathen[1], and Pål Erik Goa[2,3]
		[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology - NTNU, Trondheim, Norway, [2]Clinic of Radiology and Nuclear Medicine, St. Olavs University Hospital, Trondheim, Norway, [3]Department of Physics, Norwegian University of Science and Technology - NTNU, Trondheim, Norway, [4]Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology - NTNU, Trondheim, Norway, [5]Department of Surgery, St. Olavs University Hospital, Trondheim, Norway
		The apparent diffusion coefficient is a powerful imaging biomarker, sensitive to microstructure properties, and possessing excellent repeatability. Exclusion of perfusion influence ($b<150$ s.mm^{-2}) reflects true diffusivity, although fewer data points reduces precision, and thus repeatability. We investigate repeatability of experimental breast diffusion data, and show an unexpected increased repeatability with low b-value data inclusion, in contrast to simulated data. This indicates that experimentally-acquired low b-values contains additional noise, perhaps modulated by the non-Gaussianity of the underlying diffusion processes, that decreases diffusion modelling repeatability independent of the true diffusion curve, and should be considered as part of the analysis strategy.

5354	Computer 36	EDDY QC: Automated quality control for diffusion MRI
		Matteo Bastiani[1], Jesper Andersson[1], Michiel Cottaar[1], Fidel Alfaro-Almagro[1], Sean P Fitzgibbon[1], Sana Suri[2], Stamatios N Sotiropoulos[1,3], and Saad Jbabdi[1]
		[1]Wellcome Centre for Integrative Neuroscience (WIN) - FMRIB, University of Oxford, Oxford, United Kingdom, [2]Department of Psychiatry, University of Oxford, Oxford, United Kingdom, [3]Sir Peter Mansfield Centre, School of Medicine, University of Nottingham, Nottingham, United Kingdom

		Given the very large number of individual datasets acquired in recent population imaging studies, it is becoming essential to automate data quality control (QC). Here we present an automated QC framework to assess diffusion MRI data both at the single subject and group levels. The QC metrics are derived through different stages of FSL's pre-processing tools (TOPUP and EDDY). We show that using this framework, it is possible to distinguish between good and bad quality datasets and, importantly, identify subsets of the data that may need careful visual inspection. We hope this QC tool will help harmonisation efforts across sites/studies.

5355	Computer 37	An open-source framework for analysis of multidimensional diffusion MRI data implemented in MATLAB
		Markus Nilsson[1], Filip Szczepankiewicz[1,2], Björn Lampinen[3], André Ahlgren[3], João P. de Almeida Martins[2,4], Samo Lasic[2], Carl-Fredrik Westin[5], and Daniel Topgaard[4]
		[1]Clinical Sciences Lund, Radiology, Lund University, Lund, Sweden, [2]Random Walk Imaging, Lund, Sweden, [3]Clinical Sciences Lund, Medical Radiation Physics, Lund University, Lund, Sweden, [4]Department of Chemistry, Physical Chemistry, Lund University, Lund, Sweden, [5]Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States
		Reproducible research requires robust methods for data management and analysis. We have developed a comprehensive analysis framework for diffusion MRI data based on a robust but flexible management of data and metadata, which enables rapid prototyping and sharing of code. The framework is tailored to deal with multidimensional diffusion MRI data featuring novel types of diffusion encoding strategies, such as b-tensor encoding. It also features routines for higher order tensor mathematics as well as adapted volume registration for motion correction, an analysis GUI and other tools.

5356	Computer 38	Different Models of Ultra-high b-Value DWI for Better Detection of Restricted Diffusion
		Qiqi Tong[1], Hongjian He[1], Tianyi Qian[2], Yi Sun[3], Ting Gong[1], and Jianhui Zhong[1]
		[1]Center for Brain Imaging Science and Technology, Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]MR Collaboration NE Asia, Siemens Healthcare, Beijing, China, [3]MR Collaboration NE Asia, Siemens Healthcare, Shanghai, China
		Diffusion-weighted imaging with high b-value can potentially capture the restricted diffusion in tissues. With high-b-value diffusion weighting, the signal in tissue decays non-exponentially, thus the expansion of DWI signal usually be interpreted at second order or higher. However, in the ultra-high b-value (b>4k s/mm^2), the cumulant expansion of higher order would fail to fit the signal. In this study, DTI, DKI, biexponential and Kärger models were used for approximating DWI signals with ultra-high b-values.

5357	Computer 39	Intravoxel Incoherent Motion Imaging of Thermoregulation in Skeletal Muscle

		Kemal Sümser[1], Juan Antonio Hernandez-Tamames[2], Gerard Cornelis van Rhoon[1], and Margarethus Marius Paulides[1]
		[1]Radiation Oncology, Erasmus Medical Center, Rotterdam, Netherlands, [2]Radiology Department, Erasmus Medical Center, Rotterdam, Netherlands
		Accurate temperature dependent perfusion maps are needed for accurate thermal modelling. In this study, perfusion maps were created for human leg muscle at rest and under cold stress using Intravoxel Incoherent Motion (IVIM) Diffusion Weighted Imaging. IVIM parameters decreasesignificantly under cold stress. Consistency of inter-subject measurements proved IVIM method is suitable for imaging temperature dependent perfusion maps.

5358	Computer 40	Comparative study of DKI model and traditional DWI model in diagnosis of breast cancer
		Ting Li[1], Siying Wang[2], Yun Xiong[3], and Kangan Li[1]
		[1]Shanghai General Hospital, Shanghai, China, [2]PhilipsHealthcare, Shanghai, China, [3]Fudan University, Shanghai, China
		The aim of this study is to compare the value of diffusion kurtosis imaging model with traditional single-index diffuse weighted imaging model parameters in the differential diagnosis of benign and malignant breast lesions. The rusults showed that the parameters of DKI model and traditional DWI model can be used to differentiate benign and malignant breast lesions. The diagnostic value of MK value in DKI model is the largest. There is a certain correlation between DKI model parameters and prognostic factors.

5359	Computer 41	Differential Diagnosis of Intrahepatic Cholangiocarcinoma and Hepatocellular Carcinoma by Using Diffusion-tensor Imaging
		Lihua Chen[1], Ailian Liu[2], Qingwei Song[2], and Lizhi Xie[3]
		[1]The First Affiliated Hospital of DaLian Medical University, Dalian, China, [2]The First Affiliated Hospital of Dalian Medical University, Dalian, China, [3]GE Healthcare, MR Research China, Beijing, China
		The advent of functional MR imaging has facilitated an increased role for imaging in risk stratification and treatment planning. In this study, DTI and DWI MR measurements were performed to investigate the correlation of the FA and ADC values in ROIs of the intrahepatic cholangiocarcinoma (ICC) and hepatocellular carcinoma (HCC), and in further the sensitivity, specificity and accuracy of the parameters for the diagnosis. DTI working at present scanning hardware are more capable to detect the pathophysiological changes unattainable compare to conventional MRI techniques.

5360	Computer 42	The diagnostic capability of diffusion Kurtosis Imaging in distinguishing cervical lymphoma from nasopharyngeal carcinoma metastases Cuifang Chen[1], Jing Zhong[1], Yunbin Chen[1], and Weibo Chen[2] *[1]Fujian Medical University Cancer Hospital, Fuzhou, China, [2]Philips Healthcare, Shanghai, China* In our prospective study, We compared DKI and DWI related parameters in order to investigate the diagnostic capability of DKI in distinguishing cervical lymphoma from nasopharyngeal carcinoma(NPC) metastases. The ROC curve showed that K value of DKI had no significantly diagnostic capability, whlie D value of DKI had a better diagnostic performance than the ADC value of DWI in distinguishing the cervical lymphoma from the NPC metastases. Therefore, DKI may be a better noninvasive imaging biomarker for distinguishing the lymphoma and NPC metastases involving the head and neck.

5361	Computer 43	An Analytical Segmented (AS) Approach for Extracting IntraVoxel Incoherent Motion (IVIM) Model Parameters Erick Buko[1], Jiming Zhang[2], Afis Ajala[1], Pei-Herng Hor[1], and Raja Muthupillai[2] *[1]Physics and Texas Center for Superconductivity, University of Houston, Houston, TX, United States, [2]Diagnostic and Interventional Radiology, Baylor St Luke's Medical Center, Houston, TX, United States* Although IVIM model can provide valuable insight into tissue perfusion and microstructure without the need for contrast, the estimation of model parameters with sufficient accuracy continues to be a challenge. In this work, we propose a analytical segmented (AS) approach for estimating IVIM model parameters describing tissue perfusion (Df, and f), and tissue diffusion (Ds), and compare the performance of this work against conventional approaches using numerical simulations. Results from our work suggest that AS approach can minimize errors in the estimation of metrics characterizing perfusion, i.e., f, and Df compared to conventional approaches (full fitting , segmented and oversegmented methods) even for tissues with low Df/Ds ratios.

5362	Computer 44	Inadequate modeling of diffusion anisotropy can lead to artefactual IVIM effects: evidence from numerical simulations Gabrielle Fournet[1], Luisa Ciobanu[1], and Denis Le Bihan[1] *[1]NeuroSpin/CEA Saclay, Gif-sur-Yvette, France*

		The interest in studying perfusion anisotropy using IVIM imaging is growing. However, due to the small amount of perfusion in some tissues, IVIM imaging is highly sensitive to imperfections in the analysis. In this work, we investigate the impact of improperly modeling diffusion anisotropy on the IVIM effect. Performing numerical simulations of a perfusion-free tissue using different sets of diffusion directions and tissue orientations, we show that fitting anisotropic diffusion to the Kurtosis model creates a direction- and orientation-dependent IVIM effect, which can be minimized by taking the geometric mean of the signals with at least 6 properly chosen directions.

5363	Computer 45	Non-Gaussian DWI of breast lesions at high b-values
		Igor Vidic[1], Liv Egnell[1,2], Neil P. Jerome[2,3], Torill E. Sjøbakk[3], Agnes Østlie[2], Hans E. Fjøsne[4,5], Roshan Karunamuni[6], Nathan S. White[7,8], Rebecca Rakow-Penner[7], Anders M. Dale[7,9], Tone F. Bathen[3], and Pål Erik Goa[1,2]
		[1]Department of Physics, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [2]Clinic of Radiology and Nuclear Medicine, St. Olavs University Hospital, Trondheim, Norway, [3]Department of Circulation and Medical Imaging, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [4]Department of Cancer Research and Molecular Medicine, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [5]Department of Surgery, St. Olavs University Hospital, Trondheim, Norway, [6]Department of Radiation Medicine and Applied Sciences, University of California, San Diego, La Jolla, CA, United States, [7]Department of Radiology, University of California, San Diego, La Jolla, CA, United States, [8]Center for Multimodal Imaging and Genetics, University of California, San Diego, La Jolla, CA, United States, [9]Department of Neurosciences, University of California, San Diego, La Jolla, CA, United States
		In this work, we fit multiple non-Gaussian models to high b-value DW-MRI (b= 200-3000 s/mm^2) in benign and malignant breast lesions. Models included bi-exponential, stretched exponential, diffusion kurtosis, Padé exponent and ADC (for comparison). We evaluated the quality of fit for each model and investigated the lesion differentiation accuracy for all extracted model parameters. The bi-exponential model provided statistically significant better quality of fit than all the other models, and without systematic bias. This suggests the existence of two effective diffusion compartments in breast lesions. Several of the extracted model parameters performed equally well in terms of lesion differentiation (AUC>0.97).

5364	Computer 46	Measurement biases in diffusion and diffusion kurtosis MRI
		Nima Gilani[1], Hamidreza Saligheh Rad[2], and Glyn Johnson[3]
		[1]Maastricht Brain Imaging Centre (MBIC), Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands, [2]Department of Medical Physics and Biomedical Engineering, Tehran University of Medical Sciences, Tehran, Iran (Islamic Republic of), [3]Norwich Medical School, University of East Anglia, Norwich, United Kingdom

		Water diffusion in tissue is non-Gaussian and the expressions used to calculate diffusion parameters are approximations which introduce systematic errors dependent on the maximum b-value employed. The purpose of this study was to characterize biases in estimates of both apparent diffusion coefficient, and kurtosis and to determine their dependence on maximum b-value. Hence, equations were derived to predict biases in measured diffusion parameters and to explain much of the discrepancy between measurements obtained with different b-values. The equations may also be used to choose appropriate maximum b-values for diffusion-weighted, tensor, and kurtosis imaging.

5365	Computer 47	Can Apparent Diffusion Coefficient from Ultra-high b-Values be Used to Assess Renal Function with Murine Model of Unilateral Ureteral Obstruction?
		Anqin Li[1], Zhen Li[1], Jiali Li[1], Yao Hu[1], and Daoyu Hu[1]
		[1]Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China
		To evaluate the utility of apparent diffusion coefficient (ADC) data obtained from ultra-high b-values in renal function using with rat model of unilateral ureteral obstruction (UUO). We compared the differences of ADCuh among time points and between the sides, and determined the correlation of ADCuh with positron emission tomography (PET) renal function and expression of aquaporin 2 (AQP-2). ADCuh of the UUO sides on day 0 was significantly lower than that of on day 1, 3, 5 and 7. ADCuh was negatively correlated with SUV both on the UUO side and contralateral side. Therefore, ADCuh may have a certain value to help evaluate renal function.

5366	Computer 48	Bayesian estimation applied to stretched exponential modelling of diffusion-weighted imaging data
		Peter Thomas While[1]
		[1]Department of Radiology and Nuclear Medicine, St. Olav's University Hospital, Trondheim, Norway
		The stretched exponential model provides a means of assessing non-monoexponential signal attenuation in diffusion-weighted imaging data. However, standard least squares approaches to parameter estimation remain susceptible to noise. In this work, we apply two distinct Bayesian approaches to stretched exponential modelling, and assess their performance at low-medium *b*-values using simulations. The use of a spatial homogeneity prior is found to yield parameter maps with higher precision and accuracy than those obtained with the use of a Gaussian shrinkage prior or nonlinear least squares.

Electronic Poster

Detecting Microstructural Changes Using Diffusion

5367 Computer 49

Impact of time-of-day on diffusivity measures of brain tissue derived from diffusion tensor imaging

Cibu Thomas[1], Neda Sadeghi[2], Aaron Trefler[1], Joelle Sarlls[3], Chris Baker[1], and Carlo Pierpaoli[2]

[1]National Institute of Mental Health, Bethesda, MD, United States, [2]National Institute of Biomedical Imaging and Bioengineering, Bethesda, MD, United States, [3]National Institute of Neurological Disorders and Stroke, Bethesda, MD, United States

Although diurnal fluctuations in DTI-based measures of brain tissue properties have been reported, the underlying mechanism has not been investigated. Here, we processed multi-shell diffusion data using the conventional monoexponential tensor model as well as with a dual-compartment tensor model and assessed whether, time-of-day (TOD) fluctuations in DTI measures are due to changes in the magnitude of a CSF-like water compartment, or due to changes in the diffusion properties of parenchymal water. Our results suggest that TOD effects are due to fluctuations in the magnitude of a CSF-like water compartment rather than changes in the diffusion properties of parenchymal water.

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Longitudinal Changes in Gray Matter Regions after Cranial Radiation and Comparative Analysis with Whole Body Radiation: A DTI Study

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Radiation induced white matter changes are well known and vastly studied. However, radiation induced gray matter alterations are still a research question. In the present study, DTI based gray matter changes in C57BL/6 mice were studied following cranial and whole body irradiation at 5 Gy during sub acute and early delayed time point. Longitudinal changes in FA and MD were observed till 8 months post radiation. Comparative analysis depicted differential response after cranial and whole body radiation exposure with prominent alterations in cranially irradiated animals. with most changes at 8 months post irradiation

5369 Computer 51

Brain axonal and myelin changes after positive airway pressure treatment in patients with obstructive sleep apnea

Ashish Kaul Sahib[1], Bhaswati Roy[2], Xiaopeng Song[1], Sadhana Singh[1], Luke Ehlert[1], Ravi Aysola[3], Daniel Kang[3], Mary Woo[2], and Rajesh Kumar[1,4,5,6]

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		Newly-diagnosed, treatment-naïve obstructive sleep apnea subjects show predominately acute tissue changes in gray and white matter, in addition to autonomic, mood, and cognitive deficits, but the extent of brain tissue recovery after PAP treatment and required minimum treatment time is unclear. We examined brain axonal and myelin changes at baseline and tissue recovery after 3 and 9 months' positive airway pressure treatment in OSA compared to control subjects. Our findings indicate that brain structural changes found in newly-diagnosed OSA subjects can be reversible with long-term PAP treatment.

5370	Computer 52	Investigating the spatial pattern of structural changes of the Optic Radiation in early blind individuals.
		Lisa Novello[1], Chiara Maffei[1], Hicret Atilgan[1], Stefania Mattioni[1,2], Ceren Battal[1], Mohamed Rezk[1,2], Olivier Collignon[1,2], and Jorge Jovicich[1]
		[1]CIMeC - Center for Mind/Brain Sciences, University of Trento, Rovereto (TN), Italy, [2]Institute of Psychology (IPSY) and of Neurosciences (IoNS), University of Louvain-la-Neuve, Louvain-la-Neuve, Belgium
		The study of sensory deprived individuals shows the capability of the brain to massively reorganize. Previous studies show that the optic tract of early blind individuals undergoes structural changes, but little is known about their spatial distribution. We investigated the spatial profile of the structural changes occurring along tractography reconstruction from diffusion MRI data of the optic radiations in early blind individuals compared to age- and gender-matched healthy sighted controls.

5371	Computer 53	Abnormal cerebellar wiring in a mouse model of Down syndrome revealed by HARDI-based tractography
		Dan Wu[1], Feng Gao[2], and Roger Reeves[2]
		[1]Department of Radiology, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [2]Department of Physiology and Institute for Genetic Medicine, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States

		We investigated the cerebellar microstructure and wiring diagram in a mouse model of Down syndrome (DS), using HARDI-based tractography analysis. Our results showed an absence of cerebellar climbing fibers (CF) and/or mossy fibers (MF) in the intra-granule layer of the DS mice at neonatal stage, when those fiber tracts started to form in the control neonatal brains. In the adult mice, two groups of crossing fibers—the CF/MF fibers versus the parallel fibers (PF) were identified, but the number of crossing fibers and apparent fiber density was significantly reduced in the granule layer of the DS mice, especially for the CF/MF group.

5372	Computer 54	Using Double Diffusion Encoding (DDE) MRI to study tissue microstructure in traumatic brain injury (TBI)
		Michal E Komlosh[1,2], Dan Benjamini[1], Elizabeth B Hutchinson[2,3], Sarah King[2,3], Margalit Haber[4], Alexandru V Avram[1], Lynne A Holtzclaw[5], Abhishek Desai[6], Carlo Pierpaoli [3], and Peter J Basser[1]
		[1]Section on Quantitative Imaging and Tissue Sciences, NICHD, National Institutes of Health, Bethesda, MD, United States, [2]Center for Neuroscience and Regenerative Medicine, Uniform Service University of the Health Sciences, Bethesda, MD, United States, [3]Quantitative Medical Imagion Section, NIBIB, National Institutes of Health, Bethesda, MD, United States, [4]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States, [5]Microscopy and Imaging Core, NICHD, National Institutes of Health, Bethesda, MD, United States, [6]Laboratory of Molecular Signaling, NIAAA, National Institutes of Health, Rockville, MD, United States
		A double diffusion encoding (DDE) MRI method was used to estimate apparent mean axon diameter (AMD) in a mild traumatic brain injury (mTBI) mouse model exhibitig diffuse axonal injury (DAI). MRI data show clear tissue alterations caused by the injury, while immunohistochemistry data confirm the MRI findings. DDE could potentially be used as a non-invasive means to detect mTBI.

5373	Computer 55	Comparison of diffusion MR models in lymph nodes at ultra high field
		Andrada Ianus[1,2], Ines Santiago[1], Daniel C. Alexander[2], Celso Matos[1], and Noam Shemesh[1]
		[1]Champalimaud Research, Champalimaud Centre for the Unknown, Lisbon, Portugal, [2]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom
		Diffusion MRI could play an important role for detection and characterisation of lymph nodes, however, the standard ADC metric lacks specificity and cannot accurately capture the signal decay. Multi-compartment models aim to represent the signal contribution of different water pools in order to better explain the acquired data. In this study, a rich dMRI dataset is acquired for ex-vivo lymph nodes and various diffusion models are fitted. The results show that including compartments which feature restricted diffusion improves the signal fit. Although such models have only a slight impact on lymph node differentiation, they could potentially provide more specific biomarkers.

5374	Computer 56	Heterochronous regional white matter development in pre-adolescent children: diffusion kurtosis imaging study Farida Grinberg[1,2], Ezequiel Farrher[1], Kerstin Konrad[3,4], Irene Neuner[1,5], and N. Jon Shah[1,2] *[1]Institute of Neuroscience and Medicine 4, Forschungszentrum Jülich, Jülich, Germany, [2]Department of Neurology, Faculty of Medicine, RWTH Aachen University, Aachen, Germany, [3]Child Neuropsychology Section, Department of Child and Adolescent Psychiatry and Psychotherapy, RWTH Aachen University, Aachen, Germany, [4]Institute of Neuroscience and Medicine 3, Forschungszentrum Jülich, Jülich, Germany, [5]Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH Aachen University, Aachen, Germany* Diffusion tensor imaging, and, more recently, diffusion kurtosis imaging enables the examination of white matter connectivity and of in vivo microstructural changes across the lifespan. However, only very few diffusion kurtosis imaging studies have addressed white matter maturation. Here we explore which specific brain regions continue to develop throughout late childhood into the adulthood as revealed by kurtosis tensor metrics. We show the potential of these metrics as maturation-sensitive biomakers capable of elucidating maturation heterochronicity of various white matter tract groups, such as association, projection, and commissural fibres.

5375	Computer 57	Oscillating Gradient Spin Echo Diffusion Tensor MRI of Acute Human Stroke Christian Beaulieu[1], Leka Sivakumar[2], Ken Butcher[2], Sarah Treit[1], Derek Emery[3], and Robert Stobbe[1] *[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada, [2]Neurology, University of Alberta, Edmonton, AB, Canada, [3]Radiology, University of Alberta, Edmonton, AB, Canada* Different spatial scales of micro-structural alteration with disease can be interrogated by varying the time water has to interact with its surroundings (e.g. membranes, etc). Oscillating gradient spin echo (OGSE) diffusion MRI enables much shorter diffusion times (e.g. 6 ms) than typical pulsed gradient spin-echo (PGSE) (e.g. 40 ms). The large diffusion reduction typically observed with PGSE in ischemic lesions in human stroke was markedly less with OGSE, and the OGSE-PGSE difference was greatest for radial diffusivity in ischemic white matter. This result is consistent with the swelling and beading of the axons underlying diffusion contrast in cerebral ischemia.

5376	Computer 58	Non-invasive quantification of inflammation, axonal and myelin injury in MS: a 7T DBSI study Simona Schiavi[1], Peng Sun[2], Sirio Cocozza[3], Maria Petracca[4], Mohamed Mounir El Mendili[4], Kornelius Podranski[4], Matilde Inglese[1,4], and Sheng-Kwei Song[2,5,6,7]

		[1]DINOGMI, University of Genoa/IRCCS AOU San Martino-IST, Genoa, Italy, [2]Radiology, Washington University School of Medicine, St. Louis, MO, United States, [3]Department of Advanced Biomedical Sciences, University of Naples "Federico II", Naples, Italy, [4]Department of Neurology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [5]Hope Center for Neurological Disorders, Washington University School of Medicine, St. Louis, MO, United States, [6]Biomedical Engineering, Washington University, St. Louis, MO, United States, [7]Biomedical MR Laboratory, Washington University School of Medicine, St. Louis, MO, United States
		Diffusion basis spectrum imaging (DBSI) has successfully distinguished co-existing pathological processes in CNS diseases, such as multiple sclerosis (MS). The aim of our study was to determine the feasibility of DBSI in MS patients at 7T and to investigate the underlying pathological substrates of different lesion types and normal appearing white matter (NAWM). For the first time, we proved the feasibility of DBSI at 7T, validating the specificity of the different metrics to diverse pathological substrates. Additionally, we employed DBSI metrics to characterize focal and diffuse tissue damage in different MS phenotypes, confirming their utility as biomarkers of tissue-specific microstructural damage.

5377	Computer 59	Diffusion Basis Spectrum Imaging and Diffusion Tensor Imaging in Mouse Model of Traumatic Brain Injury
		Harri Merisaari[1], Tsen-Hsuan Lin[1], Gentian Toshkezi[2], Michele Kyle[2], Zhao Li-Ru[2], and Sheng-Kwei Song[1]
		[1]Mallinckrodt Institute of Radiology, St. Louis, MO, United States, [2]Department of Neurosurgery, SUNY Upstate Medical University, Syracuse, NY, United States
		Traumatic brain injury (TBI) is a major cause of acquired brain injury in both children and adults. Traumatic axonal injury (TAI) is a major contributor to cognitive dysfunction followed by TBI. Diffusion Tensor Imaging (DTI) has shown to characterize TAI in non-invasive manner. However, DTI as a gross measure has limitations in its parameters in detection capability of underlying pathologies. Diffusion Basis Spectrum Imaging (DBSI) is an advanced imaging technique that has been applied to investigate nervous system pathology. Accurate characterization of brain pathologies in vivo, such as axonal injury, is extremely important in the study of changes that occur over time after TBI. To investigate these two methods in TBI data, we performed a comparison in mouse model between control and injured groups.

5378	Computer 60	q-Space Novelty Detection in Short Diffusion MRI Scans of Multiple Sclerosis
		Vladimir Golkov[1], Aleksei Vasilev[1], Francesco Pasa[1,2], Ilona Lipp[3], Wassim Boubaker[1], Eleonora Sgarlata[3,4], Franz Pfeiffer[2], Valentina Tomassini[3,5], Derek K. Jones[3], and Daniel Cremers[1]

		[1]Department of Informatics, Technical University of Munich, Munich, Germany, [2]Physics Department, Technical University of Munich, Munich, Germany, [3]CUBRIC, Cardiff University, Cardiff, United Kingdom, [4]Department of Neurology and Psychiatry, Sapienza University of Rome, Rome, Italy, [5]Division of Psychological Medicine and Clinical Neurosciences, Cardiff University, Cardiff, United Kingdom
		Diffusion MRI can capture disease-related microstructural changes, but most methods use handcrafted data transformations that discard parts of the information and require quite long scan times. In contrast, q-space novelty detection (q-ND) circumvents these drawbacks, and does not require any knowledge whatsoever about the effect of disease on q-space measurements. Instead, q-ND highlights voxels that look unlike anything seen in a database of healthy scans. Here we show that novelty scores from q-ND largely coincide with multiple sclerosis lesions, and that q-ND also works at reduced scan times.

5379	Computer 61	Diffusion-weighted imaging reveals microstructural alterations in a transgenic rat model of Alzheimer’s disease - validation against immunohistochemistry
		Hamied A Haroon[1], Ben R Dickie[1], Matthias Vandesquille[1], Charlotte Auty[1], Herve Boutin[1], Geoffrey JM Parker[2,3], and Laura M Parkes[1]
		[1]Division of Neuroscience and Experimental Psychology, University of Manchester, Manchester, United Kingdom, [2]Division of Informatics, Imaging and Data Sciences, University of Manchester, Manchester, United Kingdom, [3]Bioxydyn Ltd, University of Manchester, Manchester, United Kingdom
		Diffusion-weighted imaging (DWI) holds the promise of detecting very subtle neuronal changes in Alzheimer’s disease (AD). We compare the sensitivity of different DWI metrics to microstructural change in a transgenic rat model of AD. We find genotype-related differences in regions known to be affected in AD, with NODDI metrics showing greater sensitivity than FA and MD. However, no genotype-related difference in neuronal density is detected using immunohistochemistry staining for NeuN suggesting that the DWI changes reflect alterations in the neuronal structure (dendritic density or myelination) rather than density. DWI metrics are however correlated with neuronal density on a regional basis.

5380	Computer 62	Towards a ‘resolution limit’ for DW-MRI tumour microstructural models: what microstructural changes can be distinguished?
		Damien J. McHugh[1,2] and Geoffrey J. M. Parker[1,2,3]
		[1]Informatics, Imaging and Data Sciences, The University of Manchester, Manchester, United Kingdom, [2]CRUK and EPSRC Cancer Imaging Centre in Cambridge and Manchester, Manchester, United Kingdom, [3]Bioxydyn Ltd., Manchester, United Kingdom

		The ability to detect specific changes in tumour tissue using diffusion-weighted (DW) MRI microstructural models depends on the accuracy and precision of parameter estimates, as well as the magnitude of specific biological changes. This work investigates the SNR requirements that data must meet in order to yield sufficiently precise estimates for detecting apoptotic cell shrinkage. Given the relative changes in cell size, R, and intracellular volume fraction, f_i, as a result of apoptosis, simulations indicate that detecting changes in R require ~4-fold higher SNR than detecting changes in f_i. Comparing the magnitude of biological changes with measurement accuracy and precision should form part of the validation process for potential biomarkers.

5381	Computer 63	Demyelination or not: increased radial diffusivity in Parkinson's disease
		Ruimeng Yang[1], Pen Sun[2], Xiangling Zeng[1], Ajit George[2], Ajit George[2], xinhua Wei[1], xinqing jiang[1], and Sheng-Kwei Song[2]
		[1]Guangzhou First People's Hospital, guangzhou, China, [2]Washington University School of Medicine, St. Louis, Saint Louis, MO, United States
		White matter (WM) integrity alteration has been noted in Parkinson's disease (PD). Whether the increased radial diffusivity (RD) revealed in previous study using diffusion tensor imaging (DTI) in PD patients is suggestive of demyelinating etiology remains to be established. To further investigate white matter (WM) microstructure changes in PD, diffusion tensor imaging (DTI) and diffusion basis spectrum imaging (DBSI) were analyzed using Tract Based Spatial Statistics (TBSS). Both whole brain voxel-based group analysis and reginal analysis on the corpus callosum were performed. DBSI results suggest that axonal injury is present in PD while no myelin injury was seen.

5382	Computer 64	Diffusion kurtosis imaging in chronic disorders of consciousness: state estimation and treatment prognosis
		Elena Kremneva[1], Lyudmila Legostaeva[2], Sofya Morozova[1], Elizaveta Mochalova[3], Dmitry Sinitsyn[2], Natalia Suponeva[2], Marina Krotenkova[1], Aleksandr Suslin[1], Mikhail Piradov[3], and Ivan Maximov[4,5]
		[1]Neuroradiology, Research center of neurology, Moscow, Russian Federation, [2]Neurorehabilitation, Research center of neurology, Moscow, Russian Federation, [3]Intensive care unit, Research center of neurology, Moscow, Russian Federation, [4]Department of Psychology, University of Oslo, Oslo, Norway, [5]Norwegian Centre for Mental Disorders Research (NORMENT), KG Jebsen Centre for Psychosis Research, University of Oslo, Oslo, Norway

		Chronic disorders of consciousness (DOC) are severe neurological disorders due to lesions massively affecting the brain. The treatment and prognosis in the case of DOC is an actual problem demanding novel imaging approaches, in particular, allowing one to determine the extend of brain structural changes. Diffusion-weighted MRI is a powerful candidate for in vivo probing and visualization of brain damage severity in DOC patients. In order to investigate white matter microstructural changes associated with the chronic DOC we performed tract-based spatial statistics analysis and complementary brainstem diffusion metric comparisons between patients and healthy control groups. Our findings revealed large white matter changes in the DOC patients, in particular, using novel and sensitive biomarkers based on the kurtosis scalar metrics. We hope that our discoveries help us to improve a forthcoming treatment of DOC patients.

5383	Computer 65	Spinal cord axonal diameter variations in the relapsing remitting EAE mouse model of multiple sclerosis
		Ahmad Joman Alghamdi[1,2], Ian M. Brereton[1], Nemat Khan[3,4], Maree Smith[3,4], and Nyoman D. Kurniawan[1]
		[1]The Centre for Advanced Imaging, The University of Queensland, Brisbane, Australia, [2]College of Health Sciences, Taif University, Taif, Saudi Arabia, [3]Centre for Integrated Preclinical Drug Development, Brisbane, Australia, [4]School of pharmacy, The University of Queensland, Brisbane, Australia
		This study aimed to determine the extent of axon diameter distribution changes in the lumbar spinal cord in C57BL/6 mice associated with experimental autoimmune encephalomyelitis (EAE). AxCaliber protocol was performed *ex-vivo* at 16.4T to analyze changes in mice with a range of EAE severity and the effect of treatment with alpha-lipoic acid (R-ALA), a nutraceutical compound that is recently known for suppressing microglial activation and CNS inflammation in EAE rodent models. AxCaliber showed axon diameter increases in mild relapsing remitting EAE group after R-ALA treatment. This might indicate a process of remyelination or other microstructural changes.

5384	Computer 66	Brain activations during a motor cortex paradigm: a diffusion MRI signal perspective.
		Alberto De Luca[1], Lara Schlaffke[2,3,4], Jeroen C. W. Siero[2,5], Martijn Froeling[2], and Alexander Leemans[1]
		[1]Image Sciences Institute, UMC Utrecht and University Utrecht, Utrecht, Netherlands, [2]Department of Radiology, UMC Utrecht, Utrecht, Netherlands, [3]Department of Neurology, BG-University Hospital Bergmannsheil, Ruhr-University Bochum, Bochum, Germany, [4]C.J. Gorter Center for High Field MRI, Leiden University Medical Centre, Leiden, Netherlands, [5]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands

		Brain activations during task are commonly investigated by gradient-echo functional MRI (GE-fMRI), which is sensitive to blood volume changes and blood deoxygenation. Recent studies have shown that diffusion MRI, which is regarded as static in the time-scale of minutes, might be sensitive to changes in activated areas. We investigated changes in signals acquired during a motor cortex paradigm using GE-fMRI and diffusion fMRI (dfMRI). We observed causality between the task and the dfMRI acquired at different diffusion weightings. These preliminary results suggest that the observed changes in the dfMRI signal might not be a pure result of blood volume alterations.

5385	Computer 67	White matter micro-structural alterations in Hypothyroid: A Diffusion Kurtosis Imaging study
		Mukesh Kumar[1], Poonam Rana[1], Deepak Sharma[1], Ratnesh Kanwar[2], Tarun Sekhri[2], Maria D'souza[1], and Subash Khushu[1]
		[1]NMR Research Center, Institute of Nuclear Medicine and Allied Sciences, New Delhi, India, [2]Thyroid Research Center, Institute of Nuclear Medicine and Allied Sciences, New Delhi, India
		The aim of our study was to assess changes in brain tissue microstructures in hypothyroid patients using Diffusion Kurtosis Imaging (DKI). The water diffusion in living tissue is hindered by interactions with other molecules and cell membranes. Therefore, water movement in biological tissue is often non-Gaussian and this non-Gaussian behavior may contain useful information related to tissue structure and pathophysiology. Our findings demonstrate widespread reduced kurtosis indices MK, AK; diffusion index FA was decreased and AD was increased in major white matter pathways and such abnormal white matter structure may be linked to cognitive and behavioral impairment in hypothyroid patients.

5386	Computer 68	Alterations in white matter connectivity related to language comprehension in patients with Crohn's disease in remission
		Jiancheng Hou[1], Keith Dodd[1], Veena Nair[1], Poonam Beniwal-Patel[2], Vivek Prabhakaran[1], and Sumona Saha[3]
		[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Medicine, Division of Gastroenterology and Hepatology, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Department of Medicine, Division of Gastroenterology and Hepatology, University of Wisconsin-Madison, Madison, WI, United States
		Reduced white matter integrity in patients with Crohn's disease (CD) has been previously reported. However few studies have examined the behavioral implications of compromised WM integrity in these patients. Here we report results from an exploratory study investigating group differences in diffusivity measures in patients with Crohn's disease in remission [compared to age and gender matched healthy control (HC) subjects] and examined their relationship to participants' performance on a phonemic fluency task. CD patients demonstrate altered brain microstructural changes in regions associated with several cognitive functions including language processing.

5387	Computer 69	Alteration in Diffusion Characteristic of Cerebrospinal Fluid after Neurological Disease in Rats
		Jun Tazoe[1], Yu-Chieh Jill Kao[1,2], Chia-Feng Lu[1,3], Ping-Huei Tsai[1,2], Fei-Ting Hsu[1,2], Bao-Yu Hsieh[4], and Cheng-Yu Chen[1,2]
		[1]Research Center of Translational Image, Teipei Medical University, Taipei, Taiwan, [2]Radiology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [3]Anatomy and Cell Biology, School of Medicine, College of Medicine, Taipei Medical University, Taipei, Taiwan, [4]Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan
		While the quantitative maps conducted by diffusion weighted or diffusion tensor imaging were applied to the brain parenchyma to describe the tissue type and fate, the diffusion coefficient in the cerebrospinal fluid (CSF) was not well explored. In this study, significant lower mean of diffusion constant (D-value) and change in the histogram of D-value were observed in stroke animals compared with intact rats and the mTBI animals, suggesting the brain lesion or damage may alter the diffusion characteristics in CSF.

5388	Computer 70	Spatially constrained mathematical models for diffusion weighted imaging of prostate cancer xenografts in mice: evaluation of therapy response
		Parisa Movahedi[1,2], Harri Merisaari[1], Hanne Laakso [3], Ileana Montoya Perez[1,2], Heidi Liljenbäck[4], Hannu Aronen[2], Heikki Minn[5], Anne Roivainen[4], Timo Liimatainen[3], and Ivan Jambor[1,2]
		[1]Department of Future Technologies, University of Turku, Turku, Finland, [2]Department of Diagnostic Radiology, University of Turku, Turku, Finland, [3]A.I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland, [4]Turku PET center, Turku, Finland, [5]Department of Oncology and Radiotherapy, Turku University Hospital, Turku, Finland
		Tumor growth in mice preclinical prostate cancer model (human prostate cancer cells, PC-3) was followed for 4 weeks by weekly DWI in control group (n=10) and treatment group (n=9) receiving Docetaxel. DWI data sets were acquired using 12 b-values the range of 0-2000 s/mm2. The DWI signal decays were fitted using monoexponential, biexponential, kurtosis and stretched exponential models/functions. Independent least squares fitting and spatially constrained Maximum Penalized Likelihood Estimation have been applied. The spatially constrained Maximum Penalized Likelihood Estimation revealed the effect of treatment in mice subjects, while conventional LSQ fitting failed to reveal significant difference between control and treatment.

5389	Computer 71	Generalised kurtosis imaging approach for glioblastoma evaluation
		Eduard Pogosbekian[1], Artem Batalov[1], Alexander Turkin[1], Igor Pronin[1], and Ivan Maximov[2]
		[1]Neuroimaging, N.N. Burdenko NMRCN, Moscow, Russian Federation, [2]Department of Psychology, University of Oslo, Oslo, Norway

		Primary brain gliomas are very a widespread type of intra-axial brain tumours. Brain gliomas have different cellular origins and can be differentiated by WHO 2016 classification. The most aggressive type of glioma is the glioblastoma (GB). Thus, a correct and reliable grading of gliomas, in particular, the GB, is critical for a patient treatment and prognosis. Diffusion kurtosis imaging (DKI) has been applied to glioma validation in order to perform non-invasive evaluation. DKI allowed one to obtain information about microstructure and inhomogeneity differentiation. In the present work we demonstrate advantages of generalised DKI approach for GB detection and evaluation.

5390	Computer 72	The Effect of Respiration on Apparent Diffusion Coefficient of the Brain
		Naoki Ohno[1], Tosiaki Miyati[1], Yuki Hiramatsu[1], Ryoto Shimizu[1], Mitsuhito Mase[2], Satoshi Kobayashi[1], and Toshifumi Gabata[1]
		[1]Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kanazawa, Japan, [2]Department of Neurosurgery, Nagoya City University, Nagoya, Japan
		ADC of the brain significantly changes during the cardiac cycle because of intracranial pressure changes and fluid fluctuations. We hypothesized that *ADC* of the brain changes during the respiratory cycle because intracranial pressure changes during the respiratory cycle. We determined the maximum and minimum *ADC* (ADC_{max} and ADC_{min}) and maximum change in *ADC* (ΔADC) in the respiratory cycle and non-synchronized periodical data. ADC_{max} and ΔADC in the white matter with respiratory-synchronization were significantly greater than those with non-synchronized periodical scan, whereas there was no significant difference in ADC_{min} between the scans. *ADC* of the brain changes during the respiratory cycle.

Electronic Poster

Neuro Outside the Brain

Exhibition Hall	Thursday 9:00 - 10:00

5391	Computer 73	Semi-automatic, Machine Learning Segmentation of Peripheral Nerves in Healthy Volunteers and Patients
		Fabian Balsiger[1], Mirjam Arn[2], Carolin Steindel[2], Benedikt Wagner[2], Marwan El-Koussy[2], Waldo Valenzuela[1,2], Mauricio Reyes[1], and Olivier Scheidegger[2,3]
		[1]Institute for Surgical Technology and Biomechanics, University of Bern, Bern, Switzerland, [2]Support Center for Advanced Neuroimaging (SCAN), Institute for Diagnostic and Interventional Neuroradiology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland, [3]Department of Neurology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland

		Magnetic resonance neurography (MRN) is increasingly used to diagnose peripheral neuropathy. Here, we propose a semi-automatic multimodal machine learning-based segmentation algorithm to segment peripheral nerves from MRN images. Our algorithm was tested on 9 volunteers and 25 patient cases suffering from sciatic neuropathy. Compared to manual segmentation, Dice coefficients were 0.723 ± 0.202 and 0.443 ± 0.228, respectively, with segmentation times of 5 ± 1 for semi-automatic, and 24 ± 8 minutes for manual segmentation. Our preliminary results suggest that machine learning-based segmentation of the sciatic nerve is possible in healthy and diseased nerves in clinically feasible time.

5392	Computer 74	Improved brachial plexus visualization using an adiabatic iMSDE-prepared STIR 3D TSE
		Elisabeth Klupp[1], Barbara Cervantes[2], Nico Sollmann[1], Franziska Treibel[2], Dominik Weidlich[2], Thomas Baum[1], Ernst J. Rummeny[2], Claus Zimmer[1], Jan S. Kirschke[1], and Dimitrios C. Karampinos[2]
		[1]Department of Diagnostic and Interventional Neuroradiology, Klinikum rechts der Isar, Technische Universität München, München, Germany, [2]Department of Diagnostic and Interventional Radiology, Klinikum rechts der Isar, Technische Universität München, München, Germany
		The close proximity of blood vessels to the brachial plexus nerves can confound nerve visualization in the preferably used fat suppressed 3D T2 weighted sequences. Vessel suppression can be increased by means of an additional motion-sensitizing preparation (e.g. iMSDE). The aim of this work was the evaluation of STIR 3D-TSE in conjunction with an adiabatic T2 preparation incorporating iMSDE-based motion sensitization for MRN of the brachial plexus in a clinical routine-setting quantitatively and qualitatively. The additional motion-sensitizing iMDSE preparation reveals robust blood suppression, leading to higher CNR, increased conspicuity of the nerves, better image quality and less artifacts.

5393	Computer 75	Investigating the value of arterial spin labeling (ASL) and intravoxel incoherent motion (IVIM) imaging on the diagnosis of nasopharyngeal carcinoma (NPC) in T1 stage
		Meng Lin[1], Xiaoduo Yu[1], and Lizhi xie[2]
		[1]National Cancer Center/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China, [2]GE Healthcare, MR Research China, Beijing, China
		T1-stage NPC was difficult to diagnosis using conventional MRI and additional examinations were often needed. This study aimed to investigate ASL and IVIM on diagnosing T1-stage NPC. We measured the BF by ASL and IVIM parameters (D, D*, f, fD*) of T1-stage NPC tumors and nasopharyngeal mucosa of healthy control. The mean BF and D* of T1-stage NPC were higher than those of healthy control. And the BF correlated positively with D* and fD*. Therefore, ASL and IVIM could reflect blood perfusion difference between T1-stage NPC and benign nasopharyngeal mucosa, which is potential to help the early diagnosis of NPC.

5394	Computer 76	Normalised Grey Matter and White Matter Volumes in the Neurologically Intact Conus Medullaris
		Marios C Yiannakas[1], Martina D Liechti[1,2], Patrick Cullinane[1], Xixi Yang[1,2], Ahmed T Toosy[1], Jalesh N Panicker[2], and Claudia Angela Gandini Wheeler-Kingshott[1,3,4]
		[1]Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [2]Uro-Neurology, The National Hospital for Neurology and Neurosurgery and UCL Institute of Neurology, London, United Kingdom, [3]MRI 3T Research Centre, C. Mondino National Neurological Institute, Pavia, Italy, [4]Brain and Behavioural Sciences, University of Pavia, Pavia, Italy
		Magnetic Resonance Imaging derived measures of spinal cord (SC) grey matter (GM) and white matter (WM) volume are useful for indirectly assessing neurodegeneration over time (i.e. atrophy). However, for the correct interpretation of such morphometric analyses, one must take into consideration the natural variability that exists between subjects, which is unrelated to a disease process. Various normalisation strategies have been proposed for use in the upper SC, but evidence from similar applications in the lower SC is currently lacking. In this work, we present our first approach to normalisation of GM/WM volumes in the neurologically intact conus medullaris.

5395	Computer 77	Development of the fast 3D-MR neurography using the optimized combination of the compressed sensing and parallel imaging
		Takuya Aoike[1], Noriyuki Fujima[2], Masami Yoneyama[3], Kinya Ishizaka[1], Hiroyuki Sugimori[4], and Kohsuke Kudo[2]
		[1]Department of Radiological Technology, Hokkaido University Hospital, Sapporo, Japan, [2]Department of Diagnostic and Interventional Radiology, Hokkaido University Hospital, Sapporo, Japan, [3]Philips Healthcare, Tokyo, Japan, [4]Faculty of Health Sciences, Hokkaido University, Sapporo, Japan
		We assessed the rapid acquisition design in 3D-MR neurography (3D-MRN) using compressed sensing (CS) with the combination of the parallel imaging technique. High sparsity in 3D-MRN raw data was considered to be compatible with high CS acceleration factor. This result will be make patients comfortable in daily clinical MRN scanning.

5396	Computer 78	Structural and quantitative MRI to identify lesion level dependant neurodegeneration after SCI
		Michela Azzarito[1], Patrick Grabher[1], Maryam Seif[1], and Patrick Freund[1,2,3]
		[1]Spinal Cord Injury Center Balgrist, University Hospital Zurich, University of Zurich, Zurich, Switzerland, Zürich, Switzerland, [2]Wellcome Trust Centre for Neuroimaging, UCL Institute of Neurology, University College London, London, UK, london, United Kingdom, [3]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, leipzig, Germany

		Patients with spinal cord injury (SCI) undergo neurodegeneration affecting the spinal cord and the brain. However, the volumetric and microstructural patterns of degeneration, their relation to lesion level and clinical outcomes are uncertain. In this study, both structural and quantitative MRI approaches are used in order to identify lesion dependent neurodegeneration following SCI. It was found that lesion level drives structural changes in the spinal cord but not brain.

5397	Computer 79	Spinal Cord Perfusion is Associated with Diffusion and clinical mJOA score in Preoperative Patients with Cervical Spondylotic Myelopathy
		Chunyao Wang[1], Xiao Han[2], Wen Jiang[2], Guangqi Li[1], Jinchao Wang[2], Hua Guo[1], and Huijun Chen[1]
		[1]CBIR，school of medicine, Tsinghua University, Beijing, China, [2]Jishuitan hospital, Beijing, China
		Cervical Spondylotic Myelopathy (CSM) is a chronic progressive disorder of spinal cord with a relatively ill-defined onset of pathogenesis. A series of state-of-art quantitative and functional MR imaging techniques have been proposed aiming to find out specific indicators in prediction and diagnosis of CSM at early phase, but lack of sufficient evidences. Spinal cord blood supply change was recognized as one of the crucial pathophysiological process in CSM. Hence, we investigate the relationship between spinal cord blood perfusion assessed by MR DSC with DTI metrics and clinical mJOA score. Finally, we find spinal cord blood flow is significantly correlated with diffusion metrics and mJOA.

5398	Computer 80	Diffusion weighted T2-mapping for the determination of tissue characteristics in patients with head and neck squamous cell carcinoma
		Noriyuki Fujima[1], Masami Yoneyama[2], Eunju Kim[3], Takuya Aoike[1], Suzuko Aoike[1], and Kohsuke Kudo[1]
		[1]Hokkaido University Hospital, Sapporo, Japan, [2]Philips Electronics Japan, Tokyo, Japan, [3]Philips Healthcare Korea, Seoul, Korea, Democratic People's Republic of
		We investigated the utility of T2 mapping with the pre-pulse of diffusion gradient (DW T2-map) for the determination of tissue characteristics in head and neck squamous cell carcinoma. Significant difference in T2-value of tumor tissue between that with and without diffusion gradient was observed. In addition, DW T2-map was suggested to be one of the diagnostic tool for the prediction of tumor histological grade. DW T2-map can be useful tool for the assessment of tumor tissue characteristics with greater detail.

5399	Computer 81	Simultaneous Diffusion Tensor Imaging and T2 relaxometry in Lumbar Nerve Roots using Dual-Echo Single-Shot DW-EPI
		Masami Yoneyama[1], Takayuki Sakai[2,3], Eunju Kim[4], Tetsuo Ogino[1], Atsuya Watanabe[5,6], and Marc Van Cauteren[7]

[1]Philips Japan, Tokyo, Japan, [2]Radiology, Eastern Chiba Medical Center, Chiba, Japan, [3]Division of Health Sciences, Graduate School of Medical Sciences, Kanazawa University, Ishikawa, Japan, [4]Philips Healthcare Korea, Seoul, Korea, Democratic People's Republic of, [5]General Medical Services, Chiba University Graduate School of Medicine, Chiba, Japan, [6]Orthopaedic Surgery, Eastern Chiba Medical Center, Chiba, Japan, [7]Philips Healthcare Asia Pacific, Tokyo, Japan

Diffusion tensor imaging (DTI) is promising for evaluation of lumbar nerve root compression in the extraforaminal area. A quantitative assessment using T_2 relaxometry is also promising to evaluate nerve injury. Hence, nerve root quantification using both DTI and T_2 relaxation properties may improve the diagnosis of nerve roots in patients with lower back pain, but it requires a long scan time. In this study, we developed a new sequence to simultaneously obtain both diffusion parameters and T_2 value in one single scan (Diffusion-Relaxation Matrix: DRM). DRM simultaneously provides diffusion tensor imaging and T_2 map without prolongation of acquisition time. This quantitative combination may be helpful to further assess the lumbar nerve root pathology.

5400 Computer 82

Quantitative MR Neurography with Robust Fat Suppression

Masami Yoneyama[1], Akio Hiwatashi[2], Xinzeng Wang[3], Osamu Togao[2], Ivan E. Dimitrov[4,5], Ananth J. Madhuranthakam[3,4], Iain Ball[6], and Marc Van Cauteren[7]

[1]Philips Japan, Tokyo, Japan, [2]Department of Clinical Radiology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan, [3]Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States, [4]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [5]Philips Healthcare, Gainesville, FL, United States, [6]Philips Healthcare Australia, North Ryde, Australia, [7]Philips Healthcare Asia Pacific, Tokyo, Japan

MR neurography plays a major role in the diagnostic work-up of peripheral nerve pathologies and a quantitative evaluation based on T_2 values can be clinically useful in estimating treatment effects and determining prognosis. Recently, we proposed a new sequence (SHINKEI-Quant) to add a quantitative information to MR neurography. To solve some issues caused by the current fat suppression techniques (SPAIR and STIR), we propose to combine SHINKEI-Quant with a new two-point dual-echo 3D DIXON-TSE (DE-mDIXON) technique. SHINKEI-Quant with DE-mDIXON simultaneously provides both MR neurography with high SNR, uniform fat suppression, and T_2 maps with T_2 values similar to conventional method. This sequence may be helpful to quantitatively assess nerve pathology.

5401 Computer 83

Automatic delicate segmentation of the intervertebral discs from MR spine images using deep convolutional neural networks: ICU-net

Sewon Kim[1,2], Won C Bae[3,4], and Dosik Hwang[1]

		[1]School of Electrical and Electronic Engineering, Yonsei University, Seoul, Republic of Korea, [2]Philips Korea, Seoul, Republic of Korea, [3]Department of Radiology, VA San Diego Healthcare System, San Diego, CA, United States, [4]Department of Radiology, University of California-San Diego, La Jolla, CA, United States
		The segmentation method using Deep Convolutional Neural Networks shows good performance in medical imaging. In particular, U-net is a well-known and successful model. However, U-net based on classification network shows weakness in fine segmentation. We developed a new model by changing layers and structure of U-net. Our model enables more detailed segmentation of the intervertebral discs in spine MR images.

5402	Computer 84	A longitudinal study of APT CEST contrast in the spinal cord of patients with multiple sclerosis at 3T
		Richard Dylan Lawless[1,2], Quinn R Weinberg[2], Bailey Box[2], Samantha By[3], Francesca Bagnato[4], and Seth A Smith[1,2,5]
		[1]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Phillips Healthcare, Baltimore, MD, United States, [4]Department of Neurology, Vanderbilt University, Nashville, TN, United States, [5]Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States
		Current clinical MRI sequences cannot characterize biochemical tissue changes within the spinal cord. Therefore, MRI biomarkers sensitive to biochemical tissue changes are needed. Amide proton transfer chemical exchange saturation transfer (APT CEST) is an emerging MRI contrast method sensitive to the exchange rate and concentration of amide proton moiety. In this work, we sought to assess the reproducibility and longitudinal change of spinal cord APT CEST in patients with MS. Our results suggest that APT CEST in the spinal cord is capable of reproducibly identifying underlying changes in spinal cord tissue pathology.

5403	Computer 85	Low Apparent Diffusion Coefficient Value Predicts Early Progression of Skull Base Meningiomas
		Ching Chung Ko[1], Sher Wei Lim[2], Tai Yuan Chen[1], Jeon Hor Chen[3,4], Chien Feng Li[5], and Yow Ling Shiue[6]
		[1]Medical Imaging, Chi Mei Medical Center, Tainan, Taiwan, [2]Neurosurgery, Chi Mei Medical Center, Chiali, Tainan, Taiwan, [3]Radiology, E-Da Hospital/I-Shou University, Kaohsiung, Taiwan, [4]Center for Functional Onco-Imaging, University of California Irvine, Irvine, CA, United States, [5]Pathology, Chi Mei Medical Center, Tainan, Taiwan, [6]Institute of Biomedical Science, National Sun Yat-Sen University, Kaohsiung, Taiwan

		A recent study described the extent of tumor resection and ADC values could offer better prediction of progression/recurrence (P/R) in meningiomas than histopathological grading. Although complete resection of tumor is a key determining factor of recurrence in meningiomas, it is often difficulty to achieve for the skull base meningiomas (SBM) due to complex neurovascular structures. In this study, we investigated the preoperative CT and MR imaging features for the prediction of early P/R in SBM, with emphasis on ADC values. Our results found that low ADC value and adjacent bone invasion could predict high risk of early P/R in SBM, and therefore, offer clinically vital information for the planning of treatment.

5404	Computer 86	In vivo 31P magnetic resonance spectroscopy of human parotid gland
		Toshiyuki Sato[1], Hiroyoshi Isoda[1], Hirotsugu Nakai[1], Shigeshi Kohno[1], Koji Tokunaga[1], Hironori Shimizu[1], Seiya Kawahara[1], and Kaori Togashi[1]
		[1]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan
		This is the first in vivo study to investigate major phosphorus metabolites of human parotid gland with ^{31}P magnetic resonance spectroscopy (MRS) using 3D chemical shift imaging (CSI) technique. Five healthy volunteers were measured on a clinical 3.0 T MRI scanner, and three of them were remeasured immediately after intake of tablets containing vitamin C. The spectra reveal large adenosine triphosphate (ATP) and phosphocreatine (PCr) intensities. Following intake of tablets containing vitamin C, decrease of β-ATP can be observed. In vivo ^{31}P MRS can be used to assess bioenergetics of the human parotid gland within a reasonable scan time.

5405	Computer 87	Detection of Spinal Cord Compression Injury in the Rat using Filter-Probe Diffusion Encoding
		Matthew Budde[1], Natasha Beucher[1], Seung Yi Lee[2], Brian Schmit[3], and Shekar Kurpad[1]
		[1]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Neuroscience Doctoral Program, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Biomedical Engineering, Marquette University, Milwaukee, WI, United States
		A rat model of chronic spinal cord compression was evaluated with reduced field of view (rFOV) diffusion tensor imaging and filter-probe diffusion encoding. The results demonstrate the sensitivity of diffusion MRI for detecting injury.

5406	Computer 88	Anatomically-informed and patient-specific diffusion tensor sampling schemes for the cervical spinal cord
		Kurt Schilling[1,2], Samantha By[3], Quinn Weinberg[1], Bailey Box[1], Bennett A Landman[1,2,4,5], Adam W Anderson[1,2,5], and Seth A. Smith[1,5]

[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [3]Philips Healthcare, Baltimore, MD, United States, [4]Electrical Engineering and Computer Science, Vanderbilt University, Nashville, TN, United States, [5]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States

In this study, we minimize uncertainty in Diffusion Tensor Imaging (DTI) parameters by optimally selecting diffusion gradient directions utilizing prior structural knowledge. By measuring the anatomy of the spinal cord for each subject, we created patient-specific, anatomically-informed DTI encoding schemes for 256 subjects, utilizing just 6 diffusion directions. In addition, we create an optimal encoding 6-direction scheme for the anatomically-average person. Through simulations and experimental validation on a physical fiber phantom, we show improvements in FA estimation, even when compared to conventional 30 direction schemes. This technique results in minimal scan time and increased accuracy in order to maximize clinical value.

5407 Computer 89

Oscillating Gradient Spin Echo (OGSE) Diffusion Tensor Imaging of the Human Spinal Cord: Application to Multiple Sclerosis

Samantha By[1], Seth A. Smith[2], Kurt G. Schilling[2], Quinn Weinberg[2], Sean P. Devan[2], Francesca R. Bagnato[2], and Junzhong Xu[2]

[1]Philips Healthcare, Baltimore, MD, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States

Compared to conventional pulsed gradient spin echo (PGSE) techniques, oscillating gradient spin echo (OGSE) provides access to shorter diffusion times, thereby enabling greater sensitivity to microstructure on smaller scales. Here, we report initial results of OGSE in the human spinal cord. Unlike in the brain, axial diffusivity in the spinal cord appears to be negligibly affected with diffusion time. Relative to the PGSE sequence (t_{diff}= 66 ms), the OGSE sequence (t_{diff}=8.77 ms) shows a 37% mean increase in radial diffusivity (RD) in healthy controls. When applied to MS, OGSE shows a larger difference in RD in comparison to healthy controls.

5408 Computer 90

MRI-guided Focused Ultrasound to Improve Drug Delivery in Spinal Cord Injury

Donna J. Cross[1], Allison H. Payne[1], Amanda J. Stump[1], Henrik Odéen [1], Megan A. Ostlie[1], Ethan C. Reichert [2], Chloe G. Cross[1], Yoshimi Anzai[1], and Gregory W. Hawryluk[2]

[1]Department of Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States, [2]Department of Neurosurgery, University of Utah, Salt Lake City, UT, United States

		Spinal cord injury (SCI) affects over 17,000 individuals each year in the United States, and most patients are left with some permanent paralysis. MRI-guided focused ultrasound (MRgFUS), when applied to the spinal cord with microbubbles to generate sonoporation, can transiently open the blood spinal cord barrier for effective drug delivery by breaking the glial scar. We used MRgFUS to increase permeability in the blood spinal cord barrier in a SCI rat model. Rats that underwent an MRgFUS procedure showed increased contrast caudal to the injury site, indicating drugs could potentially permeate these regions and assist with axonal regrowth.

5409	Computer 91	Evaluation of a new semi-automatic delineation method for quantitative analysis of tumors: application to head and neck squamous cell carcinoma
		Kanae Moriyama[1], Hiroyuki Sugimori[2], Noriyuki Fujima[3], and Toru Yamamoto[2]
		[1]Graduate school of Health Science, Hokkaido University, Sapporo, Japan, [2]Faculty of Health Science, Hokkaido University, Sapporo, Japan, [3]Department of Diagnostic and Interventional Radiology, Hokkaido University Hospital, Sapporo, Japan
		Objective determination of tumor region of interest (ROI) on MR images is expected for quantitative analysis of tumors. We developed a semi-automatic method of ROI delineation. We applied this method to head and neck squamous cell carcinoma and evaluated the matching of the ROI delineation by our method and an experienced radiologist. The ADC values were compared for different ROI delineation methods. Averagely, 80% of the area of the ROI matched and the difference of the ADC value was within 2% (sd), showing that our new method of tumor delineation can be used to analyze the tumor characteristics quantitatively.

5410	Computer 92	Correlation of tumor blood flow in head and neck squamous cell carcinoma by pseudo-continuous arterial spin labeling with parameters of dynamic contrast-enhanced MRI
		Young Jun Choi[1], Jeong Hyun Lee[1], and Josef Pfeuffer[2]
		[1]Asan Medical Center, Seoul, Republic of Korea, [2]Siemens healthcare, MR Application development, Erlangen, Germany
		The aim of this prospective study was to evaluate the correlation between tumor blood flow (TBF) measurement using pseudo-continuous arterial spin labeling (pCASL) and parameters of DCE-MRI in patients with head and neck squamous cell carcinoma (HNSCC). We scanned 26 patients with HNSCC using 3T MRI with both pCASL and DCE-MRI. There were significant correlation between TBF of pCASL and wash-in, signal enhancement ratio, and Vp of DCE-MRI, with a correlation coefficient of 0.649, 0.642, and 0.507, respectively ($P<0.01$). The pCASL can be a useful tool for noninvasive assessments of the TBF in patients with HNSCC.

5411	Computer 93	Texture analysis applied to MRI of nerves affected with chronic inflammatory demyelinating neuropathy. Paolo F Felisaz[1], Andrea Poli[1], Giovanni Vitale[1], Raimondo Vitale[1], Laura Piccolo[2], Andrea Cortese[2], Niels Bergsland[3], Anna Pichiecchio[3], and Stefano Bastianello[3,4] *[1]Radiology, University of Pavia, Pavia, Italy, [2]Neurology Department, C. Mondino National Neurological Institute, Pavia, Italy, [3]Neuroradiological Department, C. Mondino National Neurological Institute, Pavia, Italy, [4]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy* Introduction. Texture analysis was applied to MR images of peripheral nerves obtained with MR micro-neurography. Materials and Methods. Ankle tibial nerves were imaged at 3T in 10 patients affected with chronic inflammatory demyelinating neuropathy and 10 healthy subjects. Multiple subsets of textural features were compared, using different extraction methods and statistical analyses. The most discriminating features were selected and compared to the automatically extracted subsets. Results. Feature subset extracted from the whole pool of features performed better than the ones obtained by specific groups of features. Conclusion. Texture analysis may have a role in discriminating between pathologic and normal nerves.

5412	Computer 94	How to separate peripheral nerves from muscles Ibrahim Ibrahim[1], Jaroslav Tintěra[1], Vít Herynek[1], Antonín Škoch[1,2], Ivan Humhej[3], and Milan Hájek[1] *[1]Department of Diagnostic and Interventional Radiology, Institute for Clinical and Experimental Medicine (IKEM), Prague, Czech Republic, [2]Institute for Clinical and Experimental Medicine (IKEM), Prague, Czech Republic, [3]Department of Neurosurgery, Masaryk Hospital, Usti nad Labem, Czech Republic* MR tractography of the peripheral nerves (PN) is challenging due to the difficulty to acquire high quality DWI data for peripheral nerve bundles reconstruction. The aim of this study was to propose an algorithm for separation LSP bundles from muscles using segmentaion of cauda equina and normalized quantitative anisotropy.

5413	Computer 95	Feasibility of Quantitative Diffusion MR Tractography of the Vestibulocochlear Nerve in Children with Unilateral Profound Sensorineural Hearing Loss Ryan P Cabeen[1], Elina Kari[2], Courtney Voelkner[3], Marta Kulich[3], Laurel M Fisher[3], Yonggang Shi[1], Meng Law[1], and Arthur W Toga[1] *[1]Laboratory of Neuro Imaging, USC Stevens Neuroimaging and Informatics Institute, Keck School of Medicine of USC, Los Angeles, CA, United States, [2]Division of Otolaryngology, Department of Surgery, UC San Diego School of Medicine, San Diego, CA, United States, [3]Department of Otolaryngology, Keck School of Medicine of USC, Los Angeles, CA, United States*

		Diffusion MR tractography modeling of the vestibulocochlear nerve (VCN) has clinical value for characterizing hearing loss and surgical planning for cochlear implants; however, the neuroanatomy of the VCN presents technical challenges to image-based modeling. We conducted a feasibility study to evaluate VCN tractography in children with unilateral sensorineural hearing loss using advanced diffusion MRI acquisitions and modeling techniques. The results indicate tractography of the VCN is clinically feasible and quantitative tractography metrics reflect lateralization of hearing loss. We further found significant improvements from a reverse-phase encoding acquisition and multi-shell multi-compartment diffusion modeling.

5414	Computer 96	Phantom Validation Study for Custom-made Orbit Surface Coil
		ZONG RUI ZHANG[1], QING HUA CHEN[1], XIAO QI WANG[2], YAN TAO NIU[1], and JUN FANG XIAN[1]
		[1]Radiology, Beijing Tongren Hospital,Capital Medical University, Beijing, China, [2]Philips Healthcare China, Beijing, China
		Previously introduced the new custom-made orbit imaging surface coil was tested in this research. The study gives a brief overview of the quantitative information that can be derived from it. Combining information from normal standard 15 channel head coil can aid in answering the typical advantages and future clinical application of the new surface coil. This phantom study is to verify the orbit surface coil's feasibility in clinical use.

Electronic Poster

Neonatal & Pediatric Neuroimaging

Exhibition Hall	Thursday 9:00 - 10:00

5415	Computer 97	Working memory training and brain structural and functional correlates in children born preterm
		Claire Kelly[1], Deanne Thompson[1,2,3], Jian Chen[1,4], Elisha Josev[1], Leona Pascoe[1], Megan Spencer-Smith[1,5], Chris Adamson[1], Chiara Nosarti[6], Lex Doyle[1,2,7,8], Marc Seal[1,2], and Peter Anderson[1,2,5]
		[1]Murdoch Children's Research Institute, Melbourne, Australia, [2]Department of Paediatrics, The University of Melbourne, Melbourne, Australia, [3]Florey Institute of Neuroscience and Mental Health, Melbourne, Australia, [4]Department of Medicine, Monash Medical Centre, Monash University, Melbourne, Australia, [5]Monash Institute of Cognitive and Clinical Neurosciences, Monash University, Melbourne, Australia, [6]King's College London, London, United Kingdom, [7]Newborn Research, The Royal Women's Hospital, Melbourne, Australia, [8]Department of Obstetrics and Gynaecology, The University of Melbourne, Melbourne, Australia

In a randomised controlled trial, we investigated if adaptive, computerised working memory training using Cogmed was associated with greater neural changes compared with a placebo training program. Participants were a population-based cohort of 91 school-age children born <28 weeks' gestation or <1000 g birthweight. Children had structural, diffusion and task-based functional MRI before and two weeks following five weeks of Cogmed or placebo. There was little evidence for larger changes in cortical morphometry, white matter microstructure, or brain functional activity following Cogmed compared with placebo. In our study, Cogmed did not benefit brain structure or function in preterm-born children.

5416 Computer 98

Early Identification of Reduced Brain Functional Connectivity in Very Preterm Infants with Motor Impairments

Lili He[1,2,3], Hailong Li[1,3], and Nehal Parikh[1,2,3]

[1]Perinatal Institute, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [2]Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, OH, United States, [3]Pediatric Neuroimaging Research Consortium, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States

Very preterm infants (<32 weeks gestational age) are at high risk for motor impairments. Investigation of brain network connectivity will improve our understanding of how brain organizational changes influence motor function and can result in improved individual risk stratification. In this work, we found reduction in functional connectivity in multiple motor and sensory regions, soon after birth, in very preterm infants at high risk of motor impairments assessed at 2 years of age. Our findings may enable mechanistic understanding and facilitate early, more accurate prediction of motor impairments.

5417 Computer 99

Prevalence of brain lesions in a contemporary cohort of newborns with complex congenital heart disease prior to surgery

Christopher Kelly[1], Catarina Tristão Pereira[1], Sophie Arulkumaran[1], Lucilio Cordero Grande[1], Emer Hughes[1], Rui Pedro A. G. Teixeira[1], Johannes Steinweg[1], Joseph V Hajnal[1], John Simpson[2], A. David Edwards[1], Mary A Rutherford[1], and Serena J Counsell[1]

[1]Centre for the Developing Brain, School of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Paediatric Cardiology Department, Evelina Children's Hospital, London, United Kingdom

		Infants born with congenital heart disease (CHD) are known to experience a distinct pattern of neurodevelopmental and behavioural impairment in later life. In this study, we scanned 64 infants with complex CHD prior to surgery, and used high-resolution structural, diffusion and susceptibility-weighted magnetic resonance imaging to understand the burden of brain lesions in a contemporary cohort. We characterised lesions and produced quantitative lesion maps, registered to a population template. We found a lower incidence of infarction than has been reported in previous comparable cohorts, and we explore the clinical reasons that may explain such variation.

5418	Computer 100	Multicentre pediatric brain tumour dynamic susceptibility contrast (DSC-) MRI with contrast agent leakage correction
		Stephanie Withey[1,2,3], Jan Novak[4], Lesley MacPherson[5], Laurence Abernethy[6], Barry Pizer[7], Richard Grundy[8], Simon Bailey[9], Dipayan Mitra[10], Theodoros Arvanitis[2,3,11], Dorothee Auer[12], Shivaram Avula[6], and Andrew Peet[2,3]
		[1]RRPPS, University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom, [2]Oncology, Birmingham Children's Hospital, Birmingham, United Kingdom, [3]Institute of Cancer and Genomic Sciences, University of Birmingham, Birmingham, United Kingdom, [4]Aston University, Birmingham, United Kingdom, [5]Radiology, Birmingham Children's Hospital, Birmingham, United Kingdom, [6]Radiology, Alder Hey Children's NHS Foundation Trust, Liverpool, United Kingdom, [7]Oncology, Alder Hey Children's NHS Foundation Trust, Liverpool, United Kingdom, [8]The Children's Brain Tumour Research Centre, University of Nottingham, Nottingham, United Kingdom, [9]Sir James Spence Institute of Child Health, Royal Victoria Infirmary, Newcastle upon Tyne, United Kingdom, [10]Neuroradiology, The Newcastle upon Tyne Hospitals NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, [11]Institute of Digital Healthcare, University of Warwick, Coventry, United Kingdom, [12]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom
		Dynamic susceptibility contrast (DSC-) MRI provides measures of relative cerebral blood volume (rCBV) in pediatric brain tumors. Correction of rCBV for the effects of contrast agent leakage can be done using post-processing techniques. Forty pediatric patients with high and low grade tumors underwent DSC-MRI scans pre-treatment at four centers. DSC-data was analyzed with and without leakage correction to calculate rCBV and the leakage parameter, K2. There were significant differences between all parameters when comparing the high and low grade tumor groups. Low grade tumors tended to show T1-dominant leakage effects while high grade tumors showed predominantly T2* dominance.

5419	Computer 101	Brain growth over the first 13 years of life in typically developing and very preterm children
		Deanne Thompson[1,2,3,4], Lillian Matthews[5], Bonnie Alexander[1,2], Katherine Lee[1,3,6], Claire Kelly[1,2], Rod Hunt[1,3,7], Jeanie Cheong[1,8,9], Megan Spencer-Smith[1,10], Marc Seal[2,3], Jeffrey Neil[5], Terrie Inder[1,5], Lex Doyle[1,3,8,9], and Peter Anderson[1,3,10]

		[1]Victorian Infant Brain Studies (VIBeS), Murdoch Children's Research Institute, Melbourne, Australia, [2]Developmental Imaging, Murdoch Children's Research Institute, Melbourne, Australia, [3]Department of Paediatrics, The University of Melbourne, Melbourne, Australia, [4]Florey Institute of Neuroscience and Mental Health, Melbourne, Australia, [5]Department of Pediatric Newborn Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States, [6]Clinical Epidemiology & Biostatistics Unit, Murdoch Children's Research Institute, Melbourne, Australia, [7]Neonatal medicine, The Royal Children's Hospital, Melbourne, Australia, [8]Department of Obstetrics and Gynaecology, The University of Melbourne, Melbourne, Australia, [9]Royal Women's Hospital, Melbourne, Australia, [10]Monash Institute of Cognitive and Clinical Neurosciences, Monash University, Melbourne, Australia
		Few longitudinal cohort studies exist characterizing regional brain volumes from birth to adolescence. This study derives brain volumes in approximately 100 regions at term-equivalent, 7 and 13 years of age for 102 very preterm and 20 full-term children. The trajectory of brain development in many regions differed between very preterm and full-term children over the first 7 years of life. From 7 to 13 years brain growth slowed, ceased or regressed in both groups in a region-specific manner, apart from subcortical regions that continued to increase in volume. This study provides novel insights in typical and atypical regional brain volumetry.

5420	Computer 102	A simple semi-quantitative scale for brain MR imaging is associated with motor function, communication and cognition in dyskinetic cerebral palsy
		Olga Laporta-Hoyos[1,2,3], Simona Fiori[4,5], Kerstin Pannek[6], Julia Ballester-Plane[1], David Leiva[7], Lee B Reid[6], Alex M Pagnozzi[6], Elida Vázquez[8], Ignacio Delgado[8], Alfons Macaya[9], Roser Pueyo[1], and Roslyn N Boyd[10]
		[1]Departament de Psicologia Clínica i Psicobiologia, Universitat de Barcelona, Barcelona, Spain, [2]Institut de Neurociències. Universitat de Barcelona, Barcelona, Spain, [3]Institut de Recerca Pediàtrica Hospital Sant Joan de Déu, Barcelona, Spain, [4]IRCCS Stella Maris, Pisa, Italy, [5]The University of Pisa, Pisa, Italy, [6]Australian e-Health Research Centre. Commonwealth Scientific and Industrial Research Organisation, Brisbane, Australia, [7]Departament de Psicologia Social i Psicologia Quantitativa, Universitat de Barcelona, Barcelona, Spain, [8]Servei de Radiologia Pediàtrica. Hospital Universitari Vall d'Hebron, Barcelona, Spain, [9]Grup de Recerca en Neurologia Pediàtrica. Vall d'Hebron Institut de Recerca. Universitat Autònoma de Barcelona., Barcelona, Spain, [10]Queensland Cerebral Palsy and Rehabilitation Research Centre. Faculty of Medicine. The University of Queensland, Brisbane, Australia
		Previous neuroimaging studies of DCP have been based on categorical descriptors or advanced neuroimaging protocols that cannot be easily utilised in a clinical context. To enable clinical translation, we characterized brain lesions, and their association with clinical outcomes in 39 participants with DCP, using a semi-quantitative scale for brain MRI that is clinically accessible due to its relative simplicity and reliance only on standard clinical images. Our results indicate that (A) ventral posterior lateral thalamus and frontal lobe are the most frequent locations of observable lesions in DCP and that (B) sqMRI can index motor, communication and cognitive functioning.

5421	Computer 103	Quantitative 1H Single Voxel Spectroscopy In Metachromatic Leukodystrophy Patients Treated With Haematopoietic Stem Cell Gene Therapy: Preliminary Results
		Paola Scifo[1], Pasquale Anthony Della Rosa[2], Matteo Canini[2], Francesca Fumagalli[3,4,5], Valeria Calbi[3,4], Andrea Falini[6], Alessandro Aiuti[3,4,7], and Cristina Baldoli[6]
		[1]Nuclear Medicine Dept., IRCCS San Raffaele Scientific Institute, Milan, Italy, [2]Neuroradiology Unit and CERMAC, IRCCS San Raffaele Scientific Institute, Milan, Italy, [3]San Raffaele Telethon Institute for Gene Therapy (SR-TIGET), IRCCS San Raffaele Scientific Institute, Milan, Italy, [4]Unit of Pediatric Immunohematology and BMT Program, IRCCS San Raffaele Scientific Institute, Milan, Italy, [5]Neurology Dept., IRCCS San Raffaele Scientific Institute, Milan, Italy, [6]Neuroradiology Unit and CERMAC, Vita Salute San Raffaele University and IRCCS San Raffaele Scientific Institute, Milan, Italy, [7]Vita Salute San Raffaele University, Milan, Italy
		The efficacy of Haematopoietic Stem Cell-Gene Therapy for Metachromatic Leukodystrophy is under evaluation. CNS damage is currently rated by means of visual MR severity scores. The aim of this study was to investigate whether quantitative spectroscopy measurements correlate with MR severity scores. This preliminary analysis shows that both NAA/Cr and NAA/Cho ratios are associated with progression in total MR Severity Score, Atrophy and Demyelination Load. This suggests that MR spectroscopy could be useful to longitudinally and quantitatively evaluate the disease burden in MLD patients.

5422	Computer 104	FETAL CORTICAL PARCELLATION BASED ON GROWTH PATTERNS
		Jing Xia[1,2], Caiming Zhang[1], Fan Wang[2], Oualid M. Benkarim[3], Gerard Sanroma [3], Gemma Piella[3], Miguel A. Gonzalez Ballester[3,4], Nadine Hahner[5], Elisenda Eixarch[5], Dinggang Shen[2], and Gang Li[2]
		[1]Department of Computer Science and Technology, Shandong University, Jinan, China, [2]Department of Radiology and BRIC, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [3]DTIC, Universitat Pompeu Fabra, Barcelona, Spain, [4]ICREA, Pg. Lluis Companys 23, 08010, Barcelona, Spain, [5]Fetal i+D Fetal Medicine Research Center, BCNatal, Hospital Clínic and Hospital Sant Joan de Déu, Barcelona, Spain
		The available cortical parcellations created for adults are inapplicable for fetuses, due to dramatic differences in brain appearances and dynamic growth of fetal brains. Considering sulcal-gyral landmarks are not stably established in fetal brains, we propose to use the growth patterns of cortical properties to parcellate fetal cortical surfaces. Growth patterns, which reflect underlying changes of microstructures, enable an accurate definition of distinct regions in development and function, as microstructures determine the molecular organization and functional principles of the cortex. We apply the growth-pattern-based method on 25 normal fetuses from 26 to 29 gestational weeks and generated biologically meaningful parcellations.

5423	Computer 105	Fetal T1 mapping using multi-inversion EPI at 3T

		Borjan Gagoski[1,2], Daniel Joseph Park[3], Ville Renvall[3,4], Esra Abaci-Turk[1,5], Elfar Adalsteinsson[6,7], Thomas Witzel[2,3], Lawrence L. Wald[3,8], Patricia Ellen Grant[1,5], and Jonathan Polimeni[2,3]
		[1]Fetal Neonatal Neuroimaging and Developmental Science Center, Boston Children's Hospital, Boston, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [4]Department of Neuroscience and Biomedical Engineering, Aalto University School of Science, Espoo, Finland, [5]Department of Newborn Medicine, Harvard Medical School, Boston, MA, United States, [6]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [7]Harvard-MIT Health Sciences and Technology, Institute of Medical Engineering and Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [8]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States
		T_1 mapping of the fetal brain is hindered by substantial, frequent, and random fetal motion, making many current quantitative techniques impractical in the fetus. We have applied to the fetal brain (and adult brain for validation purposes) a recently introduced T_1 mapping technique based on EPI readout that is preceded by a non-selective inversion pulse, and where the order of the acquired slices is permuted from one inversion recovery to the next, allowing efficient, high temporal sampling of the T_1 relaxation curve. We believe that this method is capable of providing accurate T_1 maps of the fetal brain.

5424	Computer 106	Chemotherapy reduces microstructural asymmetry in the brain
		Junyu Guo[1], Yuanyuan Han[2], Yimei Li[2], and Wilburn E. Reddick[1]
		[1]Diagnostic Imaging, St Jude Children's Research Hospital, Memphis, TN, United States, [2]Biostatistics, St Jude Children's Research Hospital, Memphis, TN, United States
		Previously, we discovered two types of brain microstructural asymmetry: myelin-related asymmetry and axon-related asymmetry in healthy volunteers. In this study, we found that chemotherapy with methotrexate significantly reduced the microstructural asymmetries in patients with acute lymphoblastic leukemia, having a greater impact on asymmetries in younger patients than in older ones. Our results indicate that chemotherapy may lead to atypical brain development long before patients become symptomatic. These results may help to provide insights into neurocognitive deficits caused by chemotherapy.

5425	Computer 107	The Impact of Prenatal Endocrine-Disrupting-Chemical Exposure on Brain Function in Teenagers
		Chi-Ieong Hong[1], Shu-Li Wang[2], Chao-Yu Shen[1,3], Jeng-Dau Tasi[4], Tou-Rong Chen[1], and Jun-Cheng Weng[5,6]

		[1]Department of Medical Imaging and Radiological Sciences, Chung Shan Medical University, Taichung, Taiwan, [2]National Institute of Environmental Health Sciences, National Health Research Institutes, Miaoli, Taiwan, [3]Institute of Medicine and Department of Medical Imaging, Chung Shan Medical University and Hospital, Taichung, Taiwan, [4]School of Medicine and Department of Pediatrics, Chung Shan Medical University and Hospital, Taichung, Taiwan, [5]Department of Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan, [6]Department of Psychiatry, Chang Gung Memorial Hospital, Chiayi, Taiwan
		The products made by endocrine disrupting chemicals (EDCs) widely exists in our daily life, which could be a risk of our health. We tried to find the relationship between prenatal exposure to EDCs' concentrations and teenager's brain function using resting-state functional MRI (rs-fMRI). Our results showed the correlation between prenatal perfluorononanoic acid (PFNA)/MeHg exposure and functional alterations of the teenage brain in caudate gyrus and putamen.

5426	Computer 108	Assessment of myelination in developing brains by using the inhomogeneous magnetization transfer MRI
		Xianjun Li[1,2], Yuli Zhang[1], Fan Wu[1], Xiaoqian Jia[1], Xiaoyu Wang[1], Chao Jin[1], Qinli Sun[1], Heng Liu[1,2], Xiaocheng Wei[3], and Jian Yang[1,2]
		[1]Department of Radiology, the First Affiliated Hospital, Xi'an Jiaotong University, Xi'an, China, [2]Department of Biomedical Engineering, the Key Laboratory of Biomedical Information Engineering of the Ministry of Education, School of Life Science and Technology, Xi'an Jiaotong University, Xi'an, China, [3]MR Research China, GE Healthcare, Beijing, China
		In vivo assessment of myelination is critical for understanding the typical and pathological brain development. Inhomogeneous magnetization transfer (ihMT) has been proposed recently and may be useful to quantify myelin contents. This study tried to evaluate performances of magnetization transfer ratio (MTR) and ihMT ratio (ihMTR) in assessing the myelination of toddler and adolescent brains. The ihMTR maps hold larger image contrasts than MTR maps. Moreover, ihMTR demonstrates larger relative changes during the period from the toddler to adolescent. Results in this study suggested that ihMTR was specific for characterizing white matter and sensitive to myelination during the brain development.

5427	Computer 109	White Matter Integrity in Adolescents with Attention Deficit Hyperactivity Disorder with Comorbid Bipolar Disorder assessed by Tract Based Spatial Statistics
		Arzu Ceylan Has[1], Mahmut Mujdeci[2], Gokce Nur Say[2], Hediye Pinar Gunbey[3], Nilufer Okumus[4], Yusuf Karaer[5], Halime Tuna Cak Esen[5], Ozlem Yildiz Gundogdu[4], Rahsan Gocmen[6], and Yonca Anik[7]

		[1]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey, [2]Department of Child and Adolescents Psychiatry, On Dokuz Mayis University, Samsun, Turkey, [3]Department of Radiology, On Dokuz Mayis University, Samsun, Turkey, [4]Department of Child and Adolescents Psychiatry, Kocaeli University, Kocaeli, Turkey, [5]Department of Child and Adolescents Psychiatry, Hacettepe University, Ankara, Turkey, [6]Department of Radiology, Hacettepe University, Ankara, Turkey, [7]Department of Radiology, Kocaeli University, Kocaeli, Turkey
		White matter (WM) integrity is an important factor for the pathophysiology of attention-deficit/hyperactivity disorder (ADHD) and bipolar disorder (BD) in adolescents. In this study, we hypothesized that adolescents with attention deficit hyperactivity disorder with comorbid bipolar disorder (ADHD+BD) would yield different pattern and extent of WM abnormalities than ADHD and BD. Sixty adolescents were categorized into four groups as ADHD, BD, ADHD+BD and healthy controls. The comparative diffusion tensor imaging analyses were performed between each patient group and healthy controls. Adolescents with ADHD+BD displayed different pattern and extent of WM abnormalities than ADHD and BD revealed by tract-based spatial statistics.

5428	Computer 110	Late post-natal brain metabolic changes in healthy rats, a longitudinal in vivo 1H and 31P MRS study
		Veronika Rackayova[1], Olivier Braissant[2], Rolf Gruetter[3], Valerie McLin[4], and Cristina Cudalbu[3]
		[1]Laboratory of Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [2]Neurometabolic Unit, Service of Clinical Chemistry, University Hospital of Lausanne, Lausanne, Switzerland, [3]Centre d'Imagerie Biomédicale (CIBM), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [4]Swiss Center for Liver Disease in Children, University Hospitals Geneva, Geneva, Switzerland
		New-born rats are known to undergo important brain metabolic changes during first 4-5 weeks of their lives. However precise description of metabolic changes at latter stages is missing. At this period rats might still undergo changes due to final brain maturation what may impact data interpretation of experiments during this window. This study aimed to explore possible metabolic changes in the rat brain during the late post-natal period (post-natal days 29 - 77), using in-vivo ^{1}H and ^{31}P-MRS and a temporal resolution of 1 week. We report significant changes in Ins, tCho (mainly due to GPC increase), Tau and Glu in rats considered as young adults.

5429	Computer 111	Automated Extraction of the Fetal Brain from Functional MRI Data
		Saige E Rutherford[1], Mike Angstad[1], Jasmine Hect[2], Andre Zapico[1], Moriah Thomason[2], and Chandra Sripada[1]
		[1]Psychiatry, University of Michigan, Ann Arbor, MI, United States, [2]Wayne State University, Detroit, MI, United States

		In this study, we present a novel application of a Convolution Neural Network algorithm to a challenging image segmentation problem: fetal brain segmentation. Resting-state fMRI data was obtained from 192 fetuses (gestational age 20-40 weeks, M=31.9, SD=4.28). The output from automated extractions are compared with the ground truth of manually drawn brain masks. We report that automated fetal brain localization and extraction is achievable at the same integrity of manual methods, in a fraction of the time.

5430	Computer 112	*In vivo* ^{1}H NMR spectroscopy study of mitochondrial pyruvate carrier 1 (MPC1) deficient mouse reveals energy shift in the development of embryonic brain
		Hongxia Lei[1,2], Zeinab Ammar[2], Corina M Berset[1], and Jean-Claude Martinou[2]
		[1]Center for Biomedical Imaging (CIBM-AIT), École Polytechnique Fédérale de Lausanne, Lasuanne, Switzerland, [2]University of Geneva, Geneva, Switzerland
		Pyruvate degradation is an important step for oxidative phosphorylation. We studied brains of murine embryos devoid of mitochondrial pyruvate carrier 1 (MPC1) using ^{1}H MRS. We demonstrates that after the embryonic energy shift, lactate accumulation can explain embryonic lethality in embryo devoid of MPC1.

5431	Computer 113	Differential effects of hunger and depression on cerebral blood flow in healthy adolescents
		Céline Charroud[1,2], Emmanuelle Le Bars[2], Emily Sanrey[1,3], Jérémy Deverdun[2], Josef Pfeuffer[4], Nicolas Menjot de Champfleur[2], and Philippe Coubes[1,3]
		[1]Unité de recherche sur les comportements et mouvements anormaux (URCMA, IGF, INSERM U661 UMR 5203), Departments of neurosurgery, Montpellier University Hospital Center, Gui de Chauliac Hospital, University of Montpellier, Montpellier, France, [2]Institut d'Imagerie Fonctionnelle Humaine, I2FH, Department of Neuroradiology, Montpellier University Hospital Center, Gui de Chauliac Hospital, University of Montpellier, Montpellier, France, [3]Unité de pathologie cérébrale résistante, Department of neurosurgery, Montpellier University Hospital Center, Montpellier, France, [4]Siemens Healthcare GmbH, Application Development, Erlangen, Germany
		This study aims to explore the appetite effect on taste and depression on healthy adolescents using Arterial Spin Labeling. Fifteen participants complete the Multiscore Depression Inventory for Children test and two MRI sessions: pre-lunch (hunger) and post-lunch (satiety). We found an increased CBF – cerebral blood flow – during hunger in the posterior insula (anticipation and motivation of feeding) and during satiation in the precuneus, lingual gyrus and cuneus (inhibition pattern of food intake). We show that the correlations between depression and CBF are modulated by appetite in the precuneus, operculum, lingual, cuneus, middle frontal gyrus and inferior parietal lobule.

5432	Computer 114	Influences of the Gut Microbiome on Early Brain Development Douglas C Dean[1], Elizabeth M Planalp[1,2], Nicholas Vogt[3], Kristin Dowe[1,2], Alysha Rameshk[1], Kristine Mclaughlin[1], Abigail Freeman[1], and Andrew L Alexander[1,4,5] *[1]Waisman Center, University of Wisconsin Madison, Madison, WI, United States, [2]Psychology, University of Wisconsin Madison, Madison, WI, United States, [3]Medicine, University of Wisconsin Madison, Madison, WI, United States, [4]Psychiatry, University of Wisconsin Madison, Madison, WI, United States, [5]Medical Physics, University of Wisconsin Madison, Madison, WI, United States* Increasing evidence from animal studies suggests the gut microbiome has a significant role on early brain development and function. However, little is known about this role on human brain development and in particular, on myelination. Using quantitative multicomponent relaxometry and 16S rRNA sequencing, we examined measures of myelin content and the gut microbiome from a cohort of typical developing infants. Infant brain measures were found to be differentially associated with the relative abundancies of certain bacteria phylum, suggesting that microbial communities may have a significant influence on processes of early brain development.

5433	Computer 115	Establishing a developmentally appropriate fMRI paradigm for presurgical mapping of memory in children Amanda G Wood[1], Elaine Foley[2], Parnpreet Virk[2], Helen Ruddock[3], Paras Joshee[4], Kelly Murphy[2], and Stefano Seri[2] *[1]Life and Health Sciences, Aston Brain Centre, Aston University, Birmingham, United Kingdom, [2]Aston University, Birmingham, United Kingdom, [3]University of Liverpool, Liverpool, United Kingdom, [4]University of Birmingham, Birmingham, United Kingdom* The use of functional MRI to evaluate risk to memory function following temporal lobe surgery in children cannot rely on adult tools. We present a novel fMRI paradigm that is brief, independent of reading ability, and therefore a candidate for presurgical evaluation. Data from 36 adults and 19 children (all healthy controls) show that the paradigm captures the expected leftward asymmetry of mesial temporal activation in adults. A more symmetrical pattern is observed in children, consistent with the emergence of hemispheric specialisation across childhood. These data have important implications for the interpretation of presurgical memory fMRI in the paediatric setting.

5434	Computer 116	Trajectories of brain lactate and energy metabolite concentrations do not contribute to elevated aerobic glycolysis across childhood Helene Benveniste[1], Gerald Dienel[2], Zvi Jacob[3], Hedok Lee[1], Rany Makaryus[3], Albert Gjedde[4], Fahmeed Hyder[5], and Douglas L. Rothman[5]

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Lactate is produced in normal brain even when O_2 levels are ample, and high lactate production may explain aerobic glycolysis (AG) in developing brain. We evaluated steady state lactate concentrations ([Lac]) in brains of 87 children using 1HMRS while they underwent routine MRI examination. The trajectory of [Lac] in cerebral cortex across childhood was below the 0.5-0.7 mM range in normal adult brain. Thus, lactate accumulation and efflux are unlikely to underlie excessive AG in children.

5435 | Computer 117

Potential role of diffusion tensor imaging in assessing neonatal neurobehavior development in the newborn stage

Chao Jin[1], Xianjun Li[1], Congcong Liu[1], Yannan Cheng[1], Miaomiao Wang[1], and Jian Yang[1,2]

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Maturation of brain structure underpins its functionality. From birth, brain structure and neurobehavior abilities progressively mature. However, specific link between these two entities remains unclear. This study therefore aims to investigate such correlation between neonatal neurobehavior and brain white matter (WM) microstructural development measured by diffusion tensor imaging (DTI)-fractional anisotropy (FA). Results indicated that neonatal behavior abilities significantly correlated with sensorimotor WM FAs; while active-tone just correlated with motor-associated WM. These findings demonstrate the specialized correlations of specific neurobehavior abilities with microstructural maturation in corresponding WMs, suggesting the potential role of DTI in assessing the neonatal neurodevelopment in clinical practice.

5436 | Computer 118

Quantifying cerebral hemodynamics in developing children using multiple post-labeling delay pseudo-continuous arterial spin labeling

Nick Todd[1], Helen Santoro[2], Haley McEvoy[2], Danny JJ Wang[3], Lino Becerra[2], David Borsook[2], and Duncan J Hodkinson[2]

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		Arterial Spin Labeling (ASL) is an attractive option for studies in pediatric populations due to its ability to acquire quantitative cerebral perfusion measurements without ionizing radiation. Brain vascular dynamics in children are different from adults and rapidly changing with age. ASL sequence parameters must therefore be carefully chosen and longitudinal studies must account for normally occurring neurodevelopment. Here we present a multiple-post label delay pseudo-continuous ASL approach to quantifying cerebral blood flow, arterial transit time, and cerebral blood volume in children. We show analysis of the PLD selections with respect to ATT values and test-retest reliability of the CBF measurements.

5437	Computer 119	Changes in Resting-State Functional Brain Activity are Correlated with Waning Cognitive Functions in Pediatric HIV
		Santosh K Yadav[1], Rakesh K Gupta[2], Sheema Hashem[1], Ajaz A Bhat[1], Ravindra K Garg[3], Vimala Venkatesh[4], Pradeep K Gupta[2], Alok K Singh[3], Muhammad W Azeem[5], Deepak Kaura[6], and Mohammad Haris[1]
		[1]Division of Translational Medicine, Sidra Medicine, Doha, Qatar, [2]Department of Radiology and Imaging, Fortis Memorial Research Institute, Gurgaon, India, [3]Department of Neurology, King George Medical University, Lucknow, India, [4]Department of Microbiology, King George Medical University, Lucknow, India, [5]Department of Psychiatry, Sidra Medicine, Doha, Qatar, [6]Department of Diagnostic Imaging, Sidra Medicine, Doha, Qatar
		We evaluated the functional brain changes in HIV-infected children by mapping the amplitude-of-low-frequency-fluctuations (ALFF) and functional connectivity (FC) using rs-fMRI. Association of these changes with cognitive measures was also explored. ALFF and FC were significantly altered in multiple brain regions involved in auditory, visual, language, motor and sensory activity. The waning cognitive functions in HIV-infected children were associated with the changes in ALFF and FC. These two imaging parameters in association with the cognitive evaluation may provide better understanding of the functional brain activity in HIV-infected children.

Electronic Poster

fMRI: Acquisition, Contrast & Artifacts

Exhibition Hall	Thursday 13:15 - 14:15

5438	Computer 1	Using Virtual Conjugate Coil reconstruction for statistical improvement in highly accelerated Simultaneous Multislice fMRI
		Adam O. Kettinger[1,2], Petra Hermann[1], Pal Vakli[1], Martin Blaimer[3], Kawin Setsompop[4,5,6], Stephan A. R. Kannengiesser[7], Felix A. Breuer[3], and Zoltan Vidnyanszky[1]

		[1]Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary, [2]Department of Nuclear Techniques, Budapest University of Technology and Economics, Budapest, Hungary, [3]Magnetic Resonance and X-ray Imaging Department, Fraunhofer Development Center X-ray Technology (EZRT), Würzburg, Germany, [4]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [5]Department of Radiology, Harvard Medical School, Boston, MA, United States, [6]Harvard-MIT Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States, [7]MR Application Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany
		Simultaneous multislice EPI is a popular acquisition method for high-temporal-resolution fMRI. However, at high acceleration factors, significant noise amplification could occur that can hinder the detection of activation. Using the Virtual Conjugate Coil concept, the g-factors of such measurements can be reduced. In this work we investigate the potential statistical improvement of using Virtual Conjugate Coil reconstruction in simultaneous multislice fMRI. Our results show that using Virtual Conjugate Coil reconstruction, first-level and group-level t-values, as well as first-level effect sizes and temporal signal-to-noise ratio are increased.

5439	Computer 2	Spiral fMRI using the Gradient Impulse Response Function for Trajectory Prediction
		Nadine N Graedel[1,2], Lars Kasper[2], Maria Engel[2], Jennifer Nussbaum[2], Bertram J Wilm[2,3], Klaas P Pruessmann[2], and S Johanna Vannesjo[1]
		[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, Univeristy of Oxford, Oxford, United Kingdom, [2]Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland, [3]Skope Magnetic Resonance Technologies AG, Zurich, Switzerland
		Image artifacts resulting from gradient imperfections remain a challenge in spiral functional MRI. In this work we reconstructed spiral fMRI data using trajectories predicted by the gradient impulse response function (GIRF). The GIRF-reconstruction generates image quality and fMRI results similar to using a fully monitored trajectory. The presented approach requires only a one-time calibration per system, thus the fMRI acquisition is not prolonged or complicated by the acquisition of additional data for correction purposes.

5440	Computer 3	Gain of temporal signal-to-noise ratio with pTx universal pulses and the whole-brain fMRI 3D-GE EPI sequence at 7T
		Vincent Gras[1], Alexandre Vignaud[1], Cécile Rabrait-Lerman[1], Denis Le Bihan[1], Tony Stoecker[2], Ruediger Stirnberg[2], and Nicolas Boulant[1]
		[1]NeuroSpin, CEA, Saclay, France, [2]DZNE, Bonn, Germany

		The volumetric 3D-EPI sequence has already shown great promise for fMRI studies due to potentially increased temporal SNR (tSNR) and lower energy demands compared to 2D multi-slice acquisition schemes. For whole-brain studies the tSNR yet can suffer from sub-optimal flip angles due to RF inhomogeneity. Parallel transmission (pTx) has been shown to be a very powerful technology to mitigate these effects but has been barely used in routine due to a cumbersome calibration procedure. Here, we use Universal Pulses to skip entirely the latter step and increase locally the tSNR at 7T in the 3D-EPI GE sequence.

5441	Computer 4	High SNR Functional MRI Using Oscillating Steady State Imaging
		Shouchang Guo[1] and Douglas C. Noll[2]
		[1]Electrical and Computer Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States
		Signal-to-noise ratio (SNR), a limiting factor for functional MRI, can be improved by through the use of higher magnetic fields or through the use of array coils. This work proposes a novel acquisition scheme for BOLD fMRI that has the potential to improve SNR by a factor of 2 or more. This approach uses an oscillating steady state signal that is T2*-weighting and when combined across the period of oscillation produced robust fMRI results in both 2D and 3D imaging experiments.

5442	Computer 5	Effect of optimised coil-combinations on high-resolution laminar fMRI at 9.4T
		Sriranga Kashyap[1,2], Francisco J. Fritz[1,2], Robbert L. Harms[1], Laurentius Huber[3], Dimo Ivanov[1,2], Alard Roebroeck[1,2], Benedikt A. Poser[1,2], and Kâmil Uludağ[1,2]
		[1]Department of Cognitive Neuroscience, Maastricht University, Maastricht, Netherlands, [2]Maastricht Brain Imaging Centre (MBIC), Maastricht, Netherlands, [3]Section on Functional Imaging Methods Laboratory of Brain and Cognition, National Institute of Mental Health, Bethesda, MD, United States
		Despite the availability of more sophisticated coil-combination methods like Roemer and STARC, ultra-high field fMRI studies still use the conventional sum-of-squares (SoS) method for combining the images of the individual coils from multi-channel RF-coil arrays. Here we use a memory-efficient, CPU/GPU accelerated coil-combine toolbox written in Python to compare and characterise the effect of methods such as covariance-weighted sum-of-squares (CovSoS), Roemer and STARC on sub-millimetre resolution GE-EPI laminar fMRI data acquired at 9.4T, and demonstrate the benefit of using optimised coil-combination for UHF fMRI studies.

5443	Computer 6	Distortion-matched high-resolution reduced-FoV functional and diffusion MRI of the human brainstem at 7T

		Giovanni Savini[1,2], Fabrizio Fasano[3], Joseph Whittaker [2], Letizia Casiraghi[4,5], Fulvia Palesi[5,6], Gloria Castellazzi[5,7], Alessandro Lascialfari[1], Egidio D'Angelo[4,5], Derek Jones[2], Richard Wise[2], and Claudia Angela Gandini Wheeler-Kingshott[4,8,9]
		[1]Department of Physics, University of Milan, Milano, Italy, [2]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom, [3]Siemens Healthcare Ltd, Frimley, Camberley, United Kingdom, [4]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, [5]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy, [6]Department of Physics, University of Pavia, Pavia, Italy, [7]Department of Electrical, Computer and Biomedical Engineering, University of Pavia, Pavia, Italy, [8]Queen Square MS Centre, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [9]Brain MRI 3T Research Centre, C. Mondino National Neurological Institute, Pavia, Italy
		The brainstem plays a key role in the central nervous system, but its proximity to the oral cavity and physiological noise sources constitute major limitations for EPI imaging. We compared image quality from full and reduced-FoV spin-echo EPI sequences at ultrahigh field. Compared to standard EPI acquisitions, reduced-FoV techniques confer considerable benefits for brainstem imaging in terms of shortening TE, increasing signal-to-noise ratio and mitigating distortions. We exploited these advantages for 7T distortion-matched functional and diffusion imaging of the brainstem using ZOOM-EPI. A finger tapping task resulted in significant activations in regions corresponding to the cuneate nucleus and the pyramidal decussation.

5444	Computer 7	Enhanced fMRI Using a Novel 3D Ultrafast Gradient-echo-based Sequence Using Spatiotemporal Encoding.
		JaeKyun Ryu[1,2], Won Beom Jung[1,2], Jeong Pyo Son[1], Seong-gi Kim[1,2], and Jang-Yeon Park[1,2]
		[1]Center for Neuroscience Imaging Research, Institute for Basic Science, Suwon, Republic of Korea, [2]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Republic of Korea
		We recently introduced a novel ultrafast 3D gradient-echo-based imaging technique using spatiotemporal encoding (SPEN), which was dubbed RASE (Rapid Acquisition with Sequential Excitation). RASE has less sensitivity to field inhomogeneities and susceptibility differences compared to conventional multi-slice GE-EPI, sharing the advantages of 3D imaging such as high signal-to-noise ratio and high spatial resolution. In this preliminary study, we present very promising results of RASE-II fMRI, i.e., better t-scores, tSNR, and BOLD percent-signal-changes than conventional multi-slice GE-EPI, on a 9.4-T animal scanner.

5445	Computer 8	Human Connectome Project (HCP)-style resting state functional MRI at 7 Tesla using RF parallel transmission
		Xiaoping Wu[1], Edward J. Auerbach[1], Steen Moeller[1], Pierre-Francois Van de Moortele[1], Essa Yacoub[1], and Kamil Ugurbil[1]

[1]Medical School, University of Minnesota, Minneapolis, MN, United States

A major component of the Human Connectome Project (HCP) in the WU-Minn consortium is slice-accelerated whole-brain resting-state functional MRI (rfMRI) at both 3T and 7T. Although providing better contrast and higher spatial resolution, the 7T acquisition is compromised by RF nonuniformity. Here, we demonstrate how RF parallel transmission (pTx) can be used to improve RF uniformity for highly-accelerated, HCP-style rfMRI at 7T with simultaneous multislice multiband approach. Our results demonstrate that the combination of pTx with the 8-channel transmit/32-channel receive coil (Nova8Tx/32Rx) enhanced functional contrast-to-noise ratio (fCNR) in most cortical surfaces and subcortical voxels relative to the original HCP protocol utilizing the Nova1Tx/32Rx in combination with dielectric padding. The enhanced fCNR in turn yielded higher correlation values in seed-based connectivity measures. These results demonstrate that pTx provides significant gains in whole-brain rfMRI employed for defining the functional connectome of the human brain.

5446 Computer 9

Dual reconstructions of SLIDER-XD for high spatial and temporal resolution resting state fMRI at 7T

An Thanh Vu[1,2], Alexander Beckett[3,4], David Feinberg[3,4], and Pratik Mukherjee[1,2]

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Here we assert that the individual dithers of a SLIDER-XD dataset can be utilized in a dual fashion to reconstruct not only a high spatial resolution dataset but also a high temporal resolution dataset (termed SLIDER-XDT) suitable for fMRI experiments requiring faster TRs. While analogous to spatial smoothing where spatial resolution is traded for statistical power in post-processing, SLIDER-XDT not only provides additional statistical power but also additional temporal resolution which can be used to support detection of additional resting state networks or to temporally un-alias signals of interest.

5447 Computer 10

StImulus Locked K-space shuffling (SILK) for ultra-high resolution fMRI

An Thanh Vu[1,2], Alexander Beckett[3,4], David Feinberg[3,4], and Pratik Mukherjee[1,2]

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		Traditional EPI fMRI methods for acquiring sub-mm ultra-high resolution images require longer echo trains, resulting in SNR losses due to longer TEs, as well as, increased blurring in the phase encode (PE) direction, geometric distortion, and susceptibility dropout. StImulus Locked K-space shuffling or SILK-fMRI (e.g. in the context of 3D FLASH imaging) does not suffer from the above limitations but has never before been applied to fMRI. Here we demonstrate the feasibility of SILK fMRI vs. traditional EPI for 0.35 mm ultra-high resolution fMRI at 7T.

5448	Computer 11	Multi-Band-Accelerated T2*-Weighted Inner-Field-of-View EPI of the Human Spinal Cord with Slice-Specific z-Shimming
		Jürgen Finsterbusch[1]
		[1]Systems Neuroscience, Univ. Medical Center Hamburg-Eppendorf, Hamburg, Germany
		T2*-weighted EPI suffers from severe signal dropouts and geometric distortions in the human spinal cord due to susceptibility differences between tissue, vertebrae, and vertebral bones. With 2D-selective RF (2DRF) excitations, the field-of-view can be focused to the spinal cord without aliasing which reduces geometric distortions, shortens echo times, and increases the signal-to-noise ratio significantly. Here, this approach is accelerated with simultaneous multi-slice (SMS) imaging to shorten the acquisition time. An individual temporal shift was applied to the different bands of a multi-band 2DRF envelope which corresponds to a slice- or band-specific z-shim that compensates for the specific through-slice dephasing effects.

5449	Computer 12	Optimising the detection of subcortical auditory function using fMRI
		Rebecca Susan Dewey[1,2,3], Deborah A Hall[2,3], Hannah Guest[4], Garreth Prendergast[4], Christopher J Plack[4,5], and Susan T Francis[1]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]National Institute for Health Research (NIHR) Nottingham Biomedical Research Centre, Nottingham, United Kingdom, [3]Otology and Hearing Group, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, Nottingham, United Kingdom, [4]Manchester Centre for Audiology and Deafness (ManCAD), University of Manchester, Manchester, United Kingdom, [5]Department of Psychology, Lancaster University, Lancaster, United Kingdom
		We explore the effects of EPI distortion correction and retrospective correction of cardiac and respiratory artefacts on fMRI data quality. Further, we assess the suitability of this data to provide robust detection of subcortical sound-evoked responses for inter-group and subgroup analyses. We report an optimum acquisition, pre-processing and analysis protocol for subcortical fMRI of the ascending auditory pathway.

5450	Computer 13	Block-Interleaved Segmented EPI for voxel-wise high-resolution fMRI studies at 7T

		Guoxiang Liu[1], Adnan Shah[1], and Takashi Ueguchi[1]
		[1]CiNet, NICT, Suita-shi,Osaka, Japan
		We report a novel segmented EPI method preserving the pattern of hemodynamic response in bock design fMRI studies. The proposed method uses an EPI-based anatomical data obtained with the same distortion from task EPI scans for further fMRI analysis. At sub-millimeter spatial resolution, the proposed method avoids functional to structural registration and spatial smoothing giving us an opportunity to investigate activity dynamics at the columnar level spatial resolution with high specificity. Our results showed that the proposed method can perform voxel-wise high-resolution fMRI studies with a voxel size of 0.6×0.6×0.6 mm^3 at 7T.

5451	Computer 14	fMRI with Low Acoustic Noise using Variable-Blipped EPI with Readout Segmentation
		Patrick Liebig[1,2,3], Robin Heidemann[2], Yuehui Tao[4], Bernhard Hensel[5], Wei Liu[6], and David Porter[3]
		[1]Center of medical physics and engineering, University of Erlangen-Nuremberg, Erlangen, Germany, [2]Siemens Healthcare GmbH, Erlangen, Germany, [3]University of Glasgow, Glasgow, United Kingdom, [4]Siemens Healthcare United Kingdom, Glasgow, United Kingdom, [5]University of Erlangen-Nuremberg, Erlangen, Germany, [6]Siemens Shenzen Magnetic Resonance Ltd., Shenzen, China
		Echo-Planar-Imaging is widely used for fMRI, but generates a high level of acoustic noise This could potentially affect activation power, especially for auditory experiments. One established way to reduce acoustic noise is to use a sinusoidal readout gradient combined with a constant phase-encoding gradient. However, this data-sampling scheme is only suitable for lower acceleration factors. This study investigates an alternative EPI sampling scheme with similar acoustic-noise properties that can be used with high acceleration factors in both phase-encoding and slice-encoding directions. Acoustic noise is further reduced by using readout segmentation to reduce the readout gradient amplitude and slew rate.

5452	Computer 15	Real-time processing of image and trajectory data: Application to single-shot time series
		Josip Marjanovic[1], Jonas Reber[1], Maria Engel[1], Lars Kasper[1], Benjamin E. Dietrich[1], David O. Brunner[1], and Klaas P. Pruessmann[1]
		[1]ETH Zurich, Zurich, Switzerland
		The steady increase in data volume is a significant problem in fMRI time series. Recently proposed signal processing architectures based on digital hardware enable data reduction in real-time before the data are stored. We demonstrate that a high degree of data savings can be achieved with few simple operations. Coil compression and field probe data processing help breaking the data bottleneck in fMRI time-series.

5453	Computer 16	Enhanced BOLD Contrast-to-Noise-Ratio and Activation Sensitivity with the Intra-shot Adapted Keyhole (ISAK) Method
		Zhan Xu[1], Guangyu Chen[1], Andrew S Nencka[2], and Shi-Jiang Li[1]
		[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States
		A fast, multi-echo (ME) fMRI acquisition method, ISAK, is introduced by employing the classic keyhole method in a between-echo manner. ISAK acquires eight echoes within 70 ms, and the associated contrast-to-noise-ratio (CNR) improvement is up to more than 200%. The stronger blood-oxygen-level-dependent sensitivity, compared with regular ME fMRI with four echoes and standard single-echo fMRI without any acceleration, proves the benefit of trading a fraction of spatial samples in each image for more temporal echoes images in improving CNR.

5454	Computer 17	THE ANGULAR DEPENDENCE OF THE GRADIENT ECHO AND SPIN ECHO BOLD SIGNAL INDUCED BY CORTICAL MICRO- AND MACRO- VASCULATURE
		Mario Gilberto Báez-Yáñez[1,2], Philbert S. Tsai[3], David Kleinfeld[3,4], and Klaus Scheffler[1,5]
		[1]Department of High-Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Graduate Training Centre of Neuroscience, University of Tuebingen, Tuebingen, Germany, [3]Department of Physics, University of California at San Diego, San Diego, CA, United States, [4]Section of Neurobiology, University of California, San Diego, CA, United States, [5]Department of Biomedical Magnetic Resonance, University of Tuebingen, Tuebingen, Germany
		In recent investigations, the angular dependence of the BOLD signal with respect to the main magnetic field has been shown by Monte Carlo simulations and experimental approaches. This orientation dependence is often attributed to the contribution of large vessels (cortical surface and penetrating arteries/veins). However, the ability to resolve cortical layers and columns depends ultimately on the contribution of the MR signal generated by the capillary bed. In this work, we studied the MR signal attenuation generated by a vascular network model that was acquired from the parietal cortex of mice using a two-photon laser imaging techniques. We separately investigated the impact of macrovessels (>5 μm in diameter) and microvessels (< 5 μm in diameter) on the BOLD effect.

5455	Computer 18	Regional-specific echo-time optimization in spin-echo EPI at 3 Tesla
		Josephine Tan[1], Don M Ragot[1], and J. Jean Chen[1,2]
		[1]Rotman Research Institute, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada

		Spin-echo (SE) echo-planar imaging (EPI) is less prone to signal dropouts in brain regions of high susceptibility. Such regions are important for the study of memory and language, and have been traditionally difficult to image using the conventional gradient-echo BOLD fMRI. To maximize the contrast-to-noise of SE EPI, echo-time (TE) optimization is critical, and currently, the optimal TE is assumed to be equal to tissue T2. In this work, we use a comprehensive BOLD signal and noise model to characterize the TE dependence of SE-EPI at 3 T. We show that the optimal TE is significantly shorter than the commonly assumed tissue T2.

5456	Computer 19	A comprehensive investigation of physiologic noise modeling in resting state fMRI; phase shifted cardiac response function in EPI
		Wanyong Shin[1] and Mark J Lowe[1]
		[1]Radilogy, Cleveland Clinic, Cleveland, OH, United States
		The cardiac and respiratory response functions derived from RETROICOR have substantial variation. In this study, we investigate the source of this variation. We found the cardiac response function is phase or time shifted across the brain while the respiratory function has a fixed phase, but changes polarity across the brain. We further investigated the efficacy of physiologic noise correction accounting for this with a single response function model.

5457	Computer 20	Novel multi-slab GRASE sequences for fMRI. Comparison with EPI.
		Djaudat Idiyatullin[1], Wei Zhu[1], Yi Zhang[1], Xiao-Hong Zhu[1], Wei Chen[1], and Kâmil Uğurbil[1]
		[1]Radiology, Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States
		T2 weighted fMRI has been shown to provide higher spatial specificity than commonly used T2* contrast. However, 2D-spin-echo-EPI method, which is the most commonly employed approach, suffers from a low functional mapping contrast. Versions of single-shot 3D-GRASE sequence provide improvements in fMRI contrast, but suffer limitations particularly at ultrahigh magnetic fields due to shorter T2. To solve this problem, a new multi-slab version of the 3D-GRASE sequence with and without the capability of inner-volume selection, abbreviated as ivmsGRASE and msGRASE, respectively, are proposed. The theoretical and practical considerations of these methods in comparison with spin-echo-EPI for fMRI application are presented.

5458	Computer 21	Velocity Selective Inversion improves the sensitivity and speed of perfusion weighted FMRI
		Luis Hernandez-Garcia[1], Jon-Fredrik Nielsen[1], and Douglas Noll[1]

		[1]FMRI laboratory, University of Michigan, Ann Arbor, MI, United States
		This work compares the performance of pseudo-continuous ASL (PCASL) and velocity selective inversion ASL (VSI) for functional MRI using a simple, robust visual motor task. VSI showed increased sensitivity and allowed faster temporal resolution, resulting in further increases in sensitivity.

5459	Computer 22	Inter-site MRI scanner resolution and stability variance revealed by EPI fMRI phantom scans: a multi-site Canadian study
		M. Aras Kayvanrad[1], Aditi Chemparathy[1], Stephen Arnott[1], Fan Dong[1], Mojdeh Zamyadi[1], Tom Gee[1], Robert Bartha[2,3], Christopher Scott[4], Sandra Black[4], Sean Symons[4], Glenda MacQueen[5], Jacqueline Harris[5], Andrew Davis[6], Geoffrey Hall[6], Stefanie Hassel[5,7], and Stephen Strother[1,8]
		[1]Rotman Research Institute, University of Toronto, Toronto, ON, Canada, [2]Robarts Research Institute, Western University, London, ON, Canada, [3]Medical Biophysics, Western University, London, ON, Canada, [4]Sunnybrook Research Institute, Toronto, ON, Canada, [5]The Mathis Centre for Mental Health Research and Education, University of Calgary, Calgary, AB, Canada, [6]Department of Psychology, Behaviour and Neuroscience, McMaster University, Hamilton, ON, Canada, [7]School of Life and Health Sciences, Aston University, Birmingham, United Kingdom, [8]Medical Biophysics, University of Toronto, Toronto, ON, Canada
		The Ontario Neurodegenerative Disease Research Initiative (ONDRI) and the Canadian Biomarker Integration Network in Depression (CAN-BIND) are multisite longitudinal studies that employ 12 MRI scanners across Canada (6 in CAN-BIND) to collect neuroimaging data. To ensure comparability of neuroimaging data collected at different sites, fBIRN (functional Biomedical Informatics Research Network) phantoms have been scanned approximately monthly at each site for more than two years to obtain quality assurance (QA) measures from the fBIRN pipeline. In this abstract we present our investigations into within- and between-site variations due primarily to differences in full-width-at-half-maximum (FWHM) measures of imaging resolution.

5460	Computer 23	Correcting for the influence of cerebrospinal fluid in quantification of R2’ and deoxygenated blood volume (DBV) using quantitative BOLD
		Matthew T Cherukara[1], Alan J Stone[2], Michael A Chappell[1], and Nicholas P Blockley[2]
		[1]Institute of Biomedical Engineering, Department of Engineering Science, University of Oxford, Oxford, United Kingdom, [2]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neuroscience, University of Oxford, Oxford, United Kingdom

		Streamlined qBOLD (sqBOLD) can be used to quantify deoxygenated blood volume and the reversible relaxation rate R2' (used to estimate oxygen extraction fraction), although it is vulnerable to systematic errors from a number of confounding factors including the presence of cerebrospinal fluid (CSF). A FLAIR inversion preparation is typically used to null the CSF signal, but this results in a reduction in SNR, and increases scan time. We present a post-processing method to account for the presence of CSF that has the potential to improve both the accuracy and efficiency of the sqBOLD technique without the need for FLAIR preparation.

5461	Computer 24	Rapid 3D Blipped Spiral fMRI at 7 T
		Lars Kasper[1,2], Maria Engel[1], Christoph Barmet[1,3], Jonas Reber[1], Jakob Heinzle[2], Klaas Enno Stephan[2], and Klaas Paul Pruessmann[1]
		[1]Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland, [2]Translational Neuromodeling Unit, IBT, University of Zurich and ETH Zurich, Zurich, Switzerland, [3]Skope Magnetic Resonance Technologies, Zurich, Switzerland
		We present 3D blipped spiral fmri at 7T with a fast TR of 0.54s. Compared to 2D spirals, the 3D nature allows parallel imaging in z direction and blipped sampling of multiple planes that accelerate acquisition time, while the inherent averaging of multiple shots retains sufficient SNR. Intershot field inconsistency due to breathing and trajectory changes due to gradient heating in this high duty cycle sequence are compensated by NMR probe-based concurrent field monitoring, recovering high image quality and tSNR. We show the feasibility for fmri with 3D blipped spirals in a visual paradigm.

Electronic Poster

Analysis Methods: Task-Based fMRI

Exhibition Hall	Thursday 13:15 - 14:15

5462	Computer 25	Mouse auditory pathway mapping using BOLD fMRI coherence analysis
		Cristina Chavarrias[1], Guilherme Blazquez Freches[1], and Noam Shemesh[1]
		[1]Champalimaud Neuroscience Programme, Lisbon, Portugal

		The feasibility and potential of mapping the mouse auditory system through functional magnetic resonance imaging (fMRI) in mice was recently demonstrated. The goal of this work was to compare the conventional GLM analysis, which relies on the variability across regions of the haemodynamic response, with a coherence analysis, which is data-driven and provides rich temporal information. Coherence amplitudes closely follow the pattern of the GLM maps, whereas the delay maps obtained from the coherence phase show different latencies even inside each ROI. This suggests the utility of coherence analysis for mapping the auditory pathway in-vivo.

5463	Computer 26	Improved detection of neuronal-related BOLD events of unknown timing with Multi-Echo Sparse Paradigm Free Mapping
		Cesar Caballero-Gaudes[1], Javier Gonzalez-Castillo[2], and Peter A Bandettini[2,3]
		[1]Basque Center on Cognition, Brain and Language, San Sebastian, Spain, [2]Section on Functional Imaging Methods, National Institute of Mental Health, Bethesda, MD, United States, [3]FMRI Core, National Institute of Mental Health, Bethesda, MD, United States
		This work introduces an extension of sparse paradigm free mapping (SPFM) for multiecho (ME) fMRI: ME-SPFM. Based on the ME-fMRI signal model and L1-norm regularized estimators, ME-SPFM produces voxel-wise estimates of time-varying changes in the transverse relaxation ($$$R_2^*$$$) and the net magnetization ($$$S_0$$$) without prior information about experimental paradigms. Our evaluations demonstrate that ME-SPFM significantly outperforms its SE counterpart in terms of sensitivity and specificity, nearly matching that of traditional model-based analyses. ME-SPFM's ability to blindly detect individual events at the single-subject level makes it an ideal candidate to explore the time-varying nature of brain activity in experimentally unconstrained paradigms (naturalistic, resting-state) or clinical applications (detection of inter-ictal epileptic events).

5464	Computer 27	A comparison of distortion correction methods for EPI fMRI applied across three 7T platforms
		Ian D Driver[1], Olivier Mougin[2], William T Clarke[3], Catarina Rua[4], Adrian Carpenter[4], Keith Muir[5], Stuart Clare[3], Susan T Francis[2], Richard G Wise[1], and Richard Bowtell[2]
		[1]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [3]Wellcome Centre for Integrative Neuroimaging (FMRIB), Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [4]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [5]Institute of Neuroscience & Psychology, University of Glasgow, Glasgow, United Kingdom

		In preparation for a wider multi-site ‘travelling heads’ 7T fMRI study, we compare the performance of EPI distortion correction techniques for fMRI data across four sites, using three different 7T platforms. Specifically, we compare B_0-map and phase-encoding reversal methods, applied to both task and resting state fMRI data.

5465	Computer 28	Serial Correlations in fMRI Time-Series Arise from Non-Stochastic Signals Related to Brain Function
		Kaundinya Gopinath[1], Venkatagiri Krishnamurthy[1], and K Sathian[2,3]
		[1]Department of Radiology, Emory University, Atlanta, GA, United States, [2]VA RR&D Center of Excellence, Atlanta VAMC, Decatur, GA, United States, [3]Department of Neurology, Emory University, Atlanta, GA, United States
		In this study, we first demonstrate using resting state fMRI (rsfMRI) “null” datasets, that serial correlation in fMRI time-series arises from non-stochastic signals (e.g., coordinated activity within brain function networks unrelated to the fMRI paradigm of interest). Using this principle, we then advance a method to obtain whitened GLM first-level analysis regression residuals in task fMRI studies, by accounting for non-stochastic brain signals through principal components analysis. Importantly, the proposed methods is insensitive to the temporal resolution of fMRI time-series, unlike conventional stochastic models of serial correlation, whose parameters have to be modified depending on fMRI scan-TR.

5466	Computer 29	Predicting Individual Task Performance From Resting State fMRI: Effects of Training Task Data Quality
		Alexander D. Cohen[1], Elizabeth Zakszewski[1], and Yang Wang[1]
		[1]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States
		Resting state functional MRI (rs-fMRI) has been used to predict individual task activation by training a model to map rs-fMRI networks to task performance. This study used a multiband, multi-echo acquisition to collect motor task fMRI as training data. The effects of echo combination and denoising of the training-task data on rs-fMRI predictions were examined. Multi-echo task data resulted in increased predictive accuracy of the model. These results suggest the quality of the training-task data affects the accuracy of the prediction model.

5467	Computer 30	Predicting individual language task activation from resting state fMRI using a novel data-driven approach
		Elizabeth Zakszewski[1], Alexander Cohen[1], Oiwi Parker Jones[2], Saad Jbabdi[2], and Yang Wang[1]

		[1]Medical College of Wisconsin, Milwaukee, WI, United States, [2]Oxford Centre for Functional Magnetic Resonance Imaging of the Brain (FMRIB), University of Oxford, Oxford, United Kingdom
		This study is aimed to apply a newly developed machine learning approach to predict individual language network based on the resting state functional MRI (rs-fMRI). Despite the presence of significant variability of language network across subjects, the predicated language maps match excellently with the language task fMRI derived activation maps at the individual level. Our results suggest that rs-fMRI can be used as a promising clinical tool for mapping language network by using the novel processing approach.

5468	Computer 31	An automated method for assessing the accuracy of cross-modal registration in high-field fMRI
		Cheryl A Olman[1], Kimberly B Weldon[2], Andrea N Grant[2], Philip C Burton[3], and Essa Yacoub[2]
		[1]Department of Psychology, University of Minnesota, Minneapolis, MN, United States, [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [3]Office of the Associate Dean for Research, College of Liberal Arts, University of Minnesota, Minneapolis, MN, United States
		In this work, we developed a method for evaluating the quality of cross-modal registration of functional and anatomical MRI datasets that obviates the need for subjective human judgments. In brief, we propose that the overlap of an activation mask derived from the functional data with a binary GM mask derived from the reference anatomical volume is a useful metric for overall registration quality. In addition, we promote the use of activation consistency throughout the gray matter as an inclusion criterion for regions of interest when computing laminar (depth-dependent) profiles, provided that the activation is computed in a robust, independent localizer.

5469	Computer 32	A comparison between amplitude of low frequency fluctuation calculation methods based on R2* signal and traditional T2*-weighted signal
		Li-Xia Yuan[1], Li-Sha Yuan[1], Hong-Jian He[1], Jian-Hui Zhong[1], and Yu-Feng Zang[2]
		[1]Center for Brain Imaging Science and Technology, Key Laboratory for Biomedical Engineering of Ministry of Education, College of Biomedical Engineering and Instrumental Science, Zhejiang University, Hangzhou, China, [2]Center for Cognition and Brain Disorders and the Affiliated Hospital,Zhejiang Key Laboratory for Research in Assessment of Cognitive Impairments, Institutes of Psychological Sciences, Hangzhou Normal University, Hangzhou, China

		The amplitude of low frequency fluctuation (ALFF) is usually computed from T2*-weighted functional MRI (fMRI) signals, which is affected by R2* fluctuation, echo time, spin density, and mean R2*. To make ALFF more comparable and reliable between researches, we proposed a new method of ALFF calculation based on R2* (ALFF-R2*) in this work and further implemented for multi-echo fMRI. Statistical results from eyes-open and eyes-closed fMRI datasets show that ALFF-R2* detected an overall smaller significant regions than traditional ALFF in the paired *T* maps. The dice similarity coefficient between *T* maps from ALFF-R2* and traditional ALFF was 0.37. ALFF-R2* is potential to provide more specific results than traditional ALFF.

5470	Computer 33	Comparison of the functional correlation tensor under eyes closed and eyes open conditions
		Yang Fan[1], Jing Wang[2], and Bing Wu[1]
		[1]GE Healthcare China, Beijing, China, [2]Center for Medical Device Evaluation, CFDA, Beijing, China
		Recently, a novel technique was proposed directly integrated resting-state fMRI and DTI techniques to construct a local spatio-temporal correlation tensor from resting state fMRI data, termed as the functional correlation tensor. Previous studies demonstrated that resting-state fMRI properties varied from different resting conditions, such as eyes closed, eyes open and fixation. However, whether the functional correlation tensor will be affected by different baseline conditions is still need to be investigated. In this study, group-level properties of the functional correlation tensor were assessed and compared under eyes closed and eyes open conditions.

5471	Computer 34	Using Hierarchical Clustering Method to Reveal the Formation of Sub-groups among Subjects at Frontal Cortex in fMRI study with Complex Natural Stimulus
		Jacky, Tai-Yu Lu[1], Yi-Tien Li[2,3], Yi-Cheng Hsu[2], and Fa-Hsuan Lin[2,4]
		[1]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan, [2]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan, [3]Department of Medical Imaging, Taipei Medical University-Shuang Ho Hospital, New Taipei, Taiwan, [4]Department of Neuroscience and Biomedical Engineering, Aalto University, Espoo, Finland
		The inter-subject correlation (ISC) analysis which is widely used in functional magnetic resonance imaging (fMRI) studies with complex natural stimulus design. It has been reported that relatively lower ISC value at higher cognitive brain areas could be inferred for individual variability. This study proposed the hierarchical clustering analysis method to discover the formation of sub-groups which showed positive correlation within the sub-group members but negative or non-correlation between the sub-groups among subjects. We found that the existence of sub-groups among whole subjects rather than non-correlation at frontal cortex. The synchronized brain activity could be found at frontal cortex within each sub-group.

5472	Computer 35	Multi-site reliability of Default Mode Network and Graph Theoretical Measures in Resting State fMRI
		Sumra Bari[1], Pratik Kashyap[1], Kausar Abbas[1], Brenna C. McDonald[2], and Thomas M. Talavage[1]
		[1]Electrical and Computer Engineering, Purdue University, West Lafayette, IN, United States, [2]Departments of Radiology and Imaging Sciences, Neurology, and Psychiatry, Indiana University School of Medicine, indianapolis, IN, United States
		This study investigated the multi-site reliability of resting state fMRI (rs-fMRI) using Default Mode Network (DMN) connectivity and graph theory measures like mean shortest path distance, clustering coefficient, modularity, transitivity and global mean strength. Test-retest and between-site reliability for all metrics were calculated by variance component analysis using restricted maximum likelihood (REML) estimates. Test-retest reliability was found to be poor to fair and between-site reliability was consistently poor for all metrics.

5473	Computer 36	Accurate modelling of temporal correlations in rapidly sampled fMRI time series using “FAST”.
		Nadège Corbin[1], Nick Todd[2], Karl J Friston[1], and Martina F Callaghan[1]
		[1]Functional Imaging Laboratory (FIL) & Wellcome Center for Human Neuroimaging, UCL Institute of Neurology, London, United Kingdom, [2]Department of Radiology, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA, United States
		Accurate estimation of the temporal correlations that exist in fMRI time-series is essential in order to avoid a high false positive rate. A common approach is to pre-whiten data using an AR(1)+white noise model. However, this approach proves insufficient for repetition times (TR) <1.5s. An alternative is to expand the set of covariance components included in the model (of serial correlations), as in the “FAST” option implemented by SPM12. Here, we show that this model can be used to accurately pre-whiten rapidly sampled data, and identify an upper bound on the parameterisation (i.e., number of covariance components) that precludes numerical overflow with ill-conditioned matrices. Such a model is important given the increasing use of rapid imaging techniques, such as multiband imaging. Using this technique, 18 components provided robust results with TR times ranging from 0.35s to 2.8s.

5474	Computer 37	A support vector machine-based method to identify non-neuropsychiatric systemic lupus erythematosus with Regional Homogeneity
		Xiangliang Tan[1], Zhuqing Long[2], Yingjie Mei[3], Wenjun Qiao[1], Kai Han[4], and Yikai Xu[1]
		[1]Medical Imaging Center, Nanfang Hospital, Southern Medical University, Guangzhou, China, [2]Medical apparatus and equipment deployment, Nanfang Hospital, Southern Medical University, Guangzhou, China, [3]Philips Healthcare, Guangzhou, China, [4]Department of Dermatology, Nanfang Hospital, Southern Medical University, Guangzhou, China

		Previous studies found that changes in brain function happened in default mode network beforeNeuropsychiatric involvement (NPSLE) development by using resting-state functional magnetic resonance imaging (rs-fMRI), highlighting the need for early evaluation and intervention in SLE patients. In this study, we proposed a valid Support Vector Machine (SVM) -based method to identify non-NPSLE using regional homogeneity (ReHo). The results demonstrate that ReHo parameter is an effective classification feature for the SVM-based method to identify SLE patients from healthy subjects.

5475	Computer 38	Temporal autocorrelation bias still exists in fMRI results
		Wiktor Olszowy[1], John Aston[2], Catarina Rua[1], and Guy Williams[1]
		[1]Department of Clinical Neurosciences, University of Cambridge, Wolfson Brain Imaging Centre, Cambridge, United Kingdom, [2]Department of Pure Mathematics and Mathematical Statistics, University of Cambridge, Statistical Laboratory, Cambridge, United Kingdom
		Given the recent trend towards validating the neuroimaging methods, we compared the most popular fMRI analysis softwares: AFNI, FSL and SPM, with regard to autocorrelation modelling. We used both resting-state and task-based fMRI data, for which we assumed different experimental designs. For FSL and SPM we observed a strong relationship that the lower the assumed experimental design frequency, the more likely it was to observe significant activation. It indicates that pre-whitening in FSL and SPM does not remove a substantial part of the temporal autocorrelation in the noise. Our study points to superior autocorrelation modelling in AFNI.

5476	Computer 39	Complex-valued analysis of high-resolution SSFP-fMRI increases reliability in detecting active voxels
		Vahid Malekian[1], Arash Foroudi Ghasemabadi[1], and Abbas Nasiraei Moghaddam[1,2]
		[1]Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran (Islamic Republic of), [2]School of Cognitive Sciences, Institute for research in fundamental sciences (IPM), Tehran, Iran (Islamic Republic of)
		In this study, we evaluated the reliability of the results of a complex-valued analysis that uses both magnitude and phase data in a SSFP-fMRI technique. From the activation map of complex analysis and the corresponding magnitude one, we selected the common active voxels and calculated the average z-score over all of them. By observing an approximately 9.4% increase of z-score in complex maps compared to magnitude ones, we can conclude that by using both magnitude and phase data we are able to increase the confidence and reliability of detecting active voxels. Therefore, complex analysis method can be promising in evaluating SSFP-fMRI methods.

5477	Computer 40	High Resolution fMRI Data De-noising Technique Using Spatio-Temporal Diffusion Filter

		Vahid Malekian[1] and Abbas Nasiraei Moghaddam[1,2]
		[1]Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran (Islamic Republic of), [2]School of Cognitive Sciences, Institute for research in fundamental sciences (IPM), Tehran, Iran (Islamic Republic of)
		Diffusion-based filtering approaches are widely used in MR image de-noising literature but only a few studies, utilize this technique for fMRI applications. In these studies, 1D & 2D diffusion filters were applied using temporal and spatial information separately. Here, a novel spatio-temporal diffusion filtering method is proposed for high-spatial resolution fMRI data which has sufficient contrast between gray matter and other tissues. The results on the experimental SSFP data shows the ability of the proposed technique in improving functional sensitivity as well as preserving the edges of active regions in high-resolution fMRI techniques.

5478	Computer 41	A novel phase-based technique to reduce physiological noise in resting state fMRI data
		Vahid Malekian[1], Abbas Nasiraei Moghaddam[1,2], Daniel Gomez[3], Jose P. Marques[3], and David G. Norris[3,4]
		[1]Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran (Islamic Republic of), [2]School of Cognitive Sciences, Institute for research in fundamental sciences (IPM), Tehran, Iran (Islamic Republic of), [3]Donders Institute for Brain, Cognition and Behaviour, Centre for Cognitive Neuroimaging, Radboud University Nijmegen, Nijmegen, Netherlands, [4]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Duisburg-Essen, Essen, Germany
		In this study, a novel phase-based technique is proposed to decrease the effects of physiological noise in resting-state fMRI data. Our technique is based on extracting nuisance components from the phase of fMRI data using spatial-ICA and utilize it to clean magnitude data. To evaluate, we performed the proposed method on Multi-Band fMRI data which benefits from higher temporal resolution to encode physiological effects and compare the efficacy of the technique both with magnitude-based and with RETRIOCOR techniques. Our method has marginal higher identifiability index and z-score's mean values compared to magnitude-based and RETROICOR methods.

5479	Computer 42	Fuzzy GLM approaches based on LR and alpha-cut representations for fMRI activity detection
		Alejandro Veloz[1,2], Steren Chabert[1], Alejandro Weinstein[1,3], Hector Allende[2], and Claudio Moraga[4]
		[1]Biomedical Engineering Department, Universidad de Valparaiso, Valparaiso, Chile, [2]Informatics Department, Universidad Técnica Federico Santa María, Valparaiso, Chile, [3]Advanced Center for Electrical and Electronic Engineering, Valparaiso, Chile, [4]TU Dortmund University, Dortmund, Germany

		The General Linear Model (GLM) approach is still the standard paradigm used in routine fMRI analysis. This method is based on a model of the BOLD response which depends on the Hemodynamic Response Function (HRF). The HRF ignores the intrinsic intra- and inter-subject variability, resulting in inaccuracies in the brain activity detection. This work leverages on fuzzy sets theory with the purpose of developing a fuzzy GLM to overcome limitations of current GLM-based approaches. We performed an evaluation on simulated and in vivo fMRI data. We compare our results with aproaches based on dictionary learning and wavelet decomposition.

5480	Computer 43	Smooth global fMRI signals facilitate robust cross-subject classification of naturalistic movie stimuli
		Hendrik Mandelkow[1], Jacco de Zwart[1], and Jeff Duyn[1]
		[1]AMRI, LFMI, NINDS, NIH, Bethesda, MD, United States
		The imprecision of anatomical alignment methods commonly limits the spatial resolution and sensitivity of conventional fMRI analysis based on statistical parametric mapping. Recently proposed machine-learning methods aim to circumvent the cross-subject (XS) alignment problem by computing a linear projection of the fMRI signal from each subject's anatomical space to a common albeit abstract "functional" space [1][2]. The success of these "hyperalignment" methods is often attributed to a spatially and functionally specific (linear) correspondence between the fMRI signal in different subjects under similar stimulation conditions. Cross-subject PCA of averaged fMRI data from repeated movie-viewing experiments reveals smooth globally distributed fMRI signal components that facilitate robust cross-subject classification by Linear Discriminant Analysis (LDA). Such global cortical network activity may contribute to the success of fMRI hyperalignment strategies.

5481	Computer 44	Can Sensitivity and Specificity Be Gained Simultaneously in Neuroimaging?
		Gang Chen[1], Yaqiong Xiao[2], Paul A Taylor[3], Fengji Geng[2], Tracy Riggins[2], Elizabeth Redcay[2], and Robert W Cox[3]
		[1]SSCC/DIRP/NIMH, National Institutes of Health, Bethesda, MD, United States, [2]University of Maryland, College Park, MD, United States, [3]National Institutes of Health, Bethesda, MD, United States
		Whole brain analysis currently faces two challenges: the increasing demand of correction for multiplicity and the usual tug of war between specificity and sensitivity. In addition, sensitivity suffers substantially because of stringent correction, while specificity is not directly considered when forming clusters. Specificity can be largely guaranteed through ROI-based analysis if ROIs can be *a priori* defined. Furthermore, sharing information across ROIs through an integrated model can improve model efficiency and detection power. We offer an alternative or complementary approach to the conventional methods in resolving the dilemma of multiple comparisons and dichotomous decisions. Lastly, through the approach, we promote totality and transparency in results reporting, and avoid the hard thresholding of a p-value funnel.

5482	Computer 45	Frequency Characteristics of Blind-Deconvolved Resting-State Networks using Empirical Mode Decomposition
		Dietmar Cordes[1,2], Muhammad Kaleem[3], Xiaowei Zhuang[1], Karthik Sreenivasan[1], Zhengshi Yang[1], Tim Curran[2], and Virendra Mishra[1]
		[1]Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States, [2]University of Colorado, Boulder, CO, United States, [3]University of Management & Technology, Lahore, Pakistan
		Energy-period relationships and frequency content of Intrinsic Mode Functions (IMFs) were studied in deconvolved fMRI data using a blind deconvolution method. Results are shown for multiband MB8 resting-state data collected with a TR of 0.765s for a group of 22 healthy subjects. Findings of the present study suggest that high-frequency content in the major primary resting-state networks (such as the Default Mode Network, Visual Network, Auditory Network, or Fronto-Parietal network) is rather limited and not supported to be of any significance for high frequencies larger than 0.21 Hz, whether in BOLD data or blind-deconvolved data.

5483	Computer 46	PCA Based Noise Reduction of Delay Maps Obtained from Human Connectome Project Resting State fMRI Data
		Serdar Aslan[1] and Blaise Frederick[2]
		[1]Harvard Medical School - Mclean Imaging Center, Boston, MA, United States, [2]Harvard Medical School - Mclean Imaging Center, BOSTON, MA, United States
		Previous work from our group has presented compelling evidence that systemic low frequency oscillations (sLFOs), the major constituent of low frequency global systemic noise overlying resting state functional networks, propagate dynamically throughout the brain with cerebral blood circulation. More specifically, it has been demonstrated that sLFOs travel with the bulk cerebral blood flow with voxel-specific arrival time delays, and their spatiotemporal pattern changes in a way that tracks cerebral blood flow dynamics. We are interested in using the Human Connectome Project (HCP) dataset to determine normative blood flow delays throughout the brain. Time delay maps were obtained by the Regressor Interpolation at Progressive Time Delays (RIPTiDe) method , which was applied to 487 subjects of the HCP 500 subjects release data. While the procedure generates extremely clean mean delay maps, the individual delay maps are quite noisy. Because the circulation delays should in general be slowly varying in space, PCA noise reduction is a natural choice to preserve the spatial structure of the delay maps while removing random noise points.

5484	Computer 47	Multivariate Pattern Analysis of fMRI Data using Deep Neural Network
		Yi-Cheng Wang[1], Jia-Ren Chang[2], Chia-Lin Chen[1], Ching-Ju Yang[3], Wei-Chi Li[3], Jen-Chuen Hsieh[3,4], Li-Fen Chen[3,4,5], and Yong-Sheng Chen[2]

		[1]Institute of Biomedical Engineering, National Chiao Tung University, Hsinchu city, Taiwan, [2]Department of Computer Science, National Chiao Tung University, Hsinchu city, Taiwan, [3]Institute of Brain Science, National Yang-Ming University, Taipei city, Taiwan, [4]Integrated Brain Research Unit, Department of Medical Research, Taipei Veterans General Hospital, Taipei city, Taiwan, [5]Institute of Biomedical Informatics, National Yang-Ming University, Taipei city, Taiwan
		This paper presents a novel MVPA method based on deep neural networks, which can identify a group of voxels with their pattern of activity capable of differentiating experimental conditions. Through the forward inference procedure, the proposed deep neural network can also be applied to distinguish brain imaging data of different experimental conditions. Our experimental results suggest that deep neural networks are of great potential as an MVPA tool for functional brain mapping.

5485	Computer 48	Serotonergic Excitability and Functional Connectivity in Acute, Chronic, and Withdrawal Phases of Antidepressant Treatment
		Horea-Ioan Ioanas[1], Bechara John Saab[2], and Markus Rudin[1]
		[1]Institute for Biomedical Engineering, ETH and University of Zurich, Zürich, Switzerland, [2]Preclinical Laboratory for Translational Research into A ective Disorders, DPPP, Psychiatric Hospital, University of Zurich, Zürich, Switzerland
		The serotonergic system is characterized by high centrality and is implicated in affective disorders and their treatment. During longitudinal antidepressant (fluoxetine) administration in mice, we optogenetically stimulate the ascending serotonergic system, and infer brain activity via fMRI. We resolve serotonergic excitability and functional connectivity at 5 time points and show that a network representation is needed to adequately model the data. For acute and chronic sessions we document significantly increased serotonergic excitability, and distinctly multivariate effects on serotonergic transmission. Finally, we find a full brain function recovery to baseline after fluoxetine withdrawal.

Electronic Poster

Techniques for Myelin & Microstructure Imaging

Exhibition Hall	Thursday 13:15 - 15:15

5486	Computer 49	On the sensitivity of T1 mapping methods to myelin
		Damien Nguyen[1,2], Tobias Kober[3,4,5], and Oliver Bieri[1,2]

		[1]Radiological Physics, University Hospital Basel, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland, [3]Advanced Clinical Imaging Technology (HC CMEA SUI DI BM PI), Siemens Healthineers, Lausanne, Switzerland, [4]Department of Radiology, University Hospital (CHUV), Lausanne, Switzerland, [5]LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland
		For homogeneous and isotropic probes, different MR relaxometry methods are expected to yield consistent results. For tissues, however, wide-spread T_1 and T_2 relaxation times are reported in the literature. Especially in the brain, we hypothesize that the microstructure, e.g. the presence of myelin, affects the apparent observed T_1, as assessed by different imaging sequences. As a result, apparent differences in T_1 might reflect valuable information on the underlying tissue microstructure, such as myelination.

5487	Computer 50	Comparison of Inhomogeneous Magnetization Transfer (ihMT) and Myelin Water Fraction (MWF) In-Vivo at 3T
		Irene Vavasour[1,2], Anastasia Smolina[2,3], Erin MacMillan[2,4,5], Guillaume Gilbert[4], Michelle Lam[2,6], Piotr Kozlowski[1,2,6,7], Carl Michal[6], Alan Manning[6], Cornelia Laule[1,6,8,9], and Alex MacKay[1,2,6]
		[1]Radiology, University of British Columbia, Vancouver, BC, Canada, [2]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada, [3]Physics and Astronomy, McMaster University, Hamilton, ON, Canada, [4]MR Clinical Science, Philips Healthcare Canada, Markam, ON, Canada, [5]ImageTech Lab, Simon Fraser University, Burnaby, BC, Canada, [6]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [7]4International Collaboration on Repair Discoveries (ICORD), Vancouver, BC, Canada, [8]Pathology & Laboratory Medicine, University of British Columbia, Vancouver, BC, Canada, [9]International Collaboration on Repair Discoveries, University of British Columbia, Vancouver, BC, Canada
		Inhomogeneous Magnetization Transfer (ihMT) shows promise as a myelin-specific MRI technique. Recent publications demonstrate that ihMT contrast is generated by long-lived dipolar couplings between protons on lipid molecules. We tested ihMT's myelin specificity by comparing it to a more validated myelin measure, myelin water fraction (MWF), in 10 healthy volunteers. The ihMT ratio (ihMTR) correlated with MWF in white matter but MWF had a larger dynamic range. When MWF was zero, ihMTR was non-zero, supporting that ihMTR arises from all lipid molecules, not just those in myelin. ihMTR and MWF measure different, and complementary, aspects of tissue structure.

5488	Computer 51	Acceleration strategies for whole brain quantitative Magnetization Transfer Imaging
		Marco Battiston[1], Francesco Grussu[1,2], Torben Schneider[3], Ferran Prados[1,4], Sebastien Ourselin[4], Claudia Angela Wheeler-Kingshott[1,5,6], and Rebecca Sara Samson[1]

		[1]Queen Square MS Centre, UCL Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [2]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom, [3]Philips UK, Surrey, United Kingdom, [4]Translational Imaging Group, Centre for Medical Image Computing (CMIC), Department of Medical Physics and Bioengineering, University College London, London, United Kingdom, [5]Department of Brain and Behavioural Sciences, University of Pavia, Pavia, Italy, [6]Brain MRI 3T Research Centre, C. Mondino National Neurological Institute, Pavia, Italy
		Methods for quantitative measurement of myelin are of great interest for understanding brain tissue microstructure, and have potentially important implications in clinical settings for improved diagnosis and prognosis in demyelinating diseases. Quantitative Magnetization Transfer (qMT) has been proposed as a sensitive MRI technique for myelin mapping in the central nervous system. However, after an initial wave of interest, it has never found a successful translation into a clinical scenario, mostly due to its prohibitive scan time. Here we investigate solutions to promote the development of fast qMT protocols including simultaneous multi-slice EPI, and provide preliminary results in vivo.

5489	Computer 52	Accurate measurement of susceptibility and orientation using non-linear signal phase evolution; validation in a phantom experiment
		Elena Kleban[1], Richard Bowtell[1], Penny Gowland[1], and Molly Bright[1,2]
		[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]Division of Clinical Neuroscience, School of Medicine, University of Nottingham, Nottingham, United Kingdom
		We validate the use of non-linear signal phase evolution to estimate the susceptibility and orientation of sub-voxel structures. Capillary tubes filled with ferritin solutions of varying susceptibility were positioned in a water phantom. Multi-echo gradient-echo scans (100 echoes, echo-spacing=0.6ms) were acquired for multiple orientations of the capillaries with respect to the magnetic field. Fitting a 2-compartment model to the complex signal, processed using frequency difference mapping (FDM), resulted in susceptibility and signal fraction estimates in good agreement with theoretical predictions. Non-linear phase evolution, processed using FDM, may provide new insight into microvascular structure and physiology.

5490	Computer 53	7T GRE-MRI frequency shifts obtained from signal compartments can differentiate normal from dysplastic tissue in focal epilepsy
		Kiran Thapaliya[1], Markus Barth[1], Steffen Bollmann[1], David Reutens[1], and Viktor Vegh[1]
		[1]Center for Advance Imaging, University of Queensland, Brisbane, Australia

		Quantitative assessment of water fraction, relaxation time, and frequency shift using a multi-compartment model can be useful in understanding diseases and disorders affecting the human brain. We aimed to explore tissue microstructure information contained in voxel signals by analysing voxel compartment water fraction, $$$T_2^*$$$ and frequency shift derived from 7T multi-echo gradient recalled echo MRI data. We recruited four patients with focal cortical dysplasia and compartmentalised normal and dysplastic cortical regions. Parameterisation of tissue characteristics in focal cortical dysplasia can potentially delineate cortical areas which have undergone microstructural changes. This provides a promising framework for studying neurodegenerative processes.

5491	Computer 54	Myelin water fraction across the corpus callosum using multi-echo gradient echo at 7T - influence of model settings and flip angle
		Kiran Thapaliya[1], Viktor Vegh[1], Steffen Bollmann[1], and Markus Barth[1]
		[1]Center for Advance Imaging, The University of Queensland, Brisbane, Australia
		Proper quantitative assessment of myelin water fraction (MWF) using a multi-compartment model can be useful in improving our understanding of white matter diseases, however, MWF model estimates have been shown to be affected by model settings and also by T1 values of the myelin compartment. In this study, we investigated three common models using different number of parameters to assess MWF across the corpus callosum and the influence of acquisition flip angle at 7T.

5492	Computer 55	A procedure to scale myelin water fraction to myelin volume fraction for g-ratio mapping
		Woojin Jung[1], Hyeong-Geol Shin[1], Jingu Lee[1], Sooyeon Ji[1], Doohee Lee[1], Yoonho Nam[2], and Jongho Lee[1]
		[1]Department of Electrical and Computer Engineering, Seoul National University, Seoul, Republic of Korea, [2]Department of Radiology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea
		In this study, we propose a new scaling approach that translates myelin water fraction into myelin volume fraction using the geometric property of myelin. The method is validated by a histo-imaging dataset. A computer simulation is performed to demonstrate the robustness of the method.

5493	Computer 56	Quantifying magnetic microstructure: Beyond the perturbative regime
		Pippa Storey[1] and Dmitry S. Novikov[1]

		[1]Radiology Department, New York University School of Medicine, New York, NY, United States
		We model the magnetic microstructure of tissue by a colloidal suspension of spherical beads, whose susceptibility differs from that of the surrounding medium. We show that length scale and susceptibility differences of the microstructure can be quantified with good accuracy by imaging the suspension with a multiple gradient echo sequence and fitting the signal as a function of echo time to the results of Monte Carlo simulations. By comparison, the second-order cumulant expansion used in deriving analytic expressions for the signal is a poor approximation at long echo times, even when the dephasing is relatively small over the correlation time.

5494	Computer 57	A Feasibility Study of Quantifying Renal Microvascular Diameter and Density Using Vessel Size Imaging (VSI)
		Chengyan Wang[1,2], Hanjing Kong[2], Fei Gao[3], Li Jiang[4], Jue Zhang[2,3], and Xiaoying Wang[2,5]
		[1]Institute for Medical Imaging Technology, Shanghai Jiao Tong university, Shanghai, China, [2]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [3]College of Engineering, Peking University, Beijing, China, [4]Philips Healthcare, Suzhou, China, [5]Department of Radiology, Peking University First Hospital, Beijing, China
		Information on renal microvascular architecture is still hardly accessible by clinical MRI techniques. This study explores the feasibility of using spin- and gradient-echo (SAGE) based dynamic susceptibility-contrast MRI for the quantification of renal microvascular diameter/density. Microvascular diameter (VSI) map, Q map and vessel density (D) map were calculated based on the differential dependence of R2/R2* relaxation rates on the capillary-sized vascular structures, which may provide a potentially important MR biomarker for the detection and staging of renal cell carcinoma

5495	Computer 58	The role of ferritin and myelin in orientation dependent R2* measured from susceptibility-weighted MR signal in white matter
		Daniel Kor[1,2], Jonathan Doucette[1,3], Tianyou Xu[4], and Alexander Rauscher[1,3,5]
		[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada, [2]Engineering Physics, University of British Columbia, Vancouver, BC, Canada, [3]Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [4]Oxford Centre for Functional MRI of the Brain, University of Oxford, Headington, Oxford, United Kingdom, [5]Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada

		The R_2^* relaxation in brain's white matter(WM) exhibits a dependency on WM fibre orientation relative to the external magnetic field, B_0. Here, we introduce a computational model based on first principles derived from magnetic field inhomogeneities generated by ferritin and myelin. We investigate their effects on the multi gradient-echo signal by fitting simulated R_2^*, over angles 0–90°, to experimental R_2^* (R^2=0.94). By comparing different myelin concentrations, we present how ferritin is required to complement myelin in describing the orientation dependency in R_2^*. Additionally, we propose a model for mapping R_2^* as a function of fibre orientation, myelin and iron concentration.

5496	Computer 59	Dipolar relaxation time (T1D) mapping to assess myelin in vivo
		Victor N. D. Carvalho[1,2], Olivier M. Girard[1], Valentin H. Prevost[1], Samira Mchinda[1], Gopal Varma[3], David C. Alsop[3], Pierre Thureau[2], and Guillaume Duhamel[1]
		[1]Aix Marseille Univ, CNRS, CRMBM UMR 7339, Marseille, France, [2]Aix Marseille Univ, CNRS, ICR UMR 7273, Marseille, France, [3]Department of Radiology, Division of MR Research, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States
		The dipolar relaxation time (T_{1D}) is related to motion restricted molecules and could be used to assess myelin molecular dynamics associated with physiopathology processes. T_{1D} was measured with the inhomogeneous magnetization transfer (ihMT). T_{1D} maps were obtained from *in-vivo* mouse brain and from *ex-vivo* rat spinal cord at different temperatures. T_{1D} was approximately 5ms in brain and 1.8ms in muscle. T_{1D} in spinal cord was doubled from 26°C to 37°C, reflecting changes in molecular dynamics caused by the temperature rise. Measuring T_{1D} *in-vivo* could give information about the myelin membrane structure altered in neurological disorders.

5497	Computer 60	Immunohistochemical validation of myelin water fraction obtained with FAST-T2 at 3 Tesla
		Thanh D Nguyen[1], Mayyan Mubarak[2], Somiah Dahlawi[2], Kelly M Gillen[1], David Pitt[2], and Yi Wang[1]
		[1]Weill Cornell Medical College, New York, NY, United States, [2]Yale University, New Haven, CT, United States
		The purpose of this study was to validate MWF measurements obtained by FAST-T2 at 3T by myelin basic protein (MBP) staining in a postmortem brain. Excellent correlation (R=0.98) was found between MWF and MBP relative optical density measurements.

5498	Computer 61	The Effect of Range of Echo Time on Gradient Echo Based Myelin Water Fraction Mapping
		Hongpyo Lee[1], Yoonho Nam[2], and Dong-Hyun Kim[1]

		[1]Yonsei University, Seoul, Republic of Korea, [2]Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea
		Recently, myelin water fraction has been investigated using mGRE data. The purpose of this study is to investigate effects of the range of TE in GRE based MWF using different three fitting models. The results of simulation and in-vivo data suggest that complex model can be helpful to overcome bias due to susceptibility anisotropy compared to magnitude based models.

5499	Computer 62	In vivo high-field myelin water imaging: Investigating the T2 distribution at 7T
		Vanessa Wiggermann[1,2,3], Alex L MacKay[1,2,4], Gunther Helms[5,6], and Alexander Rauscher[1,2,3,7]
		[1]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [2]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada, [3]Pediatrics, University of British Columbia, Vancouver, BC, Canada, [4]Radiology, University of British Columbia, Vancouver, BC, Canada, [5]Swedish National 7T MRI Facility, Lund University, Lund, Sweden, [6]Medical Radiation Physics, Lund University, Lund, Sweden, [7]BC Children's Research Centre, University of British Columbia, Vancouver, BC, Canada
		With the increased frequency of human 7T scanners, there is also a drive towards the implementation advanced MR sequences, such a myelin water imaging, at high fields. Here, we demonstrate the feasibility of translating 3T myelin acquisitions scheme, GRASE, to 7T. We studied the distribution of T_2 values at 7T and determined that myelin water has a T_2<25ms. We obtained excellent agreement for myelin water fraction values in the corpus callosum between 3T and 7T.

5500	Computer 63	robust principle component analysis (rPCA) in multi-echo gradient-echo imaging: application in visualizing myelin-related signal without exponential modeling.
		Jaewook Shin[1], Hongpyo Lee[1], and Dong-Hyun Kim[1]
		[1]Electrical and Electronic engineering, Yonsei University, Seoul, Republic of Korea
		In white matter, it is possible to describe multi-echo gradient-echo (mGRE) signal as the summation of multiple exponential decays. However, fitting to this model is sensitive to the error in the raw mGRE signal. In this study, mGRE signal is decomposed to a low rank plus sparsity component using robust principle component analysis (rPCA). Through this, myelin-related signal was extracted without performing exponential modeling. The sparse signal showed myelin-like contrast similar to other mGRE based myelin water imaging.

5501	Computer 64	Varying diffusion effects in susceptibility-based myelin water imaging produce characteristic signal decay curves
		Felix T Kurz[1], Lukas R Buschle[2], Martin Bendszus[1], Christian H Ziener[2], and Johann ME Jende[1]
		[1]Heidelberg University Hospital, Heidelberg, Germany, [2]German Cancer Research Center, Heidelberg, Germany
		The biophysical origins of MR signal formation in uniform media such as an axon with its multilayered myelin envelope may produce signal characteristics that can be used to determine status and/or outcome of demyelinating disease. We extend a recently proposed model of neuronal magnetic susceptibility by including the whole dynamic range of diffusion effects to study gradient-echo MR signal decay. Our results may be used to adjust or control simulation studies on neuronal MR signal decay.

5502	Computer 65	3D Steady-State Inhomogeneous Magnetization Transfer (ihMT) Gradient Echo Sequence for Spinal Cord Imaging at 3T
		Ece Ercan[1], Marco C. Pinho[1,2], Gopal Varma[3], Ivan E. Dimitrov[2,4], Xinzeng Wang[1], Ananth J. Madhuranthakam[1,2], Robert E. Lenkinski[1,2], and Elena Vinogradov[1,2]
		[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [3]Radiology, Division of MR Research, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States, [4]Philips Healthcare, Gainesville, FL, United States
		Inhomogeneous magnetization transfer (ihMT) is an enhanced magnetization transfer method, which is sensitive to dipolar couplings in white matter. Current spinal cord applications of ihMT use long saturation followed by single-slice acquisitions. As an alternative to this implementation, in our study we implemented and optimized a pulsed ihMT-prepared 3D gradient echo sequence for a larger coverage of spinal cord. The *in vivo* ihMT results from cervical spinal cord demonstrate potential for future applications of the ihMT in the spinal cord.

5503	Computer 66	3D inhomogeneous magnetization transfer and rapid gradient echo (ihMTRAGE) imaging
		Gopal Varma[1], Olivier M Girard[2], Samira Mchinda[2], Arnaud Guidon[3], Dan W Rettmann[4], Victor Carvalho[2], Valentin H Prevost[2], Pauline W Worters[5], Marc R Lebel[6], Guillaume Duhamel[2], and David C Alsop[1]
		[1]Division of MR Research, Radiology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States, [2]CNRS, CRMBM, UMR 7339, Aix Marseille Universite, Marseille, France, [3]GE Healthcare, Boston, MA, United States, [4]GE Healthcare, Rochester, MN, United States, [5]GE Healthcare, Menlo Park, CA, United States, [6]GE Healthcare, Calgary, AB, Canada

		The inhomogeneous magnetization transfer (ihMT) technique provides a myelin-sensitive signal and has been applied for 3D acquisition in the steady-state. Sequences applied in a segmented fashion, following some magnetization preparation, provide an advantage of allowing insertion of additional modules, e.g. motion correction. An ihMT acquisition in the style of the magnetization-prepared rapid gradient-echo sequence was designed based on considerations of safety, hardware and optimizing the ihMT signal. Whole brain 3D ihMT data with 2.4mm isotropic resolution was achieved in 6-7mins. IhMT ratios between 15-20% were measured in white matter areas, and were not significantly modified by inclusion of a prospective motion correction module.

5504	Computer 67	The developmental dependence of the contrast between white and grey matter in spinal cord: the effect of non-aqueous species content
		Uzi Eliav[1], Peter J. Basser[2], Efrat Sasson[1], and Gil Navon[1]
		[1]School of Chemistry, Tel Aviv University, Tel Aviv, Israel, [2]SQITS/NICHD, NIH, Bethesda, MD, United States
		Recently an imaging pulse sequence based on selective saturation of the water that drives magnetization transfer from the non-aqueous semi-solid part of the tissues was introduced. This technique allows the estimation of the fraction of the protons in the non-aqueous species. It separates the exchange processes from T1 in a simple way. In the current study, using this technique, we demonstrate changes with age of the non-aqueous species content in porcine spinal cord.

5505	Computer 68	Quantifying the Myelin and Iron Contents of the Brain in vivo using a Linear Model of Relaxation
		Riccardo Metere[1] and Harald E. Möller[1]
		[1]NMR Unit, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
		Quantitative MRI maps are believed to strongly correlate with myelin and iron contents. Recently, a linear model combining prior information from non-MRI techniques was proposed for quantifying myelin and iron based on relaxometry (R_1 and R_2^*) in post-mortem human brain samples. Here, we propose an adaptation of the linear relaxation model that is capable of predicting (with some limitations) the myelin and iron contents of the brain under in vivo conditions. It uses prior knowledge from the literature to calibrate the linear coefficients and was validated in a cohort of 10 subjects.

5506	Computer 69	Investigation of tumor bed effect of radiotherapy using vessel size imaging in animal prostate cancer
		Yu-Chun Lin[1,2], Fang-Hsin Chen[2], Gigin Lin[1], YI-Ping Lin[3], Ho-Kai Wang[1], Jiunjie Wang[2], and Chun-Chieh Wang[3]

		[1]Dept. Medical Imaging and Intervention, Chang Gung Memorial Hospital, Linkou, Taiwan, [2]Dept. Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan, [3]Dept. Radiation Oncology, Chang Gung Memorial Hospital, Linkou, Taiwan
		MR-derived estimates of vessel size and vascular density were used to investigate the microvasculature change of tumor following preirradiation on tumor bed. The hypoxic area exhibited higher vessel size and reduced microvascular density compared with those in normoxic area. The alterations of the derived estimates were more pronounced in hypoxic regions. Significantly positive correlations were found between MRI and histology measurements. The vessel size imaging technique may be used as an imaging biomarker to characterize the tumor bed effect that occurs in recurrent tumor after radiotherapy.

5507	Computer 70	Imaging white matter damage after traumatic brain injury: a high-field multimodal approach in a rat model
		Maria Yanez Lopez[1], Nicoleta Baxan[2], Cornelius Donat[1], Marc Goldfinger[1], Peter Hellyer[3], Mazdak Ghajari[4], Steve Gentleman[1], Magdalena Sastre[1], and David Sharp[1]
		[1]Department of Medicine, Imperial College London, London, United Kingdom, [2]Biological Imaging Centre, Imperial College London, London, United Kingdom, [3]Department of Bioengineering, Imperial College London, London, United Kingdom, [4]Dyson School of Design Engineering, Imperial College London, London, United Kingdom
		The aim of this work was to study white matter microstructural and molecular changes in a rat model of TBI using CEST and multi-shell diffusion NODDI techniques. Our results suggest that the FA decrease after injury is mainly caused by an increase in fiber dispersion in the white matter, as seen with OD NODDI. MT decrease in the CC suggests an insult to the lipids in the myelin sheath and the NOE signal displays contributions from haemorrhage in the injury time point. Histology work will allow for a more accurate interpretation of the imaging results.

5508	Computer 71	Evaluating the use of Oxygen-Enhanced MRI with ICA to assess the tumour oxygenation status in murine tumour models
		Firas Moosvi[1], Jennifer H.E. Baker[2], Andrew Yung[3], Piotr Kozlowski[3], Andrew I. Minchinton[2], and Stefan Reinsberg[1]
		[1]Physics & Astronomy, University of British Columbia, Vancouver, BC, Canada, [2]Department of Integrative Oncology, BC Cancer Research Centre, Vancouver, BC, Canada, [3]UBC 7T MRI Research Centre, University of British Columbia, Vancouver, BC, Canada
		Want to assess the oxygenation status of tumours using non-invasive, contrast-agent free MRI? In this work we explore how OE-MRI can be used to extract and amplify signal from oxygen gas challenges in mouse tumours. With only dynamic T1-weighted images we can create rich oxygenation status maps that show high correlation with pimonidazole staining.

5509	Computer 72	Quantifying the Effect of Lipids' Composition on Water Proton Relaxation Oshrat Shtangel[1] and Aviv Mezer[1] *[1]Edmond and Lily Safra Center for Brain Sciences, The Hebrew University,Edmond J. Safra Campus at Givat Ram, Jerusalem, Israel* It's a major challenge to localize and quantify molecular content in the human brain for *in-vivo* MRI clinical use. Here, we formulated liposomes to model the environment of abundant lipids in the brain. To investigate the influence of those lipids on relaxation we estimated multiple quantitative MRI (qMRI) parameters. Moreover, we assess the relationship between the lipids' qMRI parameters and the water fraction (WF). Our findings show that joining multiple qMRI parameters with the WF introduces a novel possibility to separate between different lipids' mixtures. Extending this approach can potentially be used to identify molecular signatures of human tissue *in-vivo*.

Electronic Poster

Perfusion & Permeability

Exhibition Hall	Thursday 13:15 - 14:15

5510	Computer 73	Self-referenced DCE-MRI: reference region modelling without a reference tissue Zaki Ahmed[1] and Ives R. Levesque[1,2] *[1]Medical Physics Unit, McGill University, Montreal, QC, Canada, [2]Research Institute of the McGill University Health Centre, Montreal, QC, Canada* Analysis of dynamic contrast enhanced (DCE) MRI using the reference region model (RRM) requires manual identification of a reference tissue, which is typically chosen as muscle external to the tissue of interest. The current work proposes an automated technique, named the self-reference approach, for finding a suitable reference-region curve from within the tissue of interest. This approach was evaluated on in-vivo data from glioblastoma and sarcoma patients, and was found to be equally as effective as manual identification of the reference tissue in most cases, and in some cases provides substantially improved fits.

5511	Computer 74	A reference region version of the two-compartment exchange model for DCE-MRI Zaki Ahmed[1] and Ives R. Levesque[1,2]

		[1]*Medical Physics Unit, McGill University, Montreal, QC, Canada,* [2]*Research Institute of the McGill University Health Centre, Montreal, QC, Canada*
		This work proposes a version of the two-compartment exchange model (2CXM) for dynamic contrast enhanced MRI that does not require an arterial input function (AIF). Instead, the proposed model uses the tracer-concentration from a reference region, with the assumption that the AIF is shared between the reference region and tissue of interest. The proposed model was evaluated in simulation and in-vivo where it had comparable performance to the conventional 2CXM with temporal sampling faster than 10 s. With slower temporal sampling, the reference region version had better accuracy and precision than the conventional 2CXM.

5512	Computer 75	Support Vector Machine based Differentiation between Vasogenic Edema and Non-enhancing Tumor in High-Grade Glioma Patients using Pre and Post Surgery MRI Images
		Anirban Sengupta[1], Anup Singh[1], Sumeet Agarwal[2], Pradeep Kumar Gupta[3], and Rakesh Kumar Gupta[3]
		[1]*Centre for Biomedical Engineering, IIT Delhi, New Delhi, India,* [2]*Electrical Engineering, IIT Delhi, New Delhi, India,* [3]*Radiology, Fortis Memorial Research Institute, New Delhi, India*
		Differentiation of non-enhancing tumor from surrounding vasogenic edema is critical for planning tumor surgery as well as radiation therapy. Most studies suggested that histology results should be taken as ground truth instead of radiologist's decision for validating results. This study is an attempt to differentiate vasogenic-edema from non-enhancing tumor based upon pre and post-surgery MRI images using a SVM classifier. DCE-MRI obtained perfusion parameters were used for classification. A misclassification error of 2.4 % was obtained for differentiating between non-enhancing tumor and edema using a SVM classifier followed by smoothing in post-processing step.

5513	Computer 76	Effect of B1 Inhomogeneity propagated error of DCE MRI Data on Tumor Grading of Gliomas at 3T
		Anirban Sengupta[1], Anup Singh[1], Rakesh Kumar Gupta[2], and Pradeep Kumar Gupta[2]
		[1]*Centre for Biomedical Engineering, IIT Delhi, New Delhi, India,* [2]*Radiology, Fortis Memorial Research Institute, New Delhi, India*
		DCE-MRI data is generally acquired using spoiled gradient Recalled(SPGR) echo sequence which is highly sensitive to B1 inhomogeneity. The error introduced due to B1 inhomogeneity effect on SPGR sequence is propagated to various perfusion parameters calculated in DCE-MRI. These parameters are used in various clinical analysis such as grading of tumor patients. This study had evaluated the change in perfusion parameters due to B1 inhomogeneity on 35 patients. Further simulations were done to evaluate its clinical significance. This study concluded that the change in perfusion parameters because of B1 inhomogeneity can change grading of glioma patients.

5514	Computer 77	Application of spin and gradient-echo (SAGE) sequence for renal perfusion imaging
		Chengyan Wang[1,2], Hanjing Kong[2], Fei Gao[3], Li Jiang[4], Jue Zhang[2,3], and Xiaoying Wang[2,5]
		[1]Institute for Medical Imaging Technology, Shanghai Jiao Tong university, Shanghai, China, [2]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [3]College of Engineering, Peking University, Beijing, China, [4]Philips Healthcare, Suzhou, China, [5]Department of Radiology, Peking University First Hospital, Beijing, China
		Quantification of absolute R2/R2* instead of the relative signal changes provides T1-independent perfusion imaging, which is beneficial for renal blood volume (RBV) estimations. This study applied the multiple spin- and gradient-echo (SAGE) sequence for renal perfusion imaging in ischemic acute kidney injury (AKI) animals. The results show that Both RBV and Tmax were significantly attenuated during the acute phase of AKI. R2/R2*-derived RBVs were significantly lower in the AKI kidney than that in the healthy contralateral kidney. Both R2-based and R2*-based perfusion imaging can be used to detect renal injury in AKI animals.

5515	Computer 78	Slice-Accelerated Gradient-Echo Echo-Planar Imaging: Feasibility and Utility of Isotropic Perfusion Imaging
		Yasuaki Tsurushima[1], Ryuji Nojiri[1], Takahiro Mihara[1], Keiichi Ishigame[1], Tomohiro Takamura[2], and Masaaki Hori[2]
		[1]Radiology, Tokyo Medical Clinic, Tokyo, Japan, [2]Radiology, Juntendo University School of Medicine, Tokyo, Japan
		The purpose of this study was to investigate the feasibility and utility of isotropic perfusion maps obtained using multi-band (MB) single-shot echo-planar imaging (EPI) technique. We evaluated the quantitative equivalence between MB dynamic susceptibility contrast-enhanced (DSC) magnetic resonance imaging (MRI) and single-band (SB) DSC MRI, as well as the superiority of registration accuracy in isotropic MB-DSC MRI compared with anisotropic SB-DSC MRI. MB-DSC MRI yields isotropic perfusion maps that can improve the registration accuracy and multisection assessment by creating multiplane reconstruction, without deteriorating or altering the quantitative parameters.

5516	Computer 79	Robust SNR determination based on Resampling for Quality Control and Workflow Support in Quantitative DCE perfusion
		Jakob Meineke[1], Karsten Sommer[1], and Jochen Keupp[1]
		[1]Philips Research Europe, Hamburg, Germany

		A Monte-Carlo method is used to compute and predict SNR of image data for quantitative DCE-MRI perfusion measurements. This information can be used for quality assurance and to improve imaging workflow.

5517	Computer 80	Comparison of arterial input functions measured from dynamic contrast enhanced MRI and computed tomography in prostate cancer patients
		Shiyang Wang[1], Zhengfeng Lu[1], Xiaobing Fan[1], Milica Medved[1], Steffen Sammet[1], Xia Jiang[1], Ambereen Yousuf[1], Federico Pineda[1], Aytekin Oto[1], and Gregory Karczmar[1]
		[1]Radiology, University of Chicago, Chicago, IL, United States
		Arterial input functions (AIFs) measured from dynamic contrast enhanced (DCE) MRI following low dose (0.015 mmol/kg) contrast media were compared with AIFs from DCE CT as ‘gold standard’. Twenty prostate cancer patients received CT and MRI scans on the same day. To correct for different temporal resolution and sampling periods, an empirical mathematical model was used to fit the AIFs and calculate numerical AIFs. Convolution was performed to correct for differences in CT and MRI injection times (~1.5s vs. 30s). MRI and CT AIFs were very similar. Therefore, AIFs can be accurately measured by MRI following low dose contrast agent injection.

5518	Computer 81	Spinal Cord Perfusion is Associated with Diffusion in Postoperative Patients with Cervical Spondylotic Myelopathy
		Chunyao Wang[1], Xiao Han[2], Wen Jiang[2], Guangqi Li[1], Jinchao Wang[2], Hua Guo[1], and Huijun Chen[1]
		[1]CBIR，school of medicine, Tsinghua University, Beijing, China, [2]Jishuitan hospital, Beijing, China
		Cervical Spondylotic Myelopathy (CSM) is a progressive central-nervous degenerative disease caused by vertebral volume abnormalities. A certain proportion of postoperative patients suffered the fluctuation of symptoms after spinal canal decompression. Spinal cord blood supply change was reported as one of the crucial pathophysiological process in CSM. MR DTI has been verified as a relative mature technique in assessing neuro-impairment. In this study, we investigate the relationship between spinal cord blood perfusion and microstructure deficit using MR DSC and DTI technique respectively, and find a certain correlation between DSC and DTI metrics.

5519	Computer 82	High SpatiotemporalResolution DCE MRA and Perfusion in a Single 4DAcquisition Exploiting KineticModel Based Signal Priors
		Eun Ji Lim[1], Joon Sik Park[1], Eung Yeop Kim[2], Chul-Ho Sohn[3], and Jaeseok Park[1]

		[1]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Republic of Korea, [2]Department of Radiology, Gacheon University Gil Medical Center, Incheon, Republic of Korea, [3]Department of Radiology, Seoul National University, Seoul, Republic of Korea
		In this work we develop a high spatiotemporal resolution (spatial ~ 1.0 mm3, temporal ~ 1.6 sec) simultaneous DCE MRA and perfusion within a single 4D acquisition exploiting kinetic model based signal priors. It is demonstrated that the proposed, high spatiotemporal resolution DCE MRI, which enables rapid sampling of AIF, depicts microvascular permeability in pathological tissues (e.g., tumor) much more accurately than conventional DCE MRI (temporal resolution: 5.0 sec).

5520	Computer 83	Whole Brain Absolute CBF Measurements Using Ultra-Low GBCA DCE-MRI and Microsphere Model
		Ka-Loh Li[1], Daniel Lewis[1,2], Alan Jackson[1], Sha Zhao[1], and Xiaoping Zhu[1]
		[1]Division of Informatics, Imaging and Data Science, The University of Manchester, Manchester, United Kingdom, [2]Department of Neurosurgery, Salford Royal NHS Foundation Trust, Manchester, United Kingdom
		Previous authors have attempted to utilize the microsphere model and a maximum gradient (MG) based approach to estimate cerebral blood flow from DCE MRI data, which, however, was not widely accepted. This study developed a new methodology based on the microsphere theory and “early time points” method for mapping absolute CBF, using ultra-low contrast agent dose T1W-DCE-MRI. The new method was assessed using both computer simulation and in vivo data analysis in a patient with GBM, demonstrating that the new method performed better than previous approaches, e.g. MG-based methods, while using much lower dose than perfusion methods based on DSC-MRI.

5521	Computer 84	Imaging ocular water inflow in the mouse with deuterium oxide MRI
		Eric R. Muir[1,2], Shengwen Deng[2,3], and Shiliang Huang[2]
		[1]Ophthalmology, University of Texas Health Science Center, San Antonio, TX, United States, [2]Research Imaging Institute, University of Texas Health Science Center, San Antonio, TX, United States, [3]Biomedical Engineering, University of Texas at San Antonio, San Antonio, TX, United States
		Abnormal intraocular fluid flow or clearance is involved with a variety of eye diseases such as diabetic retinopathy, but there is a lack of non-destructive methods to assess the permeability directly of water in the eye. In this study we investigate the feasibility of different MRI sequences for direct imaging of deuterium oxide inflow in the mouse eye. Balanced steady state free precession provided high signal to noise ratio for imaging deuterium oxide in the intraocular fluid, providing dynamic imaging of intraocular water inflow.

5522	Computer 85	Can ve be larger than one? A modification for asymmetric vascular permeability in Toft’s model may reveal glymphatic dysfunction in tumor
		Pei-Lun Yu[1], Ming Cheng[1], Kun-I Chao[1], Cheng-He Li[1], Chi-Shiun Chiang[1], Kung-Chu Ho[2], Yi-Jui Liu[3], Ruey-Hwang Chou[4], and Fu-Nien Wang[1]
		[1]Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan, [2]Nuclear Medicine, Chang Gung Memorial Hospital, Linkou, Taiwan, [3]Department of Automatic Control Engineering, Feng Chia University, Taichung, Taiwan, [4]China Medical University Graduate Institute of Cancer Biology, Taichung, Taiwan
		The v_e is limited between 0 and 1 by definition. However, we observed large v_e when fitted the Toft’s model or its modified version to both Gd-DTPA and D_2O perfusion MRI. In this study, we modified the v_e to P_{as}*v_e to incorporate the asymmetry permeability into model. Therefore, the region with high P_{as}*v_e in D_2O perfusion imaging may be attributed to the blocked pathway of water draining, which could be correlated to glymphatic dysfunction in tumor.

5523	Computer 86	ASL meets Machine Learning: Classification of type-2 diabetes and normoglycemia using ASL-derived cerebral hemodynamic features.
		Maria-Eleni Dounavi[1,2], Christopher Martin[2,3], Dinesh Selvarajah[4], Aneurin J. Kennerley[2,3], Solomon Tesfaye[4], Eleni Vasilaki[5], and Iain D. Wilkinson[1,2]
		[1]Academic Unit of Radiology, University of Sheffield, Sheffield, United Kingdom, [2]Neuroimaging in Cardiovascular Disease (NICAD) Network, University of Sheffield, Sheffield, United Kingdom, [3]Psychology Department, University of Sheffield, Sheffield, United Kingdom, [4]Academic Unit of Diabetes and Endocrinology, University of Sheffield, Sheffield, United Kingdom, [5]Department of Computer Science, University of Sheffield, Sheffield, United Kingdom
		QUASAR ASL is an arterial transit time insensitive perfusion imaging technique which can be used to unravel hemodynamic patterns. This study evaluates cerebral perfusion hemodynamics using QUASAR in patients with type-2 diabetes mellitus (T2DM) and normoglycemic controls. In addition to standard perfusion parameters, multiple metrics were extracted from five QUASAR-derived curves pre and post acetazolamide injection both globally and locally, from regions adjacent to major vascular territories. Following feature reduction, a binary classification task was performed (normoglycemia vs. T2DM). Necessary steps were undertaken to reassure that the observed results were not due to overfitting. The achieved classification accuracy was 95%.

5524	Computer 87	Reproducibility and quality assessment of a 3D-EPI Pulsed Arterial Spin Labelling scheme at 7 T in a clinical cohort
		Richard J Dury[1], Yasser Falah[2], Penny A Gowland[1], Nikos Evangelou[2], Susan T Francis[1], and Molly G Bright[1,3]

		[1]Sir Peter Mansfield Imaging Centre, University on Nottingham, Nottingham, United Kingdom, [2]Division of Clinical Neurology, University on Nottingham, Nottingham, United Kingdom, [3]Clinical Neurology, University of Nottingham, Nottingham, United Kingdom
		3D-EPI arterial spin labelling (ASL) at 7T has been shown to provide advantages over 2D-EPI, however its reproducibility has not been determined. Here we assess the data quality of 7T 3D-EPI pulsed ASL data in healthy volunteers (HV) and Multiple Sclerosis (MS) patients demonstrating significantly higher temporal SNR (tSNR) in MS patients. On comparing repeats from two scans, acquired ~3 weeks apart, we observe good reproducibility of CBF estimates with a coefficient of variation of 14.7% in HVs and 12.1% in MS patients. This ASL method can be used to evaluate perfusion longitudinally in clinical cohorts.

5525	Computer 88	Blood transit time heterogeneity (TTH) mapping in the human brain with multi-TI pCASL
		Michael Germuska[1], Thomas Okell[2], and Richard Wise[1]
		[1]Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom, [2]Wellcome Centre for Integrative Neuroimaging (FMRIB), Oxford University, Oxford, United Kingdom
		A blood transit transit heterogeneity (TTH) mapping method is presented based on the regularised fitting of multi-TI pCASL data. The method applies a gamma variate dispersion model to account for upstream flow dispersion and tissue transit heterogeneity. The approach is shown to have sufficient sensitivity to distinguish a range of TTH times in gray matter and results are comparable with previous ROI based approaches. The mapping of TTH has the potential to be a sensitive marker for cerebrovascular dysfunction.

5526	Computer 89	Impact of calibration method on CBF quantification using multiple post-labeling-delay PASL
		Joana Pinto[1], Pedro Vilela[2], Michael A Chappell[3], and Patrícia Figueiredo[1]
		[1]ISR-Lisboa/LARSyS and Department of Bioengineering, Instituto Superior Técnico – Universidade de Lisboa, Lisbon, Portugal, [2]Imaging Department, Hospital da Luz, Lisbon, Portugal, [3]Institute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom
		Absolute CBF quantification using ASL requires the normalization of the magnetization difference images by the equilibrium magnetization of arterial blood, which is usually extrapolated from the equilibrium magnetization measured in tissue. Although different calibration methods have been previously compared, a number of subtle processing options made in their practical implementation are often assumed or overlooked, compromising the utility of absolute quantification. We systematically compared different calibration methods and associated options in multiple post-labeling-delay pulsed ASL and found that they can severely impact CBF quantification. Our results highlight the need for consistent calibration pipelines for CBF quantification using ASL.

5527	Computer 90	Increasing Arterial Spin Labeling Perfusion Image Resolution Using Convolutional Neural Networks with Residual-Learning
		Qingping Liu[1], Jun Shi[1], and Ze Wang[2]
		[1]Institute of Biomedical Engineering, School of Communication and Information Engineering, Shanghai University, Shanghai, China, [2]Temple University, Philadelphia, PA, United States
		A common problem in arterial spin labeling (ASL) perfusion MRI is the relatively low spatial resolution and subsequently the partial volume effects. We evaluated a new deep learning-based super-resolution algorithm for solving that problem. The algorithm successively produced higher resolution ASL cerebral blood flow image from low resolution data, which even outperformed an existing super-resolution method.

5528	Computer 91	Feasibility Study of Arterial Spin Labeling on a Compact 3T Scanner with High-Performance Gradient System
		Yunhong Shu[1], Shengzhen Tao[1], Marc Lebel[2], Ek Tan[3], MyungHo In[1], Joshua D Trzasko[1], Erin Gray[1], Thomas Foo[3], John Huston III[1], and Matt A Bernstein[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States, [2]GE healthcare, Waukesha, WI, United States, [3]GE Global Research, Niskayuna, NY, United States
		Our study shows that pCASL based on a 3D segmented fast spin-echo spiral sequence can be performed on a compact 3T (C3T) scanner without the need of second RF transmitter. The high performance gradient system on the C3T can reach 80 mT/m magnitude and 700 T/m/s slew rate without peripheral nerve stimulation, which helps to shorten both the TE and spiral readout length. Both the perfusion-weighted images and the cerebral blood flow maps acquired on the C3T have higher spatial resolution and less off-resonant artifacts compares to those acquired on the conventional whole-body system enabled by the high performance gradients.

5529	Computer 92	QUANTITATIVE MULTIPLE BOLI ARTERIAL SPIN LABELLING: FROM PULSED TO PSEUDO-CONTINUOUS LABELLING
		Antoine Vallatos[1,2], Camille Graff[3], Samantha Paterson[2], and William M. Holmes[2]
		[1]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom, [2]Glasgow experimental MRI centre (GEMRIC), Institute of Neurosciences and Psychology, University of Glasgow, Glasgow, United Kingdom, [3]Phelma, Grenoble, France

		A quantitative kinetic model for the recently introduced high SNR multiple boli Arterial Spin Labelling technique (mbASL) has been developed and validated both theoretically and experimentally. By varying the labelling inversion thickness, mbASL signal was shown to switch from a pseudo-continuous to a pulsed ASL behaviour. The model reflects the hybrid nature of mbASL, which combines the high labelling efficiency of pulsed ASL with the continuous labelling advantage of pseudo-continuous ASL. We use the mbASL kinetic model produce high SNR cerebral blood flow maps based on mbASL measurements.

5530	Computer 93	Accounting for pCASL labelling efficiency variation in patients with low and high arterial blood flow velocities
		Lena Vaclavu[1], Magdalena Sokolska[2], Aart J Nederveen[1], and David L Thomas[2]
		[1]Radiology & Nuclear Medicine, Academic Medical Center, Amsterdam, Netherlands, [2]Institute of Neurology/Centre for Medical Image Computing, University College London, London, United Kingdom
		Pseudo continuous arterial spin labelling (pCASL) suffers from reduced labelling efficiency in extreme flow conditions. In this work we investigated the sensitivity of labelling efficiency to velocity values measured in vivo to ascertain its variability over a clinically relevant range of velocities. We measured arterial blood velocity in the neck at the level of the labelling plane, and obtained simulated labelling efficiency values, which we found to differ significantly between high and low velocity populations. Changes in labelling efficiency induced by acetazolamide administration may have implications for future work using pCASL for cerebrovascular reserve assessments.

5531	Computer 94	Measurements of the Labeling Efficiency using super-selective Arterial Spin Labeling for Quantitative Flow Territory Mapping
		Thomas Lindner[1], Mariya Krestina[1], Olav Jansen[1], and Michael Helle[2]
		[1]Department of Radiology and Naeuroradiology, University Hospital Schleswig-Holstein, Kiel, Germany, [2]Tomographic Imaging Department, Philips Research Laboratories, Hamburg, Germany
		In this study, super-selective pseudo-continuous Arterial Spin Labeling was improved regarding the labeling efficiency and used in a volunteer study to evaluate the influence of the positioning of the focus with respect to the labeling efficiency.

5532	Computer 95	3D MRI of Blood Flow of Human Retina
		Xiang He[1], Kenneth T Wengler[2], Andrew LaBella[2], Tao Wang[1], Patricia Stefancin[1], and Tim Q Duong[1]

		[1]Radiology, Stony Brook University Hospital, Stony Brook, NY, United States, [2]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States
		Previous studies have shown that blood flow in the human retina can be measured using MRI. These studies used single-slice 2D pseudo-continuous arterial spin labeling (pCASL) which has limited spatial coverage and resolution, and is susceptible to through-plane eye motion. In this study, a pCASL with zoom-3D TSE VFA acquisition was developed to provide whole-eye coverage with $0.5\times0.5\times4mm^3$ resolution and reduced motion induced image blur. This approach should prove useful for studying different retinal disorders such as glaucoma, diabetic retinopathy and retinal ischemia.

5533	Computer 96	Efficient kidney perfusion imaging using non-segmented coronal slab 3D echo planar imaging with pseudo continuous arterial spin labeling
		Neville D Gai[1] and Ashkan A Malayeri[1]
		[1]Radiology & Imaging Sciences, Clinical Center, National Institutes of Health, Bethesda, MD, United States
		Arterial spin labeling (ASL) of the kidneys provides several advantages for the evaluation of kidney perfusion including contrast agent free studies while allowing multiple scans over a short time period. 3D acquisition provides higher SNR and with centric k-space encoding provides a well-defined post-labeling delay which makes background suppression pulses more effective. Prior techniques for 3D ASL perfusion imaging employed segmented GRASE with multi-TI FAIR and segmented TSE with pCASL. These acquisition schemes can be limited in resolution or require coached breathing along with providing limited coverage over an extended scanning time. In this work, we used non-segmented 3D EPI pCASL with coronal acquisition to efficiently image the two kidneys in a shorter time (nominal time 2:15) with increased control-label pairs. Background suppression and saturation pulses were also employed to reduce tissue related noise and signal from aorta, respectively. Cortical and medullary perfusion values were calculated in seven subjects which matched well with values from literature. In addition, good correspondence with transverse slab acquisition as well as good repeatability was shown.

Electronic Poster

fMRI: Connectivity Methods

Exhibition Hall	Thursday 14:15 - 15:15

5534	Computer 1	How people recover from extreme life stress: a longitudinal dynamic functional connectivity analysis
		Jing Jiang[1], Kaiming Li[2], Xiaoqi Huang[3], Su Lui[3], Zhiyun Jia[4], Qiang Yue[3], Qiyong Gong[3], and Qiyu Liu[1]

		[1]Department of Radiology, Mianyang Central Hospital, Mianyang, China, [2]Huaxi MR Research Center (HMRRC), West China Hospital of Sichuan University, Chengdu, China, [3]Huaxi MR Research Center (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, China, [4]Huaxi MR Research Center (HMRRC), Department of Nuclear Medicine, West China Hospital of Sichuan University, Chengdu, China
		Dynamic functional connectivity (dFC) has provided more information than commonly-used static FC analysis. With dFC, we investigated the variation characteristics of three affected resting state networks, i.e., DMN, CEN and SN, in trauma-exposed non-PTSD group using resting state fMRI scans within 25 days and 2 years after Wenchuan earthquake. Results revealed increased connectivity was mainly involved in intra-network FC of DMN and inter-network FC between SN and DMN/CEN. Decreased connectivity was mostly found in intra-network FC of CEN and inter-network FC between CEN and SN. This study may provide insights of how people recover from extreme life stress from a FC variation perspective.

5535	Computer 2	From neurons to BOLD connectivity: a validation study
		Andrea Duggento[1], Luca Passamonti[2,3], Gaetano Valenza[4], Riccardo Barbieri[5,6], Maria Guerrisi[1], and Nicola Toschi[1,7]
		[1]Department of Biomedicine and Prevention, University of Rome "Tor Vergata", Roma, Italy, [2]Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [3]Istituto di Bioimmagini e Fisiologia Molecolare, Consiglio Nazionale delle Ricerche, Milano, Italy, [4]Department of Information Engineering, University of Pisa, Pisa, Italy, [5]Department of Electronics, Informatics and Bioengineering, Politecnico di Milano, Milano, Italy, [6]Department of Anesthesia, Massachusetts General Hospital, Boston, MA, United States, [7]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States
		The use of Multivariate Granger Causality (MVGC) in estimating directed BOLD connectivity is still controversial. We employ realistic complex network models based on Izhikevich neuronal populations interlinked by realistic neuronal fiber bundles which exert compounded directed influences and cascade into Baloon-model-like neurovascular coupling. We show *in silico* that the top 1 percentile of a BOLD connectivity matrix has a Positive Predictive Value very close to 1, and demonstrate in HCP data that functional interactions between parietal and prefrontal cortices are not symmetrical, but consists of directional connectivity from parietal areas to prefrontal cortices rather than *vice versa*.

5536	Computer 3	In-variance causality: a novel layer of information in directed connectivity
		Andrea Duggento[1], Luca Passamonti[2,3], Maria Guerrisi[1], and Nicola Toschi[1,4]

		[1]Department of Biomedicine and Prevention, University of Rome "Tor Vergata", Roma, Italy, [2]Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [3]Istituto di Bioimmagini e Fisiologia Molecolare, Consiglio Nazionale delle Ricerche, Milano, Italy, [4]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States
		Multivariate Granger Causality (MVGC) approaches have recently been employed to estimate the directionality of brain connectivity. While BOLD fluctuations also contain information about neurovascular coupling, so far all MVGC estimation frameworks have focused on central tendencies, hence disregarding directed coupling between volatilities (i.e. in-variance causality). In this paper, we develop a framework for simultaneous estimation of both in-mean and in-variance causality in complex networks. We validate our approach using synthetic data from complex ensembles of coupled nonlinear oscillators, and successively employ HCP data to provide the very first estimate of the in-variance connectome of the human brain.

5537	Computer 4	Predicting Task Activation from Resting State fMRI: A Comparison of Single Band and Multiband EPI Acquisitions
		Alexander D. Cohen[1], Elizabeth Zakszewski[1], and Yang Wang[1]
		[1]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States
		Recent studies have used resting state functional MRI (rs-fMRI) to predict task activation on an individual basis using a linear-regression machine learning technique. Limited existing studies have used either low-resolution single-band (SB) or high-resolution multiband (MB) data and shown promising results. In this study, SB and MB resting state data were acquired in a group of volunteers to compare their ability to predict motor task activation. Our results showed no significant differences between SB- and MB-based motor task predictions. These findings suggest conventional SB scans might be suitable for making predictions regarding task activation in some clinical settings.

5538	Computer 5	Individual Resting-State Brain Networks using Multivariate Conditional Mutual Information
		Padmavathi Sundaram[1], Martin Luessi[2], Marta Bianciardi[1], Steven Stufflebeam[1], Matti Hamalainen[1], and Victor Solo[1,3]
		[1]Radiology, Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]BrainFPV LLC, Boston, MA, United States, [3]Electrical Engineering and Telecommunications, University of New South Wales, Sydney, Australia

		Current methods of functional brain connectivity from resting-state fMRI data such as linear correlation have limitations, which result in connectivity maps affected by indirect connections and information loss. To address these problems, we propose to use a multivariate conditional mutual information (mvCMI) measure. mvCMI is a multivariate association method, which does not discard information and eliminates indirect connections. We tested mvCMI for single-subject fMRI-connectivity analysis in 10 healthy subjects. mvCMI was able to generate single-subject maps of functional connectivity showing mostly direct connections; mvCMI-based connectivity-maps were more closely related to diffusion-tensor-imaging-based structural connectivity-maps than linear-correlation-based connectivity-maps.

5539	Computer 6	Mapping the functional recovery of brainstem injury-induced comatose rats with eigenvector-centrality mapping and seed-based analysis of resting-state fMRI
		Patricia Pais Roldán[1,2], Brian Edlow[3], Johannes Stelzer[1], Yuanyuan Jiang[1], Ming Zou[4], and Xin Yu[1]
		[1]Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Graduate Training Centre of Neuroscience, Tübingen, Germany, [3]Massachusetts General Hospital, Boston, MA, United States, [4]The Second Affiliated Hospital, Wenzhou Medical University, Wenzhou, China
		Here we used the rat brainstem coma model and rs-fMRI to systematically study the network dynamics during recovery from coma. Using whole brain connectivity analysis we obtained connectivity slope maps from the comatose animals, which revealed the brain regions with higher connectivity changes. In parallel, we performed a seed-based analysis to specify the strengthened connections between ROIs. Both methods indicated an increase in the connectivity between basal forebrain, basal ganglia and thalamus, along the acute phase of recovery from coma. These parallel analyses applied to comatose rats provided new insights into the regulations occurring during recovery of consciousness.

5540	Computer 7	A correlation of resting state DfMRI signals reflects functional connectivity in awake mouse
		Yoshifumi Abe[1], Yuki Sakai[2], Hiroaki Hamada[3], Norio Takata[1], Kenji Doya[3], and Kenji Tanaka[1]
		[1]Departemnt of Neuropsychiatry, Keio University School of Medicine, Tokyo, Japan, [2]ATR Brain Information Communication Research Laboratory Group, Kyoto, Japan, [3]Neural Computation Unit and Biological Physics Theory unit, Okinawa Insititute of Science and Technology, Okinawa, Japan
		Diffusion fMRI (DfMRI) is an imaging method to investigate brain activity regardless of hemodynamic state. The previous study has proposed that resting state DfMRI (rsDfMRI) is suitable to investigate a magnitude of basal activity. In this study, we examined our hypothesis that this rsDfMRI have a potential of detecting functional connectivity (FC). FC patterns were compared between rsDfMRI and BOLD-rsfMRI in awake mice. A strong correlation of the pattern between rsDfMRI and BOLD-rsfMRI indicated that rsDfMRI is possible to conduct FC analysis. Therefore, we propose that rsDfMRI is a powerful tool to detect brain network as well as brain activity.

5541	Computer 8	A New Method of Brain Functional Connectivity Analysis via Deep Learning Brandon Campbell[1,2], Alice Shen[2], Simon Platt[3], Franklin West[4], and Qun Zhao[1,2] *[1]Physics and Astronomy, University of Georgia, Athens, GA, United States, [2]Bio-Imaging Research Center, University of Georgia, Athens, GA, United States, [3]Department of Small Animal Medicine and Surgery, University of Georgia, Athens, GA, United States, [4]Animal and Dairy Science, University of Georgia, Athens, GA, United States* The pig brain model is an important translational model due to its similarity to the human brain anatomy and physiology. However, a lack of *a priori* information required for common functional analysis techniques dictates that new techniques are required to explore the connectivity of the pig brain. Here we present two new, unsupervised forms of analysis to find functional connectivity in healthy and ischemic stroke pigs using sparse deep convolutional neural networks and dynamic time warping with spectral clustering that yield complementary results.

5542	Computer 9	Functional Connectivity-Based Classification of Gulf War Illness Patients vs Control Veterans Unal "Zak" Sakoglu[1], Mounika Galla[1], Bruce Crosson[2,3], Robert Haley[4], and Kaundinya Gopinath[5] *[1]Computer Engineering, University of Houston - Clear Lake, Houston, TX, United States, [2]VA RR&D Center of Excellence, Atlanta VAMC, Decatur, GA, United States, [3]Neurology, Emory University, Atlanta, GA, United States, [4]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States, [5]Radiology, Emory University, Atlanta, GA, United States* Around 200,000 veterans suffer from Gulf War Illness (GWI). GWI is characterized by multiple deficits in cognitive, emotion, somatosensory and pain domains. In this study we studied 23 GWI patients and 30 age-matched controls with resting state fMRI in order to classify patients versus controls using functional connectivity among brain networks. Results show that different brain networks have discriminating power, signaling widespread impairments in functional connectivity of visual, semantic, multi-sensory, and sensory-motor processing networks in GWI consistent with multi-symptom nature of the illness.

5543	Computer 10	Dynamic network analysis reveals altered temporal variability in brain regions after brain stroke: A longitudinal resting-state fMRI study Jianping Hu[1,2], Juan Du[3], Qiang Xu[4], Fang Yang[3], Fanyong Zeng[3], Zhiqiang Zhang[4], and Guangming Lu[4] *[1]Department of Medical Imaging, Jinling Hospital, Nanjing Clinical School, Southern Medical University, Nanjing, China, Nanjing, China, [2]Department of Radiology,The First Affiliated Hospital, Fujian Medical University, Fuzhou, China., Fuzhou, China, [3]Department of Neurology, Jinling Hospital, Nanjing University School of Medicine, Nanjing, China, Nanjing, China, [4]Department of Medical Imaging, Jinling Hospital, Nanjing University School of Medicine, Nanjing, China, Nanjing, China*

		In this work, we seek to investigate the longitudinal alteration of temporal variability in resting-state brain network after cerebral stroke, by using a novel dynamic network analysis. Our study illustrated a time dependent alteration of temporal variability in brain networks following stroke recovery. These findings expand our understanding for dynamic properties of brain networks and provide new insight into the underlying mechanisms of reorganization and integration of functional networks over the recovery process after stroke.

5544	Computer 11	Combining regional homogeneity and Meta-analysis to improve preoperative language mapping with resting-state functional MRI
		Ai-Ling Hsu[1,2], Jason M Johnson[3], Kyle R Noll[4], Sujit S Prabhu[5], Donald F Schomer[3], Jyh-Horng Chen[2], and Ho-Ling Liu[1]
		[1]Department of Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan, [3]Department of Diagnostic Radiology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [4]Section of Neuropsychology, Department of Neuro-Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [5]Department of Neurosurgery, The University of Texas MD Anderson Cancer Center, Houston, TX, United States
		Resting-state (rs) fMRI has been shown its potential for pre-surgical mapping. Seed-correlation analysis is a commonly used approach for network detection. However, lesion-related spatial distortions and functional reorganization make the seed selection difficult for rs-fMRI mapping based on anatomical landmark alone. Here we proposed a novel approach to guide the seed selection for rs-fMRI mapping in patients with brain tumors by incorporating regional homogeneity (RH) confined by results of meta-analysis (MA). Our results showed performance that was equivalent to the seed localization guided by task-fMRI activation, suggesting the potential of RH+MA approach for rs-fMRI mapping in the clinical practice.

5545	Computer 12	Altered Variability in Functional Connectivity of the Anterior Cingulate Cortex in Patients with Treatment-resistant and Non-treatment-resistant Depression
		Bochao Cheng[1,2], Gang Ning[1], and Qiyong Gong[2]
		[1]Radiology, West China Second University Hospital of Sichuan University, Chengdu, China, [2]Huaxi MR Research Center, West China Hospital of Sichuan University, Chengdu, China

		Although substantial efforts have been made to elucidate the neuronal basis of both Treatment-resistant depression (TRD) and non-TRD (nTRD), the results are inconsistant. We apply the resting-state dynamic functional connectivity (D-RSFC) to explore the divergence of neuronal basis of both depression subtypes. Our results demonstrated that the prefrontal-limbic circuit is the most stable dysfunctional brain network in depression. The D-RSFC method could reveal the altered dynamic functional connectivity in both MDD subtypes and the divergence of brain networks between TRD and nTRD. Additionally, we speculate that the caudate-ACC circuit might be the biomarker for evaluating treatment response in TRD.

5546	Computer 13	Baseline dynamic functional connectivity predicts response to repetitive transcranial magnetic stimulation in patients with treatment-resistant depression
		Sarina Jennifer Iwabuchi[1,2], Dorothee P Auer[1,2], Sudheer Lankappa[3], and Lena Palaniyappan[4,5]
		[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Nottingham Biomedical Research Centre, Nottingham, United Kingdom, [3]Department of Psychiatry, Nottinghamshire Healthcare NHS Trust, Nottingham, United Kingdom, [4]Departments of Psychiatry and Medical Biophysics & Robarts Research Institute, Western University, London, ON, Canada, [5]Lawson Health Research Institute, London, ON, Canada
		Repetitive transcranial magnetic stimulation (rTMS) is becoming increasingly popular for the treatment of depression. However, there is a need for improving response through identifying predictive biomarkers and understanding mechanisms underlying treatment response to enable stratified patient care. We investigated in a group of 27 patients with treatment resistant depression, whether dynamic interactions between brain networks (measured with resting-state fMRI) can predict clinical response following 4 weeks of rTMS treatment. We found that clinical response may be more related to ‘trait’ like dynamic balance among large-scale networks that are present at the outset of treatment.

5547	Computer 14	Resting Functional Connectivity Across a Language Network Not Related to Task Based Language Laterality Index
		Akhila Ashokan[1] and Victoria L Morgan[2,3]
		[1]Electrical Engineering and Computer Science, Vanderbilt University, Nashville, TN, United States, [2]Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States
		Quantification of language dominance via a laterality index is used to assess the risk of language impairment prior to temporal lobe resection, most commonly in temporal lobe epilepsy. While task based functional MRI has become a useful non-invasive method for this measure, its reliability and accuracy can be reduced by poor task performance. In this work, resting fMRI connectivity in a language based network was investigated as an easier and more robust alternative to task based methods. However, results showed poor associations between the resting connectivity and the task based laterality.

5548	Computer 15	Regularized-Ncut: Robust functional parcellation of brain networks Qinmu Peng[1,2], Ouyang Minhui[1,2], Jiaojian Wang[1,2], Qinlin Yu[1,2], Chenying Zhao[3], Slinger Michelle[1], Hongming Li[2], Yong Fan[2], Bo Hong[4], and Hao Huang[1,2] *[1]Department of Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States, [2]Department of Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Bioengineering, School of Engineering and Applied Science, University of Pennsylvania, Philadelphia, PA, United States, [4]Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China* Human brain functional networks are critical in understanding intrinsic functional organization and systems. However, functional brain parcellation is affected by noise, resulting in artificial small patches and decreased functional homogeneity within certain networks. Using resting-state fMRI, we proposed a novel data-driven regularized-Ncut (RNcut) method by integrating a smoothing term and a small patches removal term to conventional Ncut for parcellating functional networks. The proposed method could delineate parcellated functional networks with higher functional homogeneity and better spatial contiguity with less noisy patches. A broad range of brain network applications and analyses could benefit from the proposed RNcut.

5549	Computer 16	Altered structural covariance corticothalamic networks in epilepsy. Qiang Xu[1,2], Qirui Zhang[1], Zhiqiang Zhang[1], Wei Quan[1], Junhao Xiao[1], and Guangming Lu[1] *[1]Depart. of Radiology, Jinling hospital, Nanjing, China, [2]College Of Automation Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing, China* It is the first work to depict the corticothalamus relationship by using the structural covariance connectivity. The epilepsy would significantly change the cortex-thalamus mode. The unilateral foci would lead the damage to the ipsilateral thalamus firstly. It provided a novel window to detected the mechanism of epilepsy.

5550	Computer 17	Evaluation of fuzzy clustering for the identification of separate and joint dynamic functional connectivity patterns in resting-state fMRI Margarida Solas[1], Rodolfo Abreu[2], Cátia Salgado[1], Susana Vieira[1], and Patrícia Figueiredo[2] *[1]IDMEC, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal, [2]ISR-Lisboa/LARSyS and Department of Bioengineering, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal*

		We propose to investigate the validity and applicability of fuzzy clustering (FCM) for the identification of dynamic functional connectivity (dFC) patterns in resting-state fMRI data, and comparing it with two approaches that have been used in this context (PCA and K-means). For such purpose, all methods were applied to data simulating either the joint or separate expression of dFC patterns, and to empirical data, collected from epilepsy patients. Both clustering methods, particularly FCM, outperformed PCA. Concomitantly, results from empirical data indicated that the occurrence of epileptic activity of patients was separately expressed by the dFC patterns.

5551	Computer 18	A methodology to study brain specialization and integration during the information processing
		Pedro Henrique Rodrigues da Silva[1] and Renata Ferranti Leoni[1]
		[1]Department of Physics, FFCLRP, University of São Paulo, Ribeirão Preto, Brazil
		There is interest in understanding the functional integration of cognitive functions and effective therapeutic interventions as a strategy to improve cognitive deficits. However, uncertainty about how to proceed to address those issues remains. Therefore, this study aims to propose a methodology to assess brain specialization and integration during a cognitive task for future studies on the evaluation of therapeutic strategies. Our methodology provided a network model related to the performed task, that may serve as a reference for future investigations in clinical groups; and coupling parameters that may be used to evaluate the presence of adaptative neuroplasticity after cognitive training/rehabilitation.

5552	Computer 19	Clustering-based identification of Regions-of-Interest in Functional Magnetic Resonance Images
		Camila Rojas[1], Alejandro Weinstein[1,2], Steren Chabert[1], and Alejandro Veloz[1]
		[1]Biomedical Engineering Department, Universidad de Valparaiso, Valparaiso, Chile, [2]Advanced Center for Electrical and Electronic Engineering, Valparaíso, Chile
		The first step of brain network analysis in fMRI is to detect regions of interest. The signals from these ROIs are then used to evaluate neural networks and quantify neuronal dynamics The two main methods to identify ROIs are based on brain atlas registration and clustering. In this work, both paradigms are combined by using a hierarchical two-level approach. In the first level, the anatomical parcellation is applied and then a clustering-based strategy within anatomical labels is performed. The proposed method is compared with a current approach based on spectral clustering.

5553	Computer 20	Enhanced task-related frontoparietal functional connectivity during a n-back task in children with abacus training
		Chunjie Wang[1,2], Feiyan Chen[1], and Huafeng Liu[2]

		[1]Department of Physics, Zhejiang University, Hangzhou, China, [2]Department of Optical Engineering, Zhejiang University, Hangzhou, China
		Abacus-based mental calculation (AMC) training has the potential to induce cognitive plasticity. However, the neural correlates of such benefits remain unknown. In this study, we aimed to examine impacts of AMC training on task-related functional connectivity. We obtained functional imaging data from 23 children with AMC training and 21 control children. For AMC children, we found a increase in task-related functional connectivity within the frontoparietal regions, which was also significantly correlated with the speed in the 2-back condition. Therefore, AMC training may enhance the functional integration of frontoparietal circuity, and consequently result in improved task performance.

5554	Computer 21	DEFAULT MODE NETWORK MODIFICATIONS IN FABRY DISEASE
		Sirio Cocozza[1], Giuseppe Pontillo[1], Mario Quarantelli[2], Francesco Saccà[3], Eleonora Riccio[3], Teresa Costabile[3], Gaia Olivo[4], Vincenzo Brescia Morra[3], Antonio Pisani[3], Enrico Tedeschi[1], and Arturo Brunetti[1]
		[1]Department of Advanced Biomedical Sciences, University of Naples "Federico II", Naples, Italy, [2]Institute of Biostructure and Bioimaging, National Research Council, Naples, Italy, [3]University of Naples "Federico II", Naples, Italy, [4]Department of Neuroscience, Uppsala University, Uppsala, Sweden
		We performed a Resting-State fMRI study to evaluate the integrity of the Default Mode Network (DMN) in Fabry Disease (FD), a condition in which neuropsychological symptoms are common and alterations of the functional connectivity (FC) have been recently reported. Compared to healthy controls FD patients showed clusters of increased FC involving different DMN hubs as well as the middle temporal gyri and the right cerebellum, with a significant correlation with the Corsi span test results (P=0.0001). Our results confirm the current view of a cerebral involvement in FD patients related to significant and diffuse functional changes.

5555	Computer 22	Resting-State Functional Connectivity of the Language Network in Multiple Sclerosis in Young Adults
		Andrew LaBella[1], Lauren Krupp[2], Leigh Charvet[2], Lev Bangiyev[3], and Tim Q Duong[3]
		[1]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [2]Multiple Sclerosis Comprehensive Care Center, NYU, New York, NY, United States, [3]Radiology, Stony Brook University, Stony Brook, NY, United States

		Multiple Sclerosis is affiliated with many clinical symptoms, including language deficiencies. However, the neural mechanism behind these problems hasn't yet been explored. In this study, we use resting-state fMRI to probe the known language network in MS patients. We found that functional connectivity of the language network in MS patients is significantly correlated with clinical disability and results of a verbal learning test. Based on our results, we believe resting-state fMRI may be a viable tool to monitor language deficiencies in MS patients along with clinical scores.

Electronic Poster

fMRI: Other

Exhibition Hall	Thursday 14:15 - 15:15

5556	Computer 25	Resting-State Fractional ALFF and Seed-Based Analysis as a Function of Bladder Discomfort
		Andrew LaBella[1], Kenneth Wengler[1], Justina Tam[2], Sindhuja T. Govindarajan[1], Steven Weissbart[2], Tim Q Duong[3], and Xiang He[3]
		[1]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [2]Urology, Stony Brook University, Stony Brook, NY, United States, [3]Radiology, Stony Brook University, Stony Brook, NY, United States
		The neural mechanisms underlying over active bladder are not fully understood. In addition, the neural network involved in bladder control hasn't been identified. In this study, we looked at resting-state functional MRI of healthy females as a function of bladder filling, utilizing fractional amplitude of low frequency fluctuation (fALFF) and seed-based functional connectivity measures. Our results demonstrate modulated activation amplitude and functional connectivity throughout the brain, primarily characterized by increases in the anterior brain, furthering our understanding of bladder control and setting the foundation for additional higher level analyses.

5557	Computer 26	Resting-State Functional Connectivity of Subcortical Grey Matter Correlates with Fatigue in Young Adults with Multiple Sclerosis
		Andrew LaBella[1], Lauren Krupp[2], Leigh Charvet[2], Lev Bangiyev[3], and Tim Q Duong[3]
		[1]Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States, [2]Multiple Sclerosis Comprehensive Care Center, NYU, New York, NY, United States, [3]Radiology, Stony Brook University, Stony Brook, NY, United States

		While striatal and thalamic networks have been linked with fatigue in MS, they haven't been explored in any young adult MS population. Further probing is needed to fully understand the fatigue correlate in MS and how it compares with differences between healthy controls and MS patients. In this study, we compared resting state functional connectivity measures in healthy controls, fatigued, and non-fatigued MS patients. Our results demonstrate that fatigue correlates with deficits in subcortical connectivity with several resting state networks. We found overlap between certain MS-related and fatigue-related changes, providing further insight into MS pathology and its fatigue correlate.

5558	Computer 27	Application of fMRI with seed-based analysis for assessment of functional connectivity in patients with fragile X syndrome
		Yulia Mikhailovna Rymareva[1], Evgeny Dmitrievich Petrovskiy[2], Andrey Alexandrovich Savelov[2], Evgenia Rovshanovna Isanova[3], Dmitry Vladimirovich Yudkin[1,4], Alexandr Pavlovich Chupakhin[1,5], and Andrey Alexandrovich Tulupov[1,2,5]
		[1]Novosibirsk State University, Novosibirsk, Russian Federation, [2]Institute International Tomography Center SB RAS, Novosibirsk, Russian Federation, [3]Medical Center «Avicenna», group of companies «Mother and Child», Novosibirsk, Russian Federation, [4]Institute of Molecular and Cellular Biology SB RAS, Novosibirsk, Russian Federation, [5]Lavrentyev Institute of Hydrodynamics SB RA, Novosibirsk, Russian Federation
		The purpose of the study was to find neurobiological correlates of cognitive disability in patients with fragile X syndrome using resting state fMRI and seed-based correlation analysis.

5559	Computer 28	Disrupted resting-state functional connectivity and low-frequency fluctuation in chronic pain
		Woojin Choi[1], June Sic Kim[1], and Chun Kee Chung[1]
		[1]Seoul National University, Seoul, Korea, Democratic People's Republic of
		By applying dynamic functional connectivity and low-frequency fluctuation analysis of resting-state fMRI data, the present study investigated a disrupted intrinsic resting-state network in chronic pain patients.

5560	Computer 29	Dynamic development of spontaneous neuronal activity in postpartum women: A longitudinal resting-state functional MRI study
		Kaihua Zhang[1,2], Mengxing Wang[2], Jilei Zhang[2], Haifeng Lu[2], Zhong Chen*[1], and Xiaoxia Du*[2]

[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]Shanghai Key Laboratory of Magnetic Resonance and Department of Physics, School of Physics and Materials Science, East China Normal University, Shanghai, China

Investigating the neuroanatomical and functional bases in postpartum women have contributed to understanding the processing of cognitive and emotional alterations. The objective of this study was to examine spontaneous neuronal activity and functional connectivity of resting-state networks in postpartum women using a longitudinal resting-state functional magnetic resonance imaging. Twenty-three postpartum women were recruited. Amplitude of low-frequency fluctuation (ALFF), regional homogeneity (ReHo) and functional connectivity were calculated to measure spontaneous neuronal activity and brain network. Results revealed that changes in resting state brain network might be dynamic development for adaptive changes including cognitive function and empathic processing in postpartum women.

5561 | Computer 30

Intra- and inter-scanner reliability of scaled subprofile model of principal component analysis in resting-state fMRI

Li-Xia Yuan[1], Jian-Bao Wang[2], Na Zhao[2], Yuan-Yuan Li[2], Dong-Qiang Liu[3], Hong-Jian He[1], Jian-Hui Zhong[1], Yi-Long Ma[4], and Yu-Feng Zang[2]

[1]Center for Brain Imaging Science and Technology, Key Laboratory for Biomedical Engineering of Ministry of Education, College of Biomedical Engineering and Instrumental Science, Zhejiang University, Hangzhou, China, [2]Center for Cognition and Brain Disorders and the Affiliated Hospital,Zhejiang Key Laboratory for Research in Assessment of Cognitive Impairments, Institutes of Psychological Sciences, Hangzhou Normal University, Hangzhou, China, [3]Research Center of Brain and Cognitive Neuroscience, Liaoning Normal University, Liaoning, China, [4]Center for Neurosciences, the Feinstein Institute of Medical Research, Manhasset, NY, United States

Scaled subprofile model of principal component analysis (SSM-PCA) is a multivariate statistical method, widely used in positron emission tomography (PET). Recently, SSM-PCA has been applied to resting-state functional MRI (RS-fMRI). However, the intra- and inter-scanner reliability of SSM-PCA in RS-fMRI is not investigated systematically yet. Results from eyes-open (EO) and eyes-closed (EC) dataset demonstrate that both the intra- and inter-scanner reliability is excellent for EO and EC related covariance pattern (EOEC-pattern) and fair to good for EOEC-pattern’s expression. Moreover, SSM-PCA and conventional T-test are complementary for neuroimaging researches. This study illustrates the great potential of SSM-PCA for further applications in RS-fMRI.

5562 | Computer 31

Impact of Carotid Endarterectomy on Functional Connectivity

Marc Lindley[1], Adam Bernstein[2,3], Chidi Ugonna[2], Denise Bruck[4], Kevin Johnson[5], Maria Altbach[4], Lee Ryan[6], Nan-kuei Chen[2], Ying-hui Chou[6], Gloria Guzman[4], Theodore Trouard[2], and Craig Weinkauf[7]

		[1]University of Arizona, Tucson, AZ, United States, [2]Biomedical Engineering, University of Arizona, Tucson, AZ, United States, [3]NICHD, National Institutes of Health, Rockville, MD, United States, [4]Medical Imaging, University of Arizona, Tucson, AZ, United States, [5]Siemens Healthcare, Tucson, AZ, United States, [6]Psychology, University of Arizona, Tucson, AZ, United States, [7]Surgery, University of Arizona, Tucson, AZ, United States
		Carotid endarterectomy (CEA) as a procedure has been shown effective in reducing the risk of stroke for patients with severe stenosis. The impact of CEA on the functional connectivity of the brain has not been assessed to this point. Nine patients underwent resting state fMRI pre-operatively and 1 month and 6 months post-operatively. Analysis was performed using seed based analysis and matrix based analysis to determine if there were functional connectivity changes as a result of CEA. Seed based and matrix based analysis showed that there were significant functional connectivity changes as result of CEA.

5563	Computer 32	Altered functional connectivity between cerebral and cerebellar resting-state networks in autism spectrum disorder
		Yan Wang[1], Wenjing Zhang[1], Zheng Wang[2,3,4], Jieke Liu[1], John A. Sweeney[1,5], Stormi P. White[6], Su Lui[1], and Matthew W. Mosconi[2,3,4]
		[1]Huaxi MR Research Center (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, China, [2]Schiefelbusch Institute for Life Span Studies, University of Kansas, Lawrence, KS, United States, [3]Clinical Child Psychology Program, University of Kansas, Lawrence, KS, United States, [4]Kansas Center for Autism Research and Training (K-CART), University of Kansas, Lawrence, KS, United States, [5]Department of Psychiatry and Behavioral Neuroscience, University of Cincinnati College of Medicine, Cincinnati, OH, United States, [6]Center for Autism and Developmental Disabilities, University of Texas Southwestern Medical Center, Dallas, TX, United States
		By examining the correlation between motor data and brain resting-state functional imaging and identifying the functional connectivity alteration in ASD using a seed-driven approach, individuals with ASD demonstrate altered pattern of motor activation and diffusely decreased FC within frontal-subcortical-cerebellar circuit and within cerebellar network, which may represent the underlying neurobiological mechanisms of motor dysfunction and further delayed acquisition of gestures important for socialization and communication.

5564	Computer 33	The Effect of HIV and Aging on Functional Connectivity, Connectome Similarity, and Structural changes
		Yuchuan Zhuang[1], Lu Wang[2], Madalina Tivarus [3], Xing Qiu[2], Jianhui Zhong[3], and Giovanni Schifitto[4]
		[1]Electrical and Computer Engineering, University of Rochester, Rochester, NY, United States, [2]Dept of Biostatistics and Computational Biology, University of Rochester, Rochester, NY, United States, [3]Department of Imaging Sciences, University of Rochester, Rochester, NY, United States, [4]Department of Neurology, University of Rochester, Rochester, NY, United States

		We investigated the effect of HIV-infection and aging using resting-state fMRI and T1-weighted structural images. First, we assessed the inter-network functional connectivity and identified 8 resting-state networks associate with normal aging. Second, we constructed a functional connectome similarity as a global measure of neural connectivity pattern to assess the effect of age and HIV infection. Lastly, we measured cortical thickness and brain volumetrics. We found a significant effect of aging but not a definite additive or synergistic effect of HIV infection in all three analyses.

5565	Computer 34	Creativity Performance Reflected on the Activation of Divergent Thinking and Connectivity of Inferior Frontal Gyrus
		Hong-Yu Wu[1], Bo-Cheng Kuo[2], Chih-Mao Huang[3], Jyh-Horng Chen[1], and Changwei W Wu[4]
		[1]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan, [2]Department of Psychology, National Taiwan University, Taipei, Taiwan, [3]Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan, [4]Graduate Institute of Humanities in Medicine, Taipei Medical University, Taipei, Taiwan
		Creativity is taken as a spontaneous mental process and creativity scales associates with resting-state functional connectivity in literature. However, it remains unclear that how brain integrity changes following creative thoughts. Targeting on this causal effect, we explored the functional connectivity before and after the engagement of divergent thinking. We demonstrated the interactions between brain activations in divergent thinking and functional connectivity in certain networks, especially in the locus of left inferior frontal gyrus (IFG). Meanwhile, the reduced IFG-precuneus connections could benefit the creativity performances.

5566	Computer 35	fMRI-measured brain responses to smoking-related images before and after smoking cessation treatment by varenicline
		Peng Peng[1], Li Chunlin[2], Jing Bin[2], Chu Shuilian[3], and Jiang Tao[1]
		[1]Radiology, Beijing Chao-yang Hospital, Beijing, China, [2]School of Biomedical Engineering, Capital Medical University, Beijing, China, [3]Clinical Research Center, Beijing Chao-yang Hospital, Beijing, China
		This study investigated the activation of brain regions to visual smoking cues in smokers before and after cessation treatment using an event-related design fMRI. The result demonstrated that smokers will have good tolerance to smoking-related stimuli after using varenicline. This may explain why the curative effect of varenicline is better than NRT which has been related to an increased the brain response. The results provide further evidence for medication choice of clinicians for smoking cessation.

5567	Computer 36	Effects of smoking cessation treatment on cognition of smokers by using varenicline: a fMRI study

		Peng Peng[1], Li Chunlin[2], Jing Bin[2], Chu Shuilian[3], and Jiang Tao[1]
		[1]Radiology, Beijing Chao-yang Hospital, Beijing, China, [2]School of Biomedical Engineering, Capital Medical University, Beijing, China, [3]Clinical Research Center, Beijing Chao-yang Hospital, Beijing, China
		This study investigated the working memory-related brain activity to 3 different difficulty level n-back task before and after cessation treatment. Brain activation increased with increasing task difficulty in both control and smoker groups. The brain activation of smokers was higher than that of the control group, but the activation degree of smoking cessation treatment group was significantly lower than that before treatment, which was close to that of the control group. The result demonstrated varenicline’s cure effect on improving cognitive function, which was important to improve the withdrawal symptoms and increase smoking cessation rate.

5568	Computer 37	The application of ZOOMit-BOLD for motor function localization in glioma
		Shengyu Fang[1], Tianyi Qian[2], Yinyan Wang[1], and Tao Jiang[1]
		[1]Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China, Beijing, China, [2]HC NEA DI MR COL, SLC, Beijing, China
		ZOOMit blood oxygen level dependent fMRI (ZOOMit-BOLD) can excite only a small field of view using simultaneous parallel radiofrequency pulse sequences. It provides high spatial resolution while minimizing aliasing artifacts. This prospective study compared the clinical performances of ZOOMit-BOLD and conventional-BOLD in pre-surgical hand motor function localization. Compared with conventional EPI-based BOLD acquisition, ZOOMit-BOLD is a reliable technology with higher accuracy in preoperative motor functional localization in clinical patients with gliomas, particularly when the glioma directly invades the primary motor cortex.

5569	Computer 38	Novel MRI-compatible foot-sole stimulator for characterizing the cortical regions pertaining to walking-related somatosensory perception
		Tingwei Zhang[1], Kai Zhang[1], Yufeng Chai[1], Yunfei Long[2], Xiaoying Wang[3], Junhong Zhou[4,5,6], Brad Manor[4,5,6], Lewis A. Lipsitz[4,5,6], Jue Zhang[1,2], and Jing Fang[1,2]
		[1]Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [2]College of Engineering, Peking University, Beijing, China, [3]Department of Radiology, Peking University First Hospital, Beijing, China, [4]Hebrew SeniorLife Institute for Aging Research, Roslindale, MA, United States, [5]Division of Gerontology, Beth Israel Deaconess Medical Center, Boston, MA, United States, [6]Harvard Medical School, Boston, MA, United States

		The decline of foot-sole somatosensation is one of the main contributors to diminished balance of walking. The response of brain regions to the inputs from foot-soles is critical to the somatosensory perception, which, however, remains unknown. Here we developed a dual-drive stimulator applying pressure stimuli that mimic those as experienced during walking on the feet. This stimulator is compatible for MRI and the foot-sole pressure stimuli significantly increases the excitability (i.e., BOLD signal intensity) within multiple brain regions. This stimulator may thus be a novel tool to characterize the brain's responsiveness in the perception of foot-sole somatosensation pertaining to walking.

5570	Computer 39	Brain response to stop signal task in lifelong Premature Ejaculation patients compared to healthy subjects
		Lan Zhang[1], Xuejuan Yang[1], Ming Gao[2,3], Lin Liu[1], Peng Liu[1], Jinbo Sun[1], Wei Qin[1], and Jie Tian[1]
		[1]Engineering Research Center of Molecular and Neuro Imaging of the Ministry of Education, School of Life Science and Technology, Xidian University, Xi'an, Shaan xi, China, [2]Department of Urology, Xijing Hospital, The Fourth Military Medical University, Xi'an, Shaanxi, China, [3]The ART Center, Maternal and Child Health Care Hospital of Shaanxi Province, Xi'an, China
		Life-long premature ejaculation (LPE) is a common male sexual dysfunction. Previous studies revealed ejaculation-related control mechanisms in the brain. However, whether this control network changes in patients with LPE is unclear. A stop signal test was used in this study. A study of task-related functional MRI found there was a significant difference in neural network activation between healthy controls and LPE patients during go process. This study indicates a neural network abnormality in LPE patients, which provides novel reference for understanding the neural mechanism of LPE.

5571	Computer 40	T1-dispersion curves modelling and analysis of human glioma resections: a novel biomarker of molecular dynamics
		Manuel Petit[1], Sandra Pierre[1], Maxime Leclerq[1], Pascal H. Fries[2], François Berger[1], Lionel M. Broche[3], and Hana Lahrech[1]
		[1]BrainTech Lab - INSERM U1205, Grenoble, France, [2]INAC-CEA, Grenoble, France, [3]Aberdeen University, Aberdeen, United Kingdom
		Here we aim to characterize human glioblastoma with FFC-NMR using cerebral tissue of normal pig as a reference. Power-law models and Fries-Belorisky model (quadrupolar ^{14}N-^{1}H coupling peaks (QPs)) were used to analyse the T_1-dispersion. Linear Discriminant Analysis and statistical tests of derived fit parameters were used for classification. T_1 values at low field were found significantly different between cerebral tissues and glioblastoma, a result which is well admitted by the NMR community. However our most relevant finding is the role of the molecular dynamics related parameters to discriminate glioblastoma from cerebral tissues. QPs parameters also appear as a possible biomarkers but require higher signal sensitivity.

5572	Computer 41	FFC-NMR: A promise tool to discriminate infiltrative tumour cells from solid tumours: a study of three glioma mouse models
		Manuel Petit[1], Sandra Pierre[1], Maxime Leclerq[1], Pascal H. Fries[2], François Berger[1], Lionel M. Broche[3], and Hana Lahrech[1]
		[1]BrainTech Lab - INSERM U1205, Grenoble, France, [2]INAC-CEA, Grenoble, France, [3]Aberdeen University, Aberdeen, United Kingdom
		Using Fast-Field Cycling NMR (FFC-NMR), three glioma mouse models were studied to compare T_1-dispersion curves of solid tumours (U87) versus infiltrative tumours (Glio6 and Glio96). The U87 T_1-dispersion curves were found distinct from those of Glio6 and Glio96 and fitted well to the power-law model ($1/T_1=\gamma/2\pi\ B_0^{\beta}$). Statistical tests were used to find which model parameters discriminate the two tumour types. Results confirm the interest of low magnetic fields to exploit the offset parameter A, which corresponds to relaxation T_1, but specifically highlight the interest of the low-field exponent β^L parameter which give a molecular dynamic information, that is invisible by conventional NMR methods.

5573	Computer 42	Alterations of regional homogeneity in poststroke aphasia
		Hui Zhang[1], Ying Chen[2], Ruiping Hu[2], Liqing Yang[2], Mengxing Wang[1], Jilei Zhang[1], Yi Wu[2], and Xiaoxia Du*[1]
		[1]Shanghai Key Laboratory of Magnetic Resonance and Department of Physics, School of Physics and Materials Science, East China Normal University, Shanghai, China, [2]Department of Rehabilitation Medicine, Huashan Hospital, Shanghai, China
		The purpose of this study was to investigate intrinsic local synchrony changes in poststroke aphasia patients during resting-state fMRI scans. Fifteen patients (aged, 39-62 years, 4 female) and 30 age- and gender-matched healthy controls participated. Regional homogeneity (ReHo) was calculated to measure spontaneous brain activity. The results showed that poststroke aphasia patients exhibited significantly increased ReHo in the left frontal lobe, left cingulate gyrus, left corpus callosum, left temporo-parietal areas and right middle frontal gurus. Our study showed patterns of intrinsic local synchronization are altered in poststroke aphasia patients at resting state.

5574	Computer 43	Semantic verbal memory outcome in TLE and ETLE patients after surgery using fMRI
		Kapil Chaudhary[1], Senthil Kumaran[2], P Sarat Chandra[3], Ashima Nehra[4], and Manjari Tripathi[1]
		[1]Neurology, AIIMS, New Delhi, India, [2]NMR, AIIMS, New Delhi, India, [3]Neurosurgery, AIIMS, New Delhi, India, [4]Neuropsychology, AIIMS, New Delhi, India

		Memory can be broadly classified as sensory (process > 1 second), short term (>1 minute) and long term encoding in which information is encoded, stored, and retrieved. The surgical planning in drug refractory epilepsy (DRE) patients is usually associated with memory deficits. We measured BOLD activation during semantic verbal memory task using auditory stimulus and correlation with clinical parameters in patients (pre and 6 month of post-surgery) and controls. Study revealed anterior temporal lobe resection (ATLR) including removal of medial structures surrounding anterior temporal lobe may develop memory deficits in left TLE patients.

5575	Computer 44	Coupled temporal variation and global functional connectivity density of spontaneous brain activity in self-hypnosis for respiratory motion control
		Yanjun Liu[1], Rongmao Li[1], and Yaoqin Xie[1]
		[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China
		This study aims to explore the correlative relationship between temporal variation and signal synchronization of spontaneous brain activity in self-hypnosis for respiratory motion control and relaxation. A resting-state fMRI was employed to an intra-subject of 15 hypnotist volunteers in rest state and self-hypnosis state to explore the inter-state difference of correlation within four conventional resting-state networks. The results demonstrated that coupled temporal variation and signal synchronization of brain activity in self-hypnosis. It provides neural implications of self-hypnosis, a psychological technology that can generate positively psychological and physiological effects, in controllable self-regulation, which is beneficial to cancer patients during radiotherapy.

5576	Computer 45	Verifying the Reliability of Steady-State Free Precession fMRI in Detecting Oxygen Saturation Changes in Rat C6 Glioma
		Hao Chen[1], Junwei Zhang[1], Zhen Jiang[1], Jin Xu[1], Qiqi Chen[1], Siying Wang[2], and Junkang Shen[1]
		[1]Second affiliated hospital of Soochow University, Suzhou, China, [2]Philips Healthcare, Shanghai, China
		In this study, we aim to verify the reliability of steady-state free precession (SSFP) technique for detecting oxygen saturation level changes in functional MRI (fMRI). We compared SSFP fMRI image signals in rat glioma with pO_2 values measured directly using MRI compatible fiber-optic microprobes, and we found that their temporal variations resembled each other. Therefore, SSFP fMRI, as a non-invasive imaging technique, can be used to reveal the location of re-oxygenation hence hypoxia in tumor.

5577	Computer 46	Intrinsic Frequency Specific Brain Networks of Parkinson's Disease Patients
		Xuemei Fu[1]

[1]Peking University, Beijing, China

The majority of previous studies concerning the brain network derived from resting state fMRI focused on a low frequency of signal oscillation from 0.01 to 0.1 Hz (Bullmore and Sporns 2009; Van Den Heuvel and Hulshoff Pol 2010). However, the frequency specificities with regard to the topological properties of the PD brain networks have not been fully revealed. To exam the frequency properties of Drug-naive and L-dopa-treated Parkinson's Disease Patients, we subdivided the low frequency range into five bands as previously defined (Biswal et al., 1995; Buzsáki and Draguhn, 2004; Penttonen, 2003). The results suggest that the subdivided frequency bands prominently dissociate topological organisation of brain networks between drug-naive PD patients and L-dopa- treated PD patients.

5578 Computer 47

BOLD activation pattern of cerebrum for unilateral and bilateral wrist extension task among stroke patients and healthy subjects

Neha Singh [1], Dixit Sharma [1], Megha Saini [2], Sneh Anand [1], Nand Kumar [3], MV Padma Srivastava [4], S Senthil Kumaran [5], and Amit Mehndiratta[1]

[1]Centre for Biomedical Engineering, Indian Institute of Technology Delhi, New Delhi, India, [2]Department of Biomedical Engineering, All India Institute of Medical Sciences, NEw Delhi, India, [3]Department of Psychiatry, All India Institute of Medical Sciences, NEw Delhi, India, [4]Department of Neurology, All India Institute of Medical Sciences, NEw Delhi, India, [5]Department of Nuclear Magnetic Resonance, All India Institute of Medical Sciences, NEw Delhi, India

Role of wrist-extension in motor control in upper-limb post-stroke recovery is significant. We compared neural structures controlling unilateral versus bilateral movement of wrist-extension task using fMRI in 6 healthy-volunteers and 6 stroke-patients. Significant BOLD activation was observed in PG during all three tasks in healthy-volunteers. Activation with bilateral-task were considerably higher than unilateral-task. In patients with stroke as a result of re-organization, ipsi-lesion cerebellum-area shows activation for affected-hand movement not present in healthy-volunteers, supporting evidence for advantages of bilateral-training in functional imaging. Knowledge of reorganization-pattern for coordinated-movement involved in bilateral-tasks may be helpful in addressing the rehabilitation of stroke-patients.

5579 Computer 48

Awake rat functional magnetic resonance imaging using 3D printed restrainment kit and standard RF-coils

Petteri Stenroos[1], Jaakko Paasonen[1], Raimo Salo[1], Kimmo Jokivarsi[1], and Olli Gröhn[1]

[1]Biomedical Imaging Unit, A.I. Virtanen Institute for Molecular Sciences, Kuopio, Finland

		Anesthetics are typically used in preclinical functional magnetic resonance imaging (fMRI) experiments to prevent animal movement and stress, but anesthetics can significantly affect the brain function. Therefore, several awake fMRI protocols have been developed, usually implementing house-made coils and holders. In present study, we developed a 3D printable restrainment kit that is compatible with standard Bruker rat coils and holders. Subsequently, resting state functional connectivity (RSFC) data was obtained under awake, lightly sedated, and anesthetized conditions. Our results show that even subanesthetic dose of isoflurane modulates FC significantly.

Electronic Poster

Magnetic Resonance Elastography

Exhibition Hall	Thursday 14:15 - 15:15

5580	Computer 49	Accurate High Dynamic Range Displacement Measurement in MR Elastography Using a Simultaneous Dual-Sensitivity Acquisition
		Yi Sui[1], Ziying Yin[1], Joshua D. Trzasko[1], Armando Manduca[1], Kevin J. Glaser[1], Richard L. Ehman[1], and John Huston III[1]
		[1]*Radiology, Mayo Clinic, Rochester, MN, United States*
		Phase wrapping in MR Elastography (MRE) limits the dynamic range of the displacement information that can be reliably measured. We developed a novel framework that simultaneously acquires data with 2 levels of motion sensitivity, and processes this data in a manner which increases the dynamic range of the accurately measured displacements by 8-10 times. Both shear wave and large bulk (rigid-body) motion in brain can be characterized in a single scan.

5581	Computer 50	TURBINE-MRE: A 3D Hybrid Radial-Cartesian EPI Acquisition for MR Elastography
		Yi Sui[1], Arvin Arani[1], Joshua D. Trzasko[1], Shivaram P. Arunachalam[1], Kevin J. Glaser[1], Kiaran P. McGee[1], Phillip J. Rossman[1], Armando Manduca[1], Richard L. Ehman[1], John Huston III[1], and Philip A. Araoz[1]
		[1]*Radiology, Mayo Clinic, Rochester, MN, United States*
		A 3D gradient-echo EPI MR Elastography pulse sequence has been developed using a hybrid radial-Cartesian readout scheme, named Trajectory Using Radially Batched Internal Navigator Echoes (TURBINE). The feasibility of this TURBINE-MRE sequence was demonstrated in a phantom study.

5582	Computer 51	Interventional MR Elastography and thermometry using simultaneous image refocusing (SIR) for multislice monitoring of thermal therapies Kisoo Kim[1], Elodie Breton[1], Afshin Gangi[1,2], and Jonathan Vappou[1] *[1]ICube CNRS / University of Strasbourg, Strasbourg, France, [2]Department of Interventional Imaging, Strasbourg university hospital, Strasbourg, France* Interventional MR Elastography (MRE) and thermometry (PRF) using the Simultaneous Image Refocusing (SIR) technique is proposed in order to monitor changes in temperature and biomechanical properties during thermal ablations, in multiple contiguous slices. Compared to the conventional GRE-MRE sequence, two slices are acquired in each TR, with a single motion sensitizing gradient and similar fractional motion encoding. Elasticity maps obtained with SIR-GRE MRE are validated against reference single slice GRE-MRE. Preliminary experiments show the potential of contiguous multislice acquisition to monitor the volumetric extent of the heated area obtained with High Intensity Focused Ultrasound (HIFU) in a phantom.

5583	Computer 52	Finite Volume-Based Elasticity Recovery for Magnetic Resonance Elastography: Theory and Initial Results Joaquin Mura[1], Jürgen Braun[2], Ingolf Sack[3], and Eric Barnhill[3] *[1]Biomedical Imaging Center, Pontificia Universidad Católica de Chile, Santiago, Chile, [2]Medical Informatics, Charité, Berlin, Germany, [3]Radiology, Charité, Berlin, Germany* We have developed a finite-volume based elasticity recovery method for Magnetic Resonance Elastography. The method accommodates heterogeneity and compressibility, uses only first derivatives, avoids matrix inversion and can be calculated in a highly efficient stencil format. We compared the method to a Helmholtz-type wave inversion. Visually, the method shows sharper rendering of cracks and boundaries. Quantitatively the values of the new method differ from a Helmholtz-type method in proportion to the severity of interfaces, which likely reflects the new method's sharper rendering. The resolution and sensitivity of the method lower the inherent stability, which we address here with a simultaneous multifrequency wave inversion. Future work will introduce sparsity-promoting regularization to deliver both stability and structure.

5584	Computer 53	Ristretto MRE: A Generalized Multi-Shot GRE-MRE Sequence Christian Guenthner[1], Sweta Sethi[2], Ayse Sila Dokumaci[3], Ralph Sinkus[3], and Sebastian Kozerke[1] *[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Division of Research Oncology, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, [3]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom*

		The purpose of this work is to increase GRE-MRE sequence flexibility by generalizing the multi-shot eXpresso approach. We show that Ristretto MRE allows for the fine-tuning of imaging shot durations in both multi-slice and 3D-MRE acquisitions permitting significant scan time reductions without loss of image quality.

5585	Computer 54	In Vivo Cardiac MR Elastography using a Gravitational Transducer
		Ayse Sila Dokumaci[1], Torben Schneider[2], Myrianthi Hadjicharalambous[1], Stefan-Heinz Hoelzl[1], Jelizaveta Sudakova[1], Daniel Hollands[3], Ralph Sinkus[1], and David Alexander Nordsletten[1]
		[1]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Philips Healthcare, Guildford, Surrey, United Kingdom, [3]ITL Group, Ashford, Kent, United Kingdom
		MR Elastography is valuable in evaluating biomechanical stiffness of tissues, which can exhibit marked changes in case of disease. However, the number of cardiac MRE studies remains limited due to challenges in measuring the dynamic muscle tissue using existing MRE sequences and hardware. Here, we aimed to acquire reliable cardiac MRE data by combining a gravitational transducer driven by a novel synchronising strategy with a single-shot SE-EPI-MRE sequence with flow and acceleration compensated motion encoding gradients to image the myocardium in different cardiac phases. Our method reveals higher myocardial stiffness, agreeing with results from biomechanical models/simulations, conflicting with current literature.

5586	Computer 55	Accelerating MR Elastography acquisition with compressed sensing
		Hui Wang[1], Jean Tkach[2], Andrew Trout[2], Charles Dumoulin[2], and Jonathan R. Dillman[2]
		[1]Philips, Cincinnati, OH, United States, [2]Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States
		We propose the use of compressed sensing (CS) for Magnetic Resonance Elastography (MRE). Through validation in a gel phantom and subsequent measurement of liver stiffness in vivo, we demonstrate that CS MRE can be used to accelerate image acquisition, thereby shortening breath holds.

5587	Computer 56	Inversion-recovery based MR poro-elastography for biphasic analysis of tofu phantoms and in vivo human brains
		Ledia Lilaj[1], Jürgen Braun[2], Thom Fischer[3], Ingolf Sack[1], and Sebastian Hirsch[4,5]

		[1]Department of Radiology, Charité – Universitätsmedizin Berlin, Berlin, Germany, [2]Institut of Medical Informatics, Charité – Universitätsmedizin Berlin, Berlin, Germany, [3]Department of Radiology, Interdisciplinary Ultrasound Center, Charité – Universitätsmedizin Berlin, Berlin, Germany, [4]Berlin Center for Advanced Neuroimaging, Charité – Universitätsmedizin Berlin, Berlin, Germany, [5]Bernstein Center for Computational Neuroscience, Charité – Universitätsmedizin Berlin, Berlin, Germany
		A novel magnetic resonance elastography (MRE) sequence, combining inversion recovery (IR) with MRE, is introduced to quantify poroelastic properties of biphasic materials. The method is demonstrated on custom-made tofu phantoms featuring biphasic tissue properties with different porosities and elastic moduli. IR-MRE allows for the first time to study the individual fluid and matrix motion in a biphasic medium and the interactions between the two. The same technique applied to in vivo brain also confirms fundamental predictions of poroelasticity theory and demonstrates the transferability of IR-MRE from simple biphasic model materials to complex living tissues.

5588	Computer 57	Mechanical characterization of rat liver tissue in native, lysed and decellularized states by 0.5 T tabletop magnetic resonance elastography (MRE)
		Angela Ariza de Schellenberger[1,2], Hannah Everwien[3], Nils Haep[3], Igor Sauer[3], Heiko Tzschätzsch[1], Judith Bergs[1], Jürgen Braun[2], and Ingolf Sack[1]
		[1]Elastography, Department of Radiology, Charité Universitätsmedizin, Berlin, Germany, [2]Department of Medical Informatics, Charité Universitätsmedizin, Berlin, Germany, [3]Chirurgische Klinik, Charité Universitätsmedizin, Berlin, Germany
		Establishing the ideal 3D-matrix for organ regeneration is one of the big challenges in regenerative medicine. The mechanical properties of the extracellular matrix (ECM) are incompletely understood, partly due to the limited availability of volume-based mechanical test methods such as MRE. Therefore, we used a 0.5 T compact tabletop MRE system and measured the change of stiffness in rat livers due to decellularization and cell wall disruption by lysis. While the viscoelastic properties of intact liver tissue are determined by cells and can be described by a power law behavior, decellularized tissue has more solid-like properties following a Kelvin-Voigt-model behavior.

5589	Computer 58	Experimental validation of appropriate conditions for accurate and precise Magnetic Resonance Elastography: an in vitro phantom study
		Jinlong Yue[1,2], Felicia Julea[1], Tanguy Boucneau[1], Claire Pellot-Barakat[2], and Xavier Maître[1]
		[1]Imagerie par Résonance Magnétique Médicale et Multi-Modalités, IR4M, CNRS, Univ Paris-Sud, Université Paris-Saclay, Orsay, France, [2]Imagerie Moléculaire In Vivo, IMIV, Inserm, CEA, CNRS, Univ Paris-Sud, Université Paris-Saclay, Orsay, France

		Magnetic Resonance Elastography (MRE) allows to non-invasively characterize the mechanical properties *in vivo*. The reconstruction performance is challenged by multiple experimental parameters, which can be grouped into two more comprehensive parameters: number of voxels per wavelength and acquired displacement field quality. In a previous *in silico* study, we have demonstrated that appropriate λ/a condition is crucial for accurate and precise MRE and proposed a quality parameter to effectively evaluate the voxel-wise reconstruction quality. This study experimentally validated these simulation findings on commercial model phantoms.

5590	Computer 59	Clinical Validation of a Semiautomated Workflow for MR Elastography Bogdan Dzyubak[1], Sudhakar K Venkatesh[1], Glaser J Kevin[1], and Richard L. Ehman[1] *[1]Radiology, Mayo Clinic, Rochester, MN, United States* Magnetic Resonance Elastography (MRE) is a validated method for staging hepatic fibrosis utilizing MR images of acoustic wave propagation in the liver to measure hepatic stiffness. A new MRE analysis workflow, called ALEC, in which readers are presented with preliminary, automatically generated, ROIs was validated in a clinical environment using 1347 exams. The workflow failed in <1% of cases. Manual modification was performed on 18% of the exams, leading to a stiffness change of only 1% on average. The ALEC-assisted stiffness measurement workflow offers a faster and more reproducible way to perform MRE.

5591	Computer 60	Magnetic resonance elastography accuracy and precision in rat lung and liver at 1.5 T Felicia Julea[1], Hongchen Wang[1], Jin Long Yue[1], Tanguy Boucneau[1], Claire Pellot-Barakat[2], and Xavier Maître[1] *[1]Imagerie par Résonance Magnétique Médicale et Multi-Modalités, IR4M, CNRS, University Paris Sud 11, Orsay, France, [2]Imagerie Moléculaire In Vivo, IMIV, Inserm, CEA, CNRS, University Paris-Sud 11, Orsay, France* Magnetic Resonance Elastography (MRE) is a non-invasive MRI based technique for quantitatively assessing the mechanical properties of tissues. It was formerly demonstrated in a simulation study that 6 to 9 voxels per wavelength is needed to properly quantify the mechanical properties of the tissue. This study investigates the precision and the accuracy of shear wave velocity in two organs at different mechanical excitation frequency and spatial resolution to validate in vivo the optimal conditions of ERM outcomes.

5592	Computer 61	Magnetic Resonance Elastography (MRE) Reveals Muscle Instability in Middle Aged Healthy Adults

		Michael Perrins[1,2], Michiel Simons[2,3], Paul Kennedy[4], Lisa Salisbury[5], Colin Brown[6], Timothy Walsh[1,7], Edwin J.R. van Beek[2], David Griffith[1,7], and Neil Roberts[2]
		[1]MRC Centre for Inflammation Research, University of Edinburgh, Edinburgh, United Kingdom, [2]Edinburgh Imaging Facility, University of Edinburgh, Edinburgh, United Kingdom, [3]Department of Clinical Surgery, University of Edinburgh, Edinburgh, United Kingdom, [4]Department of Radiology, Icahn School of Medicine at Mount Sinai, Manhattan, NY, United States, [5]Department of Physiotherapy, Queen Margaret University, Edinburgh, United Kingdom, [6]The Mentholatum Company Ltd., East Kilbride, Glasgow, United Kingdom, [7]Anaesthesia, Critical Care and Pain Medicine, University of Edinburgh, Edinburgh, United Kingdom
		Age-related weakness and strength has been shown to have an anatomical basis, with stability of the knee being particularly prone to effects of ageing. Magnetic Resonance Elastography (MRE) was used to obtain muscle size and stiffness measurements in a ‘Younger’ and ‘Older’ group of participants. It was found that the Quadriceps muscle group were primarily impacted by age related atrophy, whilst also increasing in stiffness with age. Furthermore, the muscles along the medial side of the leg showed significantly lower muscle stiffness in ‘Older’ participants which we determined to be a biomarker for age-related anatomical instability.

5593	Computer 62	Poroelastic and Viscoelastic MRE of Experimental Phantoms Actuated at 1Hz
		Matthew McGarry[1], Ligin Solamen[1], Scott Gordon-Wylie[1], John Weaver[1,2], and Keith Paulsen[1,2]
		[1]Thayer School of Engineering, Dartmouth College, Hanover, NH, United States, [2]Dartmouth Hitchcock Medical Center, Lebanon, NH, United States
		Poroelastic and viscoelastic inversions in a 1Hz experimental MR Elastography phantom system were investigated theoretically, numerically, and experimentally. At low frequencies, viscoelastic models have a non-uniqueness issue that can be avoided by using a poroelastic model, which has an additional fluid force term to balance elastic forces when inertial forces are negligible. Numerical experiments showed poroelastic models have much higher sensitivity to global property changes compared to viscoelastic models. Inversions of experimental phantom data with a poroelastic model gave cleaner images that are less sensitive to initial property estimates compared to a viscoelastic model.

5594	Computer 63	Dynamic Magnetic Resonance Elastography (DMRE): A Novel Imaging Technique to Identify Active Muscle Recruitment
		Michiel Robert Simons[1,2], Michael Perrins[2,3], Andre Attard[4], Colin Brown[5], Neil Roberts[2], Edwin J.R. van Beek[2], and Leela Biant[6]

		[1]Department of Clinical Surgery, University of Edinburgh, Edinburgh, United Kingdom, [2]Edinburgh Imaging Facility, University of Edinburgh, Edinburgh, United Kingdom, [3]MRC Centre for Inflammation Research, University of Edinburgh, Edinburgh, United Kingdom, [4]Dept of Bioengineering, University of Strathclyde, Glasgow, United Kingdom, [5]The Mentholatum Company Ltd., East Kilbride, Glasgow, United Kingdom, [6]Department of Trauma & Orthopaedic Surgery, University of Manchester, Manchester, United Kingdom
		Dynamic Magnetic Resonance Elastography (DMRE) is a novel imaging technique which allows the quantification of muscle characteristics during a loaded MRE scan. Thigh muscle loading results in increased muscle stiffness. DMRE offers clinicians new insights into muscle engagement which aids in diagnosis and treatment for musculoskeletal pathologies. This work has shown DMRE is a sensitive tool to detect active muscle engagement.

5595	Computer 64	Thigh Muscle Recruitment Following Total Knee Replacement Surgery Using Dynamic Magnetic Resonance Elastography (DMRE)
		Michiel Robert Simons[1,2], Michael Perrins[2,3], Gwenllian Tawy[4], Colin Brown[5], Neil Roberts[2], Edwin J.R. van Beek[2], and Leela Biant[4]
		[1]Department of Clinical Surgery, University of Edinburgh, Edinburgh, United Kingdom, [2]Edinburgh Imaging Facility, University of Edinburgh, Edinburgh, United Kingdom, [3]MRC Centre for Inflammation Research, University of Edinburgh, Edinburgh, United Kingdom, [4]Department of Trauma & Orthopaedic Surgery, University of Manchester, Manchester, United Kingdom, [5]The Mentholatum Company Ltd., East Kilbride, Glasgow, United Kingdom
		In this study, Dynamic Magnetic Elastography (DMRE) is applied to a clinical cohort. DMRE scans were carried out in patients with severe OA pre and post-op Total Knee Replacement. Muscle recruitment was identified through increased muscle stiffness. Post operatively, muscle stiffness changes observed during dynamic loading were markedly less compared with their pre-op scan. This study supports the use of personalised targeted physiotherapy in muscle rehabilitation.

5596	Computer 65	Physiomechanical noise in brain magnetic resonance elastography
		Charlotte A Chaze[1] and Curtis L Johnson[1]
		[1]Department of Biomedical Engineering, University of Delaware, Newark, DE, United States

		Magnetic resonance elastography (MRE) is an emerging MRI technology that enables in-vivo quantitative assessment of tissue stiffness, which changes with age and in disease states. The accuracy and precision of brain MRE property maps are generally noise-limited; however, most noise assessments don't appropriately consider contributions from physiological and mechanical noise sources, such as cardiac pulsation, table shaking, and imperfect actuation. In this work, we designed and carried out experiments to isolate these sources of noise. We found increasing noise from physiological vibration sources with varying behavior through space and time.

5597	Computer 66	Wave propagation in multi-excitation magnetic resonance elastography of the brain
		Daniel R Smith[1], Philip V Bayly[2], Anthony J Romano[3], and Curtis L Johnson[1]
		[1]Biomedical Engineering, University of Delaware, Newark, DE, United States, [2]Mechanical Engineering and Materials Science, Washington University in St. Louis, St. Louis, MO, United States, [3]Naval Research Laboratory, Code 7160, Washington, DC, United States
		MR elastography (MRE) is capable of measuring the mechanical properties of the human brain; however, MRE generally assumes isotropic properties and misses the anisotropic behavior of brain white matter. Anisotropic MRE methods are under development, and the use of multiple wave propagation directions is likely necessary for accurate inversion. In this work, we characterize waves in brain MRE from multiple excitations and evaluate whether sufficient wave propagation is present. We find that multi-excitation MRE motion fields in the brain exhibit wave content in white matter tracts sufficient for anisotropic inversion.

5598	Computer 67	3D Magnetic Resonance Elastography of the Lungs in A Breathhold: A Reproducibility Study.
		Faisal Fakhouri[1,2], Huiming Dong[1,2], and Arunark Kolipaka[1,2,3]
		[1]Department of Biomedical Engineering, The Ohio State University, Columbus, OH, United States, [2]Department of Radialogy, The Ohio State University - Wexner Medical Center, Columbus, OH, United States, [3]Department of Internal Medicine-Division of Cardiology, The Ohio State University - Wexner Medical Center, Columbus, OH, United States
		Lung stiffness changes with different diseases; in which some diseases make the lung stiffer while others make it softer. This study was performed on 15 healthy volunteers to validate the reproducibility of proposed technique and to determine a base line shear stiffness of healthy lungs at both residual volume (RV) and total lung capacity (TLC) by using magnetic resonance elasotgraphy (MRE). It was found that the actual shear stiffness of the lung at RV is 0.66±0.11 kPa and at TLC is 1.05±0.31 kPa. Also, the technique was successfully reproducible with high correlation coefficients (R^2=0.879 at RV and R^2=0.961 at TLC).

5599	Computer 68	Helmholtz Inversion Using Unconstrained Optimization for MR Elastography Huiming Dong[1,2], Rizwan Ahmad[2], and Arunark Kolipaka[1,2] *[1]Department of Radiology, The Ohio State University Wexner Medical Center, Columbus, OH, United States, [2]Department of Biomedical Engineering, The Ohio State University, Columbus, OH, United States* MR elastography (MRE) is a phase-contrast MR technique in which the shear stiffness of soft tissues can be estimated. Helmholtz equation-based inversion is used to obtain stiffness of interest from MRE measurements. It is challenging to accurately estimate stiffness due to the presence of noise. In this work, an inversion method based on unconstrained optimization has been proposed where noise is reduced from the measured data while the sparsity of stiffness map in wavelet domain is being explored. Results demonstrated that optimization yielded more accurate stiffness estimation with lower root-mean-square error and lower maximum error when compared to local-frequency estimation.

5600	Computer 69	Power-Law Multi-Frequency MR Elastography of the Human Brain with Super-resolution Imaging via Non-Linear Inversion Elijah E.W. Van Houten[1], Julien Testu[2], Florian Dittmann[3], Matthew D.J. McGarry[4], John B. Weaver[4,5], Keith D. Paulsen[4,5], and Ingolf Sack[3] *[1]Département de génie mécanique, Université de Sherbrooke, Sherbrooke, QC, Canada, [2]SoundBite Medical Solutions Inc., Sherbrooke, QC, Canada, [3]Department of Radiology, Charité-Universitätsmedizin, Berlin, Germany, [4]Thayer School of Engineering, Dartmouth College, Hanover, NH, United States, [5]Department of Radiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH, United States* This abstract presents a non-linear inversion based power-law multi-frequency MR Elastography reconstruction, capable of reconstructing images at resolutions finer than the acquired displacement data. Reconstructed power-law parameters are compared with those obtained by logarithmic regression based on mono-frequency reconstructions of the same data.

5601	Computer 70	Comparison of Magnetic Resonance Elastography (MRE) Inversion Reproducibility using MDEV and MREdge in the Brain for the Same Subjects at 1.5, 3 and 7 Tesla Helen Marshall[1,2], Lucy Hiscox[1,3], Michael Perrins[1,2], Ingolf Sack[4], Jürgen Braun[4], Tom Meyer[4], Tim Herrmann[5], Johannes Bernarding[5], Edwin J R van-Beek[1], Neil Roberts[1], and Eric Barnhill[4]

		[1]University of Edinburgh, Edinburgh, United Kingdom, [2]Centre for Inflammation Research, Queen's Medical Research Institute, University of Edinburgh, Edinburgh, United Kingdom, [3]Alzheimer Scotland Dementia Research Centre, University of Edinburgh, Edinburgh, United Kingdom, [4]Department of Radiology, Charité – Universitätsmedizin Berlin, Berlin, Germany, [5]Institute for Biometrics and Medical Informatics, Otto von Guericke University Magdeburg, Magdeburg, Germany
		Magnetic Resonance Elastography (MRE) provides quantitative measures of the mechanical properties of biological tissues. As MRE becomes more widely used, it is important to assess different methods of data acquisition and analysis. In this study, a comparison was made between 3 field strengths using Multi-frequency duel Elasto Visco inversion (MDEV) and the new MREdge pipeline. Both inversions demonstrated significant differences in stiffness at each field strength, MDEV also displayed excellent correlation at 1.5, 3 and 7T. MDEV remains the preferred method of inversion with MREdge offering the prospect of an automatic pipeline which provides stiffness estimates for specific brain regions.

5602	Computer 71	Real-time ECG-gated continuous vibration multi-shot spiral elastography acquisition: application to time-resolved cerebral stiffness measurements during arterial pulsation.
		Carsten Warmuth[1,2], Felix Schrank[1], Thomas Elgeti[1], Jürgen Braun[3], and Ingolf Sack[1]
		[1]Department of Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Visage Imaging GmbH, Berlin, Germany, [3]Institute for Medical Informatics, Charité - Universitätsmedizin Berlin, Berlin, Germany
		We implemented a versatile spiral MRE sequence that synchronizes the acquisition in real-time to a continuous harmonic vibration. Using multi-shot gradient echo readout and fractional motion encoding, multiple phases can be acquired in the cardiac cycle with high temporal resolution. Optionally, prospective respiratory gating and slice tracking allow for imaging moving organs like the heart or the liver in free breathing. As a first application, we measured cerebral stiffness maps in multiple phases of the cardiac cycle to detect changes induced by arterial pulsation.

5603	Computer 72	Magnetic Resonance Elastography Measures Predict White Matter Microstructure and Aging
		Boris Gutman[1], Aaron T Anderson[2,3], Nicolas Gallo[4], and John G Georgiadis[4]
		[1]Stevens Neuroimaging and Informatics institute, University of Southern California, Marina Del Rey, CA, United States, [2]Mechanical Science & Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [4]Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, United States

		We assessed the relationship between microstructural measures derived from diffusion tensor imaging (DTI) and shear moduli estimated from magnetic resonance elastography (MRE). We also compared the predictive power of fractional anisotropy, storage and loss moduli, estimation using nonlinear inversion (NLI) to model age in humans. Our results suggest some statistical relationship between MRE measures, particularly the loss modulus, and microstructure (FA, RD). The decrease in FA with age is accompanied by an increase in viscosity, especially in association fibers (Superior Longitudinal Fasciculus). The regional MRE measure provides more predictive power than the best regional FA.

Electronic Poster

Contrast Mechanisms: Relaxation & More

Exhibition Hall	Thursday 14:15 - 15:15

5604	Computer 73	Improve PCASL Brain Imaging at 7T Using Dynamically Applied B1+ Shimming Solutions
		Xiufeng Li[1], Dingxin Wang[1], Xiaoping Wu[1], Pierre-Francois Van de Moortele[1], Kamil Ugurbil[1], and Gregory J. Metzger[1]
		[1]Center for Magnetic Resonance Research, School of Medicine, University of Minnesota, Minneapolis, MN, United States
		The rapid decline of transmit B_1 (B_1^+) toward the inferior brain regions and large B_1^+ inhomogeneity across blood feeding arteries at the labeling plane impose great challenges for high quality pseudo-continuous arterial spin labeling (PCASL) brain imaging at 7T. Recent studies at 7T have suggested that dynamically applied B_1^+ shimming solutions separately targeted to imaging and labeling regions can help to overcome these challenges. We implemented and evaluated the dynamic B_1^+ shimming approach for PCASL brain imaging at 7T, demonstrating that such an approach can greatly improve B_1^+ performance for blood tagging.

5605	Computer 74	Characterize the relaxation effect during the adiabatic radiofrequency (RF) pulses on relaxation model for continuous wave constant amplitude spin-lock
		Weitian Chen[1] and Baiyan Jiang[1]
		[1]Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong, Hong Kong

		Adiabatic RF pulses can be used for simultaneous compensation of B1 RF and B0 field inhomogeneity during continuous wave constant amplitude spin-lock. However, due to a relatively long duration of the adiabatic RF pulses, the relaxation effect during the adiabatic RF pulses can introduce a non-negligible effect on the conventional mono-exponential model used to describe T1rho relaxation during the spin-lock. Consequently, quantification using the conventional model can introduce errors. Based on Bloch equations, we derived that such relaxation effect contributes a DC component to the conventional mono-exponential model. We used simulation and in vivo MRI scan to demonstrate our theory.

5606	Computer 75	Validation of Fat Quantitation in Human Liver using SSGR technique
		Meining Chen[1], Hai Luo[1], Beck Zhu[1], Richard Chou[1], Chao Wang[1], Xia Liu[1], Wei Bian[1], and Ziyue Wu[1,2]
		[1]Alltech Medical Systems, Chengdu, China, [2]Alltech Medical System America, Solon, OH, United States
		MRI has become the mainstay for noninvasive fat quantification in liver in routine clinical practice. To quantify fat fraction, the Dixon method is used most often. However, it is associated with a nontrivial image reconstruction process. In this study, we aim to perform fat quantification using the slice-selective gradient reversal (SSGR) technique, which was proposed previously but has not been validated in human liver. Our evaluation shows that the technique can efficiently separate water and fat, quantifying fat fraction that is highly correlated with that using the Dixon method.

5607	Computer 76	Comparison of two alternative sequences for human in-vivo brain MR Current Density Imaging (MRCDI)
		Cihan Göksu[1,2], Lars G. Hanson[1,2], Hartwig R. Siebner[2,3], Philipp Ehses[4,5], Klaus Scheffler[4,6], and Axel Thielscher[1,2]
		[1]Center for Magnetic Resonance, DTU Elektro, Technical University of Denmark, Kgs. Lyngby, Denmark, [2]Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital, Hvidovre, Denmark, [3]Department of Neurology, Copenhagen University Hospital, Bispebjerg, Denmark, [4]High-Field Magnetic Resonance Center, Max-Planck-Institute for Biological Cybernetics, Tübingen, Germany, [5]German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany, [6]Department of Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany
		MRCDI is a novel technique, utilizing different phase-sensitive MR methods for non-invasive measurements of weak currents in the human body, which is important in several neuroscience applications. Here, we compare the in-vivo performance of two different MR methods, multi-echo spin echo (MESE) and steady-state free precession free induction decay (SSFP-FID), with single- vs. multi-gradient-echo readouts. We demonstrate that multi-gradient-echo readouts improve both methods. We validate the linear dependence of the measured current-induced magnetic field on the injected current strength for both methods, and propose the more efficient SSFP-FID method as being well suited for highly sensitive single-slice human in-vivo MRCDI.

5608	Computer 77	Magnitude and Complex Single- and Multi-echo Water Fat Separation via End-to-End Deep Learning
		James W Goldfarb[1] and Jie Jane Cao[1]
		[1]Research and Education, St Francis Hospital, Roslyn, NY, United States
		The feasibility of water-fat separation using an end-to-end ConvNet approach was demonstrated for complex, magnitude and single echo acquisitions. The ConvNet approach showed images visually comparable to the GraphCut method with slightly higher signal to noise in typical cardiac image planes. Quantitative PDFF, R2* and off-resonance values had excellent correlation with a conventional analytical model based method. ConvNet based water-fat separation is a promising method capable of learning the water-fat separation problem with corrections for bipolar gradients, a multi-peak model, R2* and off-resonance.

5609	Computer 78	Multicenter Validation of the Magnetic Resonance T2* Technique for Quantification of Pancreatic Iron
		Antonella Meloni[1], Vincenzo Positano[1], Daniele De Marchi[1], Laura Pistoia[1], Stefania Renne[2], Riccardo Righi[3], Paolo Preziosi[4], Nicolò Schicchi[5], Massimiliano Missere[6], Antonino Vallone[7], Giuseppe Peritore[8], Ada Riva[9], Emanuele Grassedonio[10], and Alessia Pepe[1]
		[1]Fondazione G. Monasterio CNR-Regione Toscana, Pisa, Italy, [2]Presidio Ospedaliero “Giovanni Paolo II”, Lamezia Terme, Italy, [3]Ospedale del Delta, Lagosanto (FE), Italy, [4]Ospedale "Sandro Pertini", Roma, Italy, [5]Azienda Ospedaliero-Universitaria Ospedali Riuniti "Umberto I-Lancisi-Salesi", Ancona, Italy, [6]Fondazione di Ricerca e Cura "Giovanni Paolo II", Campobasso, Italy, [7]Azienda Ospedaliera "Garibaldi" Presidio Ospedaliero Nesima, Catania, Italy, [8]"ARNAS" Civico, Di Cristina Benfratelli, Palermo, Italy, [9]Ospedale “SS. Annunziata” ASL Taranto, Taranto, Italy, [10]Policlinico "Paolo Giaccone", Palermo, Italy
		The gradient-echo T2* MRI technique is an accurate and reproducible means for the calculation of pancreatic iron and may be transferred between MRI scanners in different centers from different manufacturers

5610	Computer 79	Robust Water-Fat Separation in Multi-Echo GRE Sequence using Patch-Based Neural Network
		JaeJin Cho[1], Kinam Kwon[1], Seohee So[1], Byungjai Kim[1], and HyunWook Park[1]
		[1]Korea Advanced Institute of Science and Technology (KAIST), DaeJeon, Republic of Korea

		The water-fat separation techniques using a multi-echo GRE sequence has suffered from an inaccurate and swapped water-fat separation results caused by several issues. In the abstract, we propose a robust water-fat separation method using patch-based neural network to overcome this problem. The neural network is trained using the relationship between the multi-echo images obtained from the multi-echo GRE sequence and the reliable water-fat separated images that are reconstructed by IDEAL from the multiple single-echo GRE acquisitions with different echo times. The in-vivo experiment results show the proposed method can successfully separate accurate water-fat images from the multi-echo GRE images in comparison with IDEAL.

5611	Computer 80	A non-local low rank approach for high resolution parameter mapping
		Sagar Mandava[1], Zhitao Li[1], Diego R Martin[2], Maria I Altbach[2], and Ali Bilgin[1,2]
		[1]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States, [2]Department of Medical Imaging, University of Arizona, Tucson, AZ, United States
		Inversion recovery (IR) based single-shot approaches have become popular for rapid T1 mapping. Due to the highly accelerated nature of the acquisition, it is challenging to generate high quality contrast images and T1 maps from this dataset. To tackle this problem, we present a non-local low rank regularization model that is inspired by block matching approaches. For a given relaxation signal, we identify the top L similar relaxation signals within a spatial neighborhood and constrain them to have a low rank. We demonstrate this approach in single-shot high-resolution radial steady-state-free-precession (SSFP) brain and abdomen imaging.

5612	Computer 81	Technical Challenges in Measuring Adipose Tissue T2*
		Maximilian N. Diefenbach[1], Franziska Treibel[1], Daniela Franz[1], Jan Syväri[1], Stefan Ruschke[1], Holger Eggers[2], and Dimitrios C. Karampinos[1]
		[1]Diagnostic and Interventional Radiology, Technical Univeristy of Munich, Munich, Germany, [2]Philips Research Laboratory, Hamburg, Germany
		This work investigates the accuracy and precision of T_2^* estimated from standard water–fat imaging techniques with respect to the *a priori* assumed fat spectrum. A bias in measuring T_2^* with a low number of echoes and a mismatch of the *a priori* to the true fat spectrum is detected. Through simulations and *in vivo* scans it is shown how the bias is reduced by increasing the number of echoes. Results also indicate remaining inaccuracies due to a mismatch in the assumed fat spectrum to the true fat spectrum in a voxel.

5613	Computer 82	Brain Tumor and Prostate EPI MR Elastography Distortion Reduction and Correction Using rFOV and PSF-EPI Techniques

		Yi Sui[1], Myung-Ho In[1], Kay M. Pepin[1], Kevin J. Glaser[1], Erin M. Gray[1], Phillip J. Rossman[1], Matt A. Bernstein[1], Richard L. Ehman[1], and John Huston III[1]
		[1]Radiology, Mayo Clinic, Rochester, MN, United States
		Image distortion is a common problem in EPI-based MR elastography (MRE) acquisitions, especially in regions with high susceptibility, including regions adjacent to air-tissue interfaces, such as the paranasal sinuses and the prostate. In this study, we explored a reduced-field-of-view (rFOV) technique and a point-spread-function (PSF) mapping EPI correction method to reduce or correct the distortions in EPI MRE images of brain tumors and the prostate.

5614	Computer 83	Dual Echo Water-Fat Separation Using Deep Learning
		Tao Zhang[1], Yuxin Chen[2], Shreyas Vasanawala[3], and Ersin Bayram[1]
		[1]Global MR Applications and Workflow, GE Healthcare, Houston, TX, United States, [2]Electrical Engineering, Princeton University, Princeton, NJ, United States, [3]Radiology, Stanford University, Stanford, CA, United States
		Water-fat separation is widely used in many MR applications and is known to be challenging in various situations. Traditionally, region growing, spatial smoothing, and global optimization have been applied in dual echo water-fat separation. These methods require complex-valued images acquired at two echo times and occasionally suffer from global or local swaps due to inaccurate field map estimation. In this work, a deep learning approach for dual echo water-fat separation is investigated.

5615	Computer 84	Accuracy of Fatty Acid Quantification using Bipolar Multi-Echo MRI for Varying Numbers of Echoes
		Manuel Schneider[1], Felix Lugauer[1], Elisabeth Hoppe[1], Dominik Nickel[2], Brian M Dale[3], Berthold Kiefer[2], Andreas Maier[1], and Mustafa R Bashir[4,5]
		[1]Pattern Recognition Lab, Department of Computer Science, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [2]MR Application Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany, [3]MR R&D Collaborations, Siemens Healthineers, Cary, NC, United States, [4]Radiology, Duke University Medical Center, Durham, NC, United States, [5]Center for Advanced Magnetic Resonance Development, Duke University Medical Center, Durham, NC, United States
		Multi-echo MRI data can be used to quantify the fatty acid composition of human adipose tissue. The total echo train readout length and the number of acquired echoes are important parameters affecting the overall accuracy of the fatty acid parameter maps. The purpose of this study was to quantify the expected error in fatty acid estimates depending on the used total echo train readout length, using an oil phantom at 3T. Echo train readout lengths of at least 13-14ms were required to accurately estimate the different fat components. Shorter echo train readouts led to less accurate parameter maps.

5616	Computer 85	Quantitative Assessment of Early Lens Disease in Type 2 Diabetic Patient Using T1 and T2-Mapping Ma Junchao[1], Xu Xiaotong[1], Wang Shaoyu[2], and Yu Nan[1] *[1]The affiliated hospital of Chinese traditional medical university, Xian Yang, China, [2]Siemens Healthcare, Scientific marketing, Xian Yang, China* This study aimed to explore the feasibility of magnetic resonance T1 and T2 mapping techniques in the evaluation of early complications of lens in type two diabetes mellitus. Patients with type two diabetes mellitus with negative eye slit lamp examination and control group underwent eye MRI scanning, T1 and T2 mapping sequences were collected, and two samples t test was used to analyze the differences of T1 and T2 values between groups. The values of T1 and T2 in diabetic group were significantly higher than those in control group. Magnetic resonance T1 and T2 mapping techniques can detect abnormal lens in diabetic patients with negative slit lamp examination.

5617	Computer 86	Single Breath-hold 3D T2-weighted bSSFP Imaging (T2-TIDE) for Treatment Planning on a Low-field MRI-guided Radiotherapy System Yu Gao[1,2], Fei Han[1], Ziwu Zhou[1], Jiaxin Shao[1], Percy Lee[3], Ann Raldow[3], Daniel A Low[2,3], Yingli Yang[2,3], and Peng Hu[1,2] *[1]Department of Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Physics and Biology in Medicine IDP, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Radiation Oncology, University of California, Los Angeles, Los Angeles, CA, United States* A T2-transition into driven equilibrium (T2-TIDE) technique along with compressed sensing reconstruction was proposed to generate 3D T2-weighted images in a single breath-hold for radiotherapy treatment planning on a low-field MRI-guided radiotherapy system. Phantom and volunteer studies were performed to determine the optimal parameters that provided the best contrast. Five patients with abdominal tumors were recruited to compare the proposed T2-TIDE technique with the conventional bSSFP approach. Improved tumor/organ contrast were observed for all five patients, indicating the superior quality of T2-TIDE technique for tumor/organ delineation.

5618	Computer 87	T1 and T2 relaxation times of uterus and cervical cancer in vivo at 1.5T Xue Wu[1], Stacie L Mackey[2], Carol H Bertelsman[2], Yuan (James) Rao[1], Jacqueline E Zoberi[1], Jose Garcia-Ramirez[1], Perry W Grigsby[1], Stephanie S Markovina[1], Julie K Schwarz[1], Sasa Mutic[1], and H Michael Gach[1] *[1]Radiation Oncology, Washington University in St Louis, St Louis, MO, United States, [2]Radiation Oncology, Barnes-Jewish Hospital, St Louis, MO, United States*

		T_1 and T_2 maps were acquired at 1.5 T in three cervical cancer patients (52.3±9.0 years) receiving brachytherapy and external beam radiation therapy. Measurements occurred at weeks 1, 3, and 6, where possible. The average T_1 values were 1448.2 ± 209.1ms in the uterus and 1242.9 ± 202.4 ms in the tumor tissue (cervical carcinoma). The average T_2 values were 86.4 ± 15.6 ms in the uterus and 81.1 ± 20.6 ms in the tumor. There was no significant difference in the T_1 and T_2 in the uterus and tumor based on an analysis of variance.

5619	Computer 88	Simultaneous T_1/T_2 Mapping of Hyperpolarized ^{13}C Compounds using the bSSFP Sequence
		Eugene Milshteyn[1], Galen D. Reed[2], Jeremy W. Gordon[1], Peng Cao[1], Cornelius von Morze[1], Shuyu Tang[1], Andrew Leynes[1], Peder E. Z. Larson[1], and Daniel B. Vigneron[1]
		[1]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States, [2]GE Healthcare, Dallas, TX, United States
		Hyperpolarized ^{13}C imaging development has enabled monitoring of different physiological processes, such as metabolism and perfusion, in various diseases, such as cancer and diabetes. The relaxation parameters T_1 and T_2 are essential in sequence optimization and modeling, and can be used for assessment of healthy versus diseased tissue. The goal of this project was to develop and apply simultaneous *in vivo* T_1 and T_2 mapping of hyperpolarized ^{13}C probes using bSSFP sequence. Results indicated multiple approaches can be used to obtain high resolution T_1 and T_2 maps.

5620	Computer 89	Magnetization Transfer contrast in in-vivo Locus Coeruleus and Substantia Nigra compared to a Neuromelanin phantom
		Stan C. J. van Boxel[1], Nikos Priovoulos[1], Heidi I.L. Jacobs[1,2,3], Benedikt A. Poser[2], and Dimo Ivanov[2]
		[1]Faculty of Health, Medicine and Life science, Alzheimer Center Limburg, Maastricht University, Maastricht, Netherlands, [2]Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands, [3]Department of Radiology, Division of Nuclear Medicine and Molecular Imaging, Massachusetts General Hospital/Harvard Medical School, Boston, MA, United States
		Magnetization Transfer (MT) MRI has proven valuable in imaging the Locus Coeruleus (LC) and Substantia Nigra (SN). The MT contrast in the LC and SN is assumed to be caused due to the accumulation of neuromelanin. An agar-based phantom containing samples of two neuromelanin models was compared to the *in vivo* human LC and SN. MT spectra and relaxation times of the phantom, LC and SN were measured. While LC and SN show less MT effect, the phantom does not show neuromelanin-specific MT contrast, suggesting that these models are not representative of the *in vivo* LC and SN.

5621	Computer 90	Liquid Crystal Magnetic Resonance Visible Thermometer Kathryn E Keenan[1], Elizabeth Mirowski[2], Michael Snow[2], Karl F Stupic[1], and Stephen E Russek[1] *[1]Physical Measurement Laboratory, National Institute of Standards and Technology, Boulder, CO, United States, [2]High Precision Devices, Boulder, CO, United States* A magnetic resonance thermometer with liquid crystal compartments was designed and prototyped to provide a method of non-invasively measuring temperature when imaging MR phantoms. We successfully demonstrate the liquid crystal MR visible (LC-MRV) thermometer using different, fast, sequences on both pre-clinical and clinical systems. The LC-MRV thermometer is designed to exhibit rapid cholesteric to isotropic transitions in the room temperature range spanning 15.0°C to 25.0°C in 0.1°C to 1.0°C increments. It is demonstrated that the LC-MRV thermometer is resilient to large magnetic fields and therefore variations in the magnetic field, providing an accurate determination of the temperature during quality control scans where bore temperatures can vary day-to-day and scanner-to-scanner. It also provides a rapid assessment of temperature changes over the duration of the scan.

5622	Computer 91	Accuracy of 2D APT imaging with short acquisition time based on a self B0 correction using the TSE-Dixon method Chiaki Tokunaga[1], Tatsuhiro Wada[1], Osamu Togao[2], Yasuo Yamashita[1], Kouji Kobayashi[1], and Yoshiyuki Umezu[1] *[1]Division of Radiology, Department of Medical Technology, Kyushu University Hospital, Fukuoka, Japan, [2]Department of Clinical Radiology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan* The purpose of our study was to investigate the accuracy of amide proton transfer (APT) imaging using the Dixon method. Five samples were prepared from egg white albumin at the different concentration diluted with phosphate buffer solution. We measured APT signal intensities of the phantoms using the conventional method with separate B0 map and the TSE-Dixon method. No statistical significant differences were found among the APT weighted signals measured with the two different acquisition methods at each concentration. The TSE-Dixon method enabled shorter acquisition time and had an equivalent quantitative accuracy compared to the conventional method with separate B0 mapping.

5623	Computer 92	Approximation of Contrast Source for Fast Integral-Based MR-EPT and the Calculation of Incident Electric Field Lei Guo[1], Jin Jin[1], Mingyan Li[1], Yaohui Wang[2], Chunyi Liu[1], Haiwei Chen[1], Feng Liu[1], and Stuart Crozier[1] *[1]ITEE, The University of Queensland, Brisbane, Australia, [2]South China University of Technology, Guangzhou, China*

		Integral-based Magnetic Resonance Electrical Properties Tomography (MR-EPT), has seen rapid development in recent years. Compared with differential-based MR-EPT methods, integral-based methods are less sensitive to measurement noise and free from boundary conditions. The integral-based MR-EPT methods rely on the global convolution between the Green function and the contrast source, and also require the knowledge of incident fields. This study investigates a novel method to approximate the contrast source, and then utilizes this approximation to calculate the incident electric fields.

5624	Computer 93	Monte Carlo Bloch Simulation of T1, T2 uncertainties in NMR and MRI pulse sequences
		Stephen E Russek[1], Michael A Boss[1], Andrew M Dienstfrey[1], Zydrunas Gimbutas[1], Kathryn E Keenan[1], Jolene D Splett[1], and Karl F Stupic[1]
		[1]NIST, Boulder, CO, United States
		A Monte Carlo Bloch solver has been developed and used to establish the bias and uncertainty of T1, T2 values in primary reference solutions for MRI phantoms. Errors and uncertainties are on the order of 1% when using a NMR system and robust pulse sequences. Errors and uncertainties in MRI systems are much larger, 5% to 40% for T1 values. The Monte Carlo Bloch solver can help determine uncertainties and imperfections in a scanner and then determine the bias and uncertainty of measured biomarkers for different pulse sequences. At present, the source of the large errors and scanner-to-scanner variation in T1 and T2 measured using the NIST/ISMRM system phantom are unknown.

5625	Computer 94	Measuring the reproducibility of time-encoded pseudo-continuous arterial spin labeling with a perfusion phantom
		Jeffrey Visser[1], Aaron Oliver-Taylor[2], Tom Hampshire[2], Juan Antonio Hernandez-Tamames[3], Marion Smits[3], Xavier Golay[2,4], and Esther Warnert[1]
		[1]Radiology & Nuclear Medicine, Erasmus MC, Rotterdam, Netherlands, [2]Gold Standard Phantoms Limited, London, United Kingdom, [3]Department of Radiology & Nuclear Medicine, Erasmus MC, Rotterdam, Netherlands, [4]University College London, London, United Kingdom
		Arterial Spin Labeling (ASL) is a magnetic resonance imaging (MRI) technique for measuring cerebral blood flow (CBF). Here, we present data on the reproducibility of measuring CBF with time-encoded multi post-labeling delay (PLD) pseudo-continuous ASL (pCASL) in a healthy volunteer compared to a flow phantom. This work shows the potential of using a flow phantom to assess the reproducibility of quantified CBF with ASL.

5626	Computer 95	T1 mapping based on Look-Locker and variable-flip-angle techniques: comparison in phantom measurements and in a patient collective

		Claudia Fellner[1], Stefanie Pölsterl[1], Niklas Verloh[1], Dominik Nickel[2], Stephan Kannengießer[2], Philipp Wiggermann[1], Christian Stroszczynski[1], and Michael Haimerl[1]
		[1]Institute of Radiology, University Hospital Regensburg, Regensburg, Germany, [2]MR Applications Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany
		Two methods for T1 mapping – 2D Look-Locker (LL) and 3D variable-flip-angle (VFA) combined with a 2-point-Dixon technique – were compared in phantom and patient measurements. LL yielded reliable results with homogeneous T1 maps of the liver, but was restricted to 3 slices. VFA yielded T1 mapping of the whole liver, but the homogeneity of T1 values across the liver was reduced which led to marked reduction of mean T1 in some patients compared with LL. The VFA variants based on in-phase and water signals showed differences in T1 for increased hepatic fat.

5627	Computer 96	3D isotropic multi-parameter mapping and synthetic imaging of the brain with 3D-QALAS: comparison with 2D MAGIC
		Ken-Pin Hwang[1], Suchandrima Banerjee[2], Tao Zhang[3], and Marcel Warntjes[4]
		[1]Department of Imaging Physics, The University of Texas M.D. Anderson Cancer Center, Houston, TX, United States, [2]MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [3]MR Applications and Workflow, GE Healthcare, Waukesha, WI, United States, [4]SyntheticMR, Linkoping, Sweden
		3D QALAS is a promising new technique that simultaneously maps T1, T2, and PD in a single 3D acquisition. Both 3D QALAS and 2D MAGIC were applied for synthetic imaging and quantification in human brains. While T1 and T2 values were comparable between the two techniques, 3D QALAS was simpler to process and achieved smaller voxel sizes over larger matrices with similar acquisition times, resulting in less partial volume effects. 2D MAGIC maintained the high in-plane resolution and efficiency of an interleaved multi-slice technique. 3D QALAS thus presents an attractive quantification method for therapy planning and tissue volume measurement applications.

Electronic Poster

Parameter Quantification

Exhibition Hall	Thursday 14:15 - 15:15

5628	Computer 97	3D multi-parameter mapping of the breast with Dixon fat-water separation
		Ken-Pin Hwang[1], Jong Bum Son[1], Suchandrima Banerjee[2], Tao Zhang[3], Jingfei Ma[1], Gaiane Margishvili Rauch[4], and Marcel Warntjes[5]

[1]Department of Imaging Physics, The University of Texas M.D. Anderson Cancer Center, Houston, TX, United States, [2]MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [3]MR Applications and Workflow, GE Healthcare, Waukesha, WI, United States, [4]Department of Radiology, The University of Texas M.D. Anderson Cancer Center, Houston, TX, United States, [5]SyntheticMR, Linkoping, Sweden

3D QALAS is a promising new technique that simultaneously maps T1, T2, and PD in a single 3D acquisition. However, the presence of fat can confound multi-parameter mapping of voxels with mixed species. We modified the sequence to acquire dualecho readouts and apply a joint field map estimation across all echoes to produce water-only images for multi-parameter fitting. The technique was applied in the breast and parameter maps were compared with those generated from a 2D unsuppressed acquisition. By eliminating partial volume effects of fat, the technique potentially extends the use of 3D multi-parameter mapping into body, breast, and spine.

5629 | Computer 98

Comparison of reconstruction algorithms for quantitative susceptibility mapping in the upper abdomen

Taisuke Harada[1], Kohsuke Kudo[1], Ryota Sato[2], Masato Yoshikawa[1], Satoshi Yabusaki[1], Toru Shirai[2], and Yoshitaka Bito[3]

[1]Department of Diagnostic and Interventional Radiology, Hokkaido University Hospital, Sapporo, Japan, [2]Research & Development Group, Hitachi, Ltd., Tokyo, Japan, [3]Healthcare Business Unit, Hitachi, Ltd., Tokyo, Japan

We compared three QSM reconstruction algorithms for use in the upper abdomen: the water-fat separation method (WF), MUDICK, and iLSQR. A healthy male was scanned nine times, in different positions, and three QSM reconstructions from the same source data were compared. The intra-scan SD, representing image homogeneity among images, and the inter-scan SD, representing repeatability among scans, were lower in WF than in MUDICK and iLSQR. Thus, the WF method yielded better homogeneity and repeatability for susceptibility values in the upper abdomen. This forms the basis for further clinical studies and applications of QSM in the abdomen.

5630 | Computer 99

Fast 3D Multi-Parameter Mapping of Relaxation Times and Susceptibility Using Partially RF-Spoiled Gradient Echo at 3T

Yo Taniguchi[1], Suguru Yokosawa[1], Toru Shiraii[1], Ryota Sato[1], Tomoki Amemiya[1], Hisaaki Ochi[1], and Yoshihisa Soutome[1]

[1]Research & Development Group, Hitachi, Ltd., Kokubunji, Tokyo, Japan

		A method is presented to simultaneously quantify multiple tissue parameters, including susceptibility, by using a partially RF-spoiled gradient echo sequence. The method successfully obtained whole-brain T1, T2*, PD, B1, and susceptibility maps in 1.1-mm isotropic resolution in 12 minutes at 3T. T1, T2*, PD, and B1 maps were estimated simultaneously by a least-squares fit using twelve 3D source images. The intensity function for the fit was formulated by Bloch simulations. Scan parameters were optimized for T1 and T2* values of the brain at 3T. The susceptibility map was estimated by using six multi-echo images in the source images.

5631	Computer 100	Robust PD mapping using multi-contrast variable flip angle (VFA) data
		Sara Lorio[1], Tim Tierney[2], Amy McDowell[1], Owen Arthurs[3], Antoine Lutti[4], Nikolaus Weiskopf[5], and David W. Carmichael[1]
		[1]Great Ormond Street Institute of Child Health, UCL, London, United Kingdom, [2]Wellcome Trust Centre for Neuroimaging, UCL, London, United Kingdom, [3]Department of Radiology, Great Ormond Street Hospital, London, United Kingdom, [4]LREN, University of Lausanne, Dept. of clinical neurosciences, CHUV, Lausanne, Switzerland, [5]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
		Proton density (PD) maps measure the amount of free water molecules in the tissue and can be used in a range of neurological disorders. However, current PD estimation methods in the brain rely on anatomical prior information which can be problematic in the case of severe tissue abnormalities. Here we propose a new approach for PD mapping based on a multi-contrast acquisition protocol, and a data-driven estimation method for inhomogeneity correction and map scaling. This approach can be applied on ex-vivo samples and in case of pronounced brain pathology because it does not require any anatomical nor tissue information.

5632	Computer 101	Validation of a quantitative susceptibility mapping acquisition and reconstruction pipeline using a new iron sucrose based MR susceptibility phantom.
		Jeremy Deverdun[1], Francois Molino[2], Nicolas Menjot de Champfleur[1], and Emmanuelle Le Bars[1]
		[1]Neuroradiology, I2FH - CHU Gui de Chauliac, Montpellier, France, [2]CNRS UMR 5221, université Montpellier, Laboratoire Charles-Coulomb, Montpellier, France
		Quantitative susceptibility mapping (QSM) is a new technique, and it has been shown that results can vary according to the MRI device, phase reconstruction, and susceptibility estimation algorithms. Porting this mapping on the clinical practice would be of interest in numerous kind of pathology. However, it requires a validation which should be performed using a dedicated MR phantom. We described an easy to build MR susceptibility phantom based on iron sucrose. Using optimal parameters, the quantitative susceptibility mapping provides a very good estimation of the iron concentrations in the phantom.

5633	Computer 102	Higher-order subspace denoising for improved multi-contrast imaging and parameter mapping Sagar Mandava[1], Mahesh B Keerthivasan[1], Diego R Martin[2], Maria I Altbach[2], and Ali Bilgin[1,2] *[1]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States, [2]Department of Medical Imaging, University of Arizona, Tucson, AZ, United States* Multi-contrast image acquisitions are valuable for diagnostics but the scan time scales with the number of contrast images. Accelerated acquisitions are necessary for practical scan times and require the use of constrained reconstructions. Subspace-constraints, which constrain the multi-contrast data to lie in a low-dimensional subspace, are popularly used to reconstruct these datasets. Despite yielding good quality images at most imaging contrasts, these constraints create poor image quality at certain contrasts. We demonstrate that this is due to poor recovery of higher order subspace coefficients and present a model to enable high quality recovery of these coefficients and consequently the echo-images.
5634	Computer 103	Rapid B1 mapping based on the Bloch-Siegert shift using a single offset frequency and multi-echo readout Nadège Corbin[1], Julio Acosta-Cabronero[1], Oliver Josephs[1], Nikolaus Weiskopf[1,2], and Martina F Callaghan[1] *[1]Functional Imaging Laboratory (FIL) & Wellcome Center for Human Neuroimaging, UCL Institute of Neurology, London, United Kingdom, [2]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany* The advance towards in vivo histology benefits greatly from the quantification of specific physical parameters[1]. The longitudinal relaxation rate (R_1) has proven a reliable surrogate for myelination, facilitating investigation of the relationship between brain microstructure and function in vivo[2–5]. R_1 maps can be estimated by combining spoiled gradient-echo volumes, acquired with variable flip angles, and calibration data correcting for flip angle inhomogeneities. The Bloch-Siegert shift (BSS) approach[6] is a relatively time-efficient method that allows the calibration data to be acquired with an identical gradient-echo readout thereby matching distortions across all data needed to map R_1. However, it requires data to be acquired at two off-resonance frequencies to remove B_0 dependence up to second order and suffers from high specific-absorption-rate (SAR). Here, we investigate a modified BSS-based B_1^+ mapping approach that aimed to overcome these shortcomings by using a single offset frequency and a multi-echo readout.
5635	Computer 104	SCOPE-T1ρ: Signal Compensation for Low-rank Plus Sparse Matrix Decomposition for Fast T1ρ Mapping Yuanyuan Liu[1], Yanjie Zhu[1,2], Leslie Ying[3], Yi-Xiang J Wang[4], Jing Yuan[5], Xin Liu[1], and Dong Liang[1]

		[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Department of Medicine (Cardiovascular Division), Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States, [3]Department of Biomedical Engineering and Department of Electrical Engineering, University at Buffalo, The State University of New York, Buffalo, NY, United States, [4]Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong, China, [5]Medical Physics and Research Department, Hong Kong Sanatorium & Hospital, Hong Kong, China
		Quantitative $T_{1\rho}$ mapping typically requires the acquisition of multiple images with different spin-lock times, which greatly prolongs the scanning time, limiting its clinical applications. We developed a novel reconstruction method using a low-rank plus sparse model to obtain the parameter-weighted images from highly undersampled k-space data. This method exploited both the parameter-weighted image properties and priori information from the parameter model. Specifically, a signal compensation strategy was introduced to promote the low rankness along the parametric direction. The proposed method achieved a five-fold acceleration in the acquisition time and obtained more accurate $T_{1\rho}$ maps than the existing methods.

5636	Computer 105	High Resolution T1 quantification from golden-angle radial 3D acquisitions.
		Oliver Maier[1], Matthias Schloegl[1], Jasper Schoormans[2], Bram Coolen[2], Tobias Block[3,4], Thomas Benkert[3,4], Gustav Strijkers[2], and Rudolf Stollberger[1]
		[1]Institute of Medical Engineering, Graz University of Technology, Graz, Austria, [2]Department of Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Netherlands, [3]Center for Advanced Imaging Innovation and Research, New York University School of Medicine, New York, NY, United States, [4]Bernard and Irene Schwartz Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States
		A model-based reconstruction approach is presented that allows time efficient encoding of radial data for high resolution 3D T1 quantification e.g. (256x256x52, 1mm^3, t_{scan}=96s) by exploiting structural similarities in 3D and between different parameter maps. The proposed method employs a 3D TGV-Frobenius regularization to achieve high quality parameter maps from 3D VFA and 3D IRLL data. A dedicated reconstruction framework, consisting of an iteratively-regularized Gauss-Newton algorithm combined with a Primal-Dual splitting is employed to solve the optimization problem. Reconstructed parameter maps exhibit high SNR and no residual streaking artifacts while reconstructed T1 values agree well with reported values from literature.

5637	Computer 106	Quantifying Perfusion Properties with DCE-MRI Using a Dictionary Matching Approach
		Satyam Ghodasara[1], Sam Frankel[1], Yong Chen[2], Mark Griswold[3], Nicole Seiberlich[3], Vikas Gulani[3,4,5], and Katherine Wright[4]

		[1]School of Medicine, Case Western Reserve University, Cleveland, OH, United States, [2]Biomedical Engineering, University of North Carolina, Chapel Hill, NC, United States, [3]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [4]Radiology, Case Western Reserve University, Cleveland, OH, United States, [5]Radiology, University Hospitals, Cleveland, OH, United States
		To overcome the shortcomings of curve fitting to quantify perfusion properties, a dictionary matching approach like that used in magnetic resonance fingerprinting is proposed. This dictionary matching approach could be used for any DCE application or model, but is demonstrated and validated here for a dual-input single-compartment model of liver DCE-MRI data. The dictionary matching method provides similar results to the curve fitting method while being simpler to implement and dramatically faster.

5638	Computer 107	STimulated Echo based Mapping (STEM) of T1, T2 and Apparent Diffusion Coefficient
		Yuxin Zhang[1,2], Xiaoke Wang[1,3], Valentina Taviani[4], and Diego Hernando[1,2]
		[1]Radiology, University of Wisconsin Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin Madison, Madison, WI, United States, [3]Biomedical Engineering, University of Wisconsin Madison, Madison, WI, United States, [4]Global MR Applications & Workflow, GE Healthcare, Menlo Park, CA, United States
		This study proposed an approach for joint estimation of T1 and T2 relaxation as well as quantitative diffusion parameters. The proposed approach has been evaluated in quantitative relaxation-diffusion phantom, in-vivo brain imaging and prostate imaging. The overall T1, T2 and ADC measurements have been shown to be accurate compared to reference maps. In this feasibility study, the acquisition was over-sampled in TM-TE-b space, which limited the scan time. Future work will introduce undersampling and protocol optimization. In summary, this method has the potential to enable multi-dimensional tissue characterization in clinically feasible acquisition times.

5639	Computer 108	Single-shot multi-slice T1 mapping using inversion recovery radial FLASH and model-based reconstruction
		Xiaoqing Wang[1], Dirk Voit[1], Volkert Roeloffs[1], Martin Uecker[2], and Jens Frahm[1]
		[1]Biomedizinische NMR Forschungs GmbH am Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany, [2]Department of Interventional and Diagnostic Radiology of the University Medical Center Göttingen, Göttingen, Germany

		Fast quantitative T1 mapping can be achieved within a single inversion recovery based on recent advances in real-time MRI and/or model-based reconstructions. However, efforts have been mainly focused on single-slice T1 mapping. To further take advantage of inherent data redundancy, we propose a single-shot high-resolution multi-slice T1 mapping technique which bases on a spoke-interleaved radial FLASH data acquisition scheme and a recent proposed model-based reconstruction technique. Initial results show that we could achieve high resolution seven-slice human brain T1 maps or three-slice abdominal T1 maps within 4 seconds.

5640	Computer 109	Online Free-Breathing Liver Perfusion Imaging Using Parallel Computing and the Gadgetron Framework
		Kun Yang[1], Yong Chen[2], Satyam Ghodasara[3], Wei-Ching Lo[1], Yun Jiang[2], Nicole Seiberlich[1], Katherine Wright[2], and Vikas Gulani[1,2]
		[1]Dept. of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Dept. of Radiology, University Hospitals of Cleveland, Cleveland, OH, United States, [3]School of Medicine, Case Western Reserve University, Cleveland, OH, United States
		Accelerated image acquisition, advanced reconstruction and registration methods, and perfusion modeling have recently enabled free-breathing and quantitative 4D DCE MRI in the liver. However, the reconstruction, registration and model fitting steps are performed offline as they are time consuming; each data set takes more than a day to analyze. This makes quantitative 3D liver perfusion unsuitable for clinical deployment. We propose using a GPU-based Gadgetron framework for parallelized and near-immediate provision of all data, including a Spiral GRAPPA reconstruction, non-rigid image registration, and pharmacokinetic modeling using a dictionary-based approach. This approach reduces the reconstruction time from hours to minutes.

5641	Computer 110	Simultaneous mapping of R2*, T1, and proton density fat fraction for the liver: single breath-hold acquisition with multi-echo spoiled gradient echo and compressed sensing
		Daiki Tamada[1], Tetsuya Wakayama[2], Utaroh Motosugi[1], and Hiroshi Onishi[1]
		[1]Department of Radiology, University of Yamanashi, Chuo, Japan, [2]GE Healthcare Japan, Hino, Japan
		In this study, we developed multi-parameter mapping including T1, R2*, and proton density fat fraction with a single breath-hold, to evaluate liver disease and liver function. Six-echo spoiled gradient echo sequence with dual flip angles was used to acquire a 12-set MRI volume dataset. To shorten the scan time, undersampling and multi-contrast compressed sensing reconstruction were used. Quantitative values were validated by performing phantom and volunteer studies.

5642	Computer 111	Information Theory Quantification of Acquisition Parameter Impact on Synthetic MRI Reconstruction Uncertainty Drew Mitchell[1], David Fuentes[1], Tao Zhang[2], and Ken-Pin Hwang[1] *[1]The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]GE Healthcare, Houston, TX, United States* We develop a mutual information-based mathematical framework to quantify the information content of a parameter space composed of several pulse sequence acquisition parameters of interest for model-based image reconstruction. We apply this framework to the signal model for a multi-contrast inversion- and T2-prepared gradient echo sequence. Mutual information between parametric map uncertainty and measured data is determined for variable acquisition parameters to characterize the performance of each acquisition. This framework allows for the strategic selection of synthetic MR acquisition parameters for specific applications and also provides a quantitative understanding of parameter space information content in an acquisition for multi-parameter mapping.

5643	Computer 112	Simultaneous T1 and T2 parametric mapping and synthetic MRI with IR-prepared echo-split gradient-echo and spin-echo imaging and parametric POCSMUSE reconstruction Mei-Lan Chu[1,2] and Nan-kuei Chen[2] *[1]Department of Biomedical Sciences and Engineering, National Central University, Taoyaun, Taiwan, [2]Department of Biomedical Engineering, University of Arizona, Tucson, AZ, United States* Our novel simultaneous T1 and T2 mapping framework, integrating IR-prepared echo-split GRASE acquisition and parametric POCSMUSE reconstruction, has the following advantages. First, T1 and T2 maps can be derived from four sets of single-shot IR-prepared echo-split GRASE data, with very high scan efficiency. Second, T1 and T2 relaxation time constants can be accurately measured by the parametric POCSMUSE algorithm, which models multiplexed signals across CPMG echoes and multiple IR-prepared data of multi-echo-pathway. Third, synthetic multi-contrast images can be generated from the measured parametric maps.

5644	Computer 113	Improved quantification of cerebral blood flow in gray matter and white matter using non-Fourier based reconstruction Phil Lee[1,2], Peter Adany[2], and In-Young Choi[1,2,3] *[1]Molecular & Integrative Physiology, University of Kansas Medical Center, Kansas City, KS, United States, [2]Hoglund Brain Imaging Center, University of Kansas Medical Center, Kansas City, KS, United States, [3]Neurology, University of Kansas Medical Center, Kansas City, KS, United States*

		Accurate quantification of CBF in GM and WM is challenging due to intrinsically low SNR and low spatial resolution of CBF maps. In this study we propose a new approach in quantifying CBF in GM and WM, based on spectral localization by imaging (SLIM), which provides accurate CBF values in compartments with complex shapes, e.g., GM and WM by incorporating high-resolution anatomical information into CBF reconstruction at reduced scan time.

5645	Computer 114	Spectral Model Dependent Quantification of Triglyceride Composition using Chemical Shift Encoded Magnetic Resonance Imaging
		Gregory Simchick[1,2], Amelia Yin[3,4], Hang Yin[3,4], and Qun Zhao[1,2]
		[1]Physics and Astronomy, University of Georgia, Athens, GA, United States, [2]Bio-Imaging Research Center, University of Georgia, Athens, GA, United States, [3]Biochemistry and Molecular Biology, University of Georgia, Athens, GA, United States, [4]Center for Molecular Medicine, University of Georgia, Athens, GA, United States
		Dynamic processes such as brown adipose tissue (BAT) activation and white adipose tissue (WAT) beiging have been shown to change triglyceride composition. Therefore, accurate spatial quantification of triglyceride composition is important for the monitoring of these processes. Presented here is an evaluation of the performance of various fat spectral models on the quantification of triglyceride composition using chemical shift encoded magnetic resonance imaging (CSE-MRI). Variations as large as 45% and less than 2.82% are observed in the average estimations of triglyceride composition and proton density fat fraction (*PDFF*), respectively. Estimations obtained using a material specific model correlate better with spectroscopy estimations than other examined models.

5646	Computer 115	An investigation into the effect of body composition on the agreement between whole-body fat mass determined by MRI and air-displacement plethysmography.
		Andrew Weedall[1], Adrian Wilson[2,3], and Sarah Wayte[1]
		[1]Department of Clinical Physics and Bioengineering, University Hospitals Coventry and Warwickshire, Coventry, United Kingdom, [2]Research and Development Department, University Hospitals Coventry and Warwickshire, Coventry, United Kingdom, [3]Department of Physics, University of Warwick, Coventry, United Kingdom
		The agreement between whole-body fat mass determined using MRI and air-displacement plethysmography (ADP) was investigated for a range of non-pathological body mass indexes (BMIs). The whole-body fat mass was determined for ten volunteers by two methods: firstly by ADP using a BODPOD®; and secondly using two different MRI sequences (LAVA-flex and IDEAL IQ). The whole-body fat mass determined by both MRI protocols showed good agreement with, but were consistently higher than, the ADP determination (mean difference: LAVA-flex=4±3kg; IDEAL IQ=2±3kg). In addition, analysis of Bland-Altman plots showed no change in the differences between the MRI and ADP fat mass with BMI.

5647	Computer 116	Linear B1-Dependent Correction of Quantitative in vivo T2 Maps Acquired with Fast Spin Echo Techniques Ulrike Nöth[1], Manoj Shrestha[1], Jan-Rüdiger Schüre[2], and Ralf Deichmann[1] *[1]Brain Imaging Center (BIC), Goethe University, Frankfurt/Main, Germany, [2]Department of Neuroradiology, Goethe University, Frankfurt/Main, Germany* A method is proposed for correcting the effects of stimulated echoes in T2 mapping based on fast spin echo sequences. In contrast to existing techniques, the proposed method does not require a priori knowledge of the radio frequency pulse profiles. A linear relationship between uncorrected apparent T2 (T2app) and corrected T2 values with B1-dependent regression parameters was found which facilitates the conversion of T2app into T2 maps. In vivo results show that corrected T2 values correspond closely to reference values and have an improved consistency across protocols.

5648	Computer 117	MR Thermometry in Phantoms Using Bulk Magnetic Susceptibility Scott Swanson[1], Dariya Malyarenko[1], and Thomas Chenevert[1] *[1]Department of Radiology, University of Michigan, Ann Arbor, MI, United States* We have developed a phantom for absolute temperature measurement based on the bulk magnetic susceptibility (BMS) of solutions of paramagnetic ions. This work shows that a solution of 150 mM dysprosium creates a BMS shift of approximately 0.09 ppm/°C.

5649	Computer 118	Improved Accuracy of Accelerated 3D T2* Mapping with Coherent Parallel Maximum Likelihood Estimation Wajiha Bano[1,2], Mohammad Golbabee[1], Arnold Julian Vinoj Benjamin[1,2], Ian Marshall[2], and Michael Davies[1] *[1]School of Engineering, Institute for Digital Communications, University of Edinburgh, Edinburgh, United Kingdom, [2]Centre for Clinical Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom*

		We propose an approach that can reconstruct isotropic T2* Maps from undersampled data with improved accuracy by utilizing the phase information. Our approach extends the acceleration attained in Parallel Imaging(PI) to Maximum Likelihood Estimation (MLE) by imposing the exponential relaxation directly in the complex signal domain. The method was tested on a Multiecho Gradient Echo(MEGE) T2* mapping experiment in a numerical phantom and a human brain with realtime (prospective) undersampling. The approach showed that incorporating the phase information to perform coherent fitting resulted in better denoising and improved accuracy of the parametric maps.

5650	Computer 119	Correction for insufficient spoiling of transverse magnetization in T1 mapping based on the variable flip angle technique
		Simon Baudrexel[1], Ulrike Noeth[2], Jan-Ruediger Schuere[3], and Ralf Deichmann[2]
		[1]Department of Neurology, Goethe University, Frankfurt/Main, Germany, [2]Brain Imaging Center, Goethe University, Frankfurt/Main, Germany, [3]Department of Neuroradiology, Goethe University, Frankfurt/Main, Germany
		A method is proposed for the correction of insufficient spoiling of transverse magnetization components in gradient echo data that are used for T1 quantification via the variable flip angle (VFA) approach. The method is based on the use of modified flip angles in the VFA algorithm that differ from the actual angles. The advantage is the versatility of the proposed method: from a given set of 21 values P(k,l), suitable correction parameters can be derived for any VFA protocol. In vitro and in vivo experiments show that this novel correction technique considerably increases the accuracy of measured T1 values.

5651	Computer 120	Controlling magnetisation transfer and exchange effects in mcDESPOT relaxometry.
		Daniel J. West[1], Rui Pedro A. G. Teixeira[1], Jacques-Donald Tournier[1], Joseph V. Hajnal[1], and Shaihan J. Malik[1]
		[1]Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom
		Magnetisation transfer (MT) has been found to contribute to parameter estimation bias in sequences used in the two-pool relaxometry technique, mcDESPOT. Recent work shows that using controlled saturation magnetisation transfer (CSMT) RF-pulses, a two-pool system (free- and bound-pools) can behave as a single pool with modified equilibrium magnetisation and longitudinal relaxation rate. Here, we investigate the use of CSMT to model MT-effects in a three-pool system (exchange + MT) and show that under these conditions, signal behaves as a two-pool system and matches a mcDESPOT model but characterised by different parameters than those originally assumed.