ELECTRONIC POSTER

Cartilage

Hall B Monday 14:00-16:00 Computer 1

14:00 ***3164*. Longitudinal T1ρ MRI of Adults with Chondromalacia Following Arthroscopy**

Matthew Fenty[1], Walter RT Witschey[2], Ari Borthakur[2], Kalli Grasley[2], John Bruce Kneeland[3], Jess Lonner[4], Ravinder Reddy[2]

[1]Center for Magnetic Resonance and Optical Imaging , University of Pennsylvania School of Medicine, Philadelphia, PA, United States; [2]Center for Magnetic Resonance and Optical Imaging, University of Pennsylvania School of Medicine, Philadelphia, PA, United States; [3]Radiology, Pennsylvania Hospital, Philadelphia, PA, United States; [4]3B Orthopaedics, Pennsylvania Hospital, Philadelphia, PA, United States

The objective of this study was to measure the longitudinal changes in chondromalacia cartilage T1ρ MRI over a period of 9 months following arthroscopy.

14:30 ***3165*. T1rho MRI of Menisci and Cartilage in Mild Osteoarthritis Patients at 3T**

Ligong Wang[1], Gregory Chang[1], Michael Recht[1], Ravinder R. Regatte[1]

[1]NYU Langone Medical Center, New York, NY, United States

The purpose of this study was to assess T1rho values of cartilage and menisci in patients with mild osteoarthritis (OA) at 3T. Mild OA patients (K-L Score=2, n=15) were scanned. There are significant differences in T1rho relaxation times between femoral-tibial cartilage and the meniscus (anterior, central, and posterior) in both lateral and medial compartments ($P < 0.001$). T1rho relaxation time of the central meniscus was also increased in the medial compared to lateral compartment ($P = 0.033$). These data could serve as useful reference standards in future studies and suggest that T1rho MRI might provide useful information about meniscal involvement in OA pathogenesis.

15:00 ***3166*. Pseudo Steady State Fast Spin Echo Acquisition for Quantitative 3D T1rho Imaging**

Weitian Chen[1], Reed F. Busse[2], Ann Shimakawa[1], Eric T. Han[1]

[1]MR Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [2]MR Applied Science Lab, GE Healthcare, Madison, WI, United States

Three-dimensional T1rho imaging is promising in a number clinical applications. We present a 3D T1rho imaging method based on pseudo steady fast spin echo acqustion. High SNR and scan efficiency are demonstrated using in-vivo scan. Unlike the other existing 3D T1rho imaging methods, no prior knowledge of tissue propeties are required for the presented method.

15:30 ***3167*. The Relationship Between T1rho Measurements in the Meniscus and Cartilage in Healthy Subjects and Patients with Osteoarthritis**

Zinta Zarins[1], Radu Bolbos[1], Jean-Baptiste Pialat[1], Thomas Link[1], Xiaojuan Li[1], Sharmila Majumdar[1]

[1]Radiology, UC San Francisco, San Francisco, CA, United States

The purpose of this study was to investigate the relationship between T1rho measurements in cartilage and meniscus using quantitative MRI. Our study involving 64 subjects (including both healthy subjects and patients with osteoarthritis) found that 48% of the subjects had a meniscal tear, with the incidence being highest in the posterior medial horn. Despite these findings, we did not find a significant correlation between the T1rho cartilage and the posterior medial horn of the meniscus. However, significant correlations were found between the T1rho of the lateral meniscus and the cartilage sub compartments.

Tuesday 13:30-15:30 Computer 1

13:30 ***3168*. Sodium Imaging of Patients After Matrix-Associated Chondrocyte Transplantation at 7 Tesla: Preliminary Results and Comparison with DGEMRIC at 3 Tesla**

Siegfried Trattnig[1], David Stelzeneder[1], Vladimir Juras[1,2], Pavol Szomolanyi[1,2], Goetz Hannes Welsch[1,3], Tallal Charles Mamisch[4], Stefan Zbyn[1]

[1]MR Centre - High field MR, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Imaging Methods, Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia; [3]Department of Trauma Surgery, University Hospital of Erlangen, Erlangen, Germany; [4]Department of Orthopedic Surgery, Inselspital, Bern, Switzerland

The feasibilty of sodium imaging in 12 patients after matrix-associated autologous chondrocyte transplantation was demonstrated at 7 Tesla. The repair tissue was well delineated on sodium imaging at 7T and with one exception lower normalized sodium values and thus a lower glycosaminoglycan content was found in the repair tissue compared to healthy cartilage as a reference. A good correlation between normalized sodium values at 7T and postcontrast T1 relaxation time values at 3T was found. Sodium imaging at 7T is a promising tool in the monitoring of the maturation of repair tissue after matrix-associated autologous chondrocyte transplantation.

14:00 ***3169*. Advanced Morphological 3D- Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) Scoring Using an Isotropic PDfs-Weighted 3D-TSE-Sequence and an Isotropic 3D-Steady-State Free Precession Sequence**

Goetz Hannes Welsch[1,2], Lukas Zak[3], Tallal Charles Mamisch[4], Dominik Paul[5], Lars Lauer[5], Friedrich Frank Hennig[2], Stefan Marlovits[6], Siegfried Trattnig[1]
[1]MR Center, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Trauma and Orthopaedic Surgery, University Hospital of Erlangen, Erlangen, Germany; [3]Center for Joints and Cartilage, Department of Trauma Surgery, Medical University of Vienna, Austria; [4]Department of Orthopaedic Surgery, University of Basel, Basel, Switzerland; [5]Siemens Healthcare, Erlangen, Germany; [6]Center for Joints and Cartilage, Department of Trauma Surgery, Medical University of Vienna, Vienna, Austria

The recently described 3D-magnetic resonance observation of cartilage repair tissue (MOCART) score was prepared by standard MR sequences, by an isotropic PDfs-weighted 3D-TSE-sequence (PD-SPACE), and by an isotropic 3D-steady-state-free-precession sequence (True-FISP) to assess correlations in the diagnostic performance of the different sequences in post-operative articular cartilage imaging. Although all sequences were able to assess cartilage repair tissue after matrix-associated autologous chondrocyte transplantation, the isotropic sequences with the possible multiplanar-reconstruction provided more information in less time. The PD-SPACE sequence seems slightly superior to the True-FISP sequence due to a better performance in the depiction of the subchondral bone and less artifacts.

14:30 ***3170*. Hybrid Morphological and Biochemical T2 Evaluation of Cartilage Repair Tissue Based on a Recently Described Double Echo at Steady State (DESS-T2d) Approach**

Goetz Hannes Welsch[1,2], Tallal Charles Mamisch[3], Lukas Zak[4], Andreas Mauerer[2], Sebastian Apprich[1], Michael Deimling[5], Stefan Marlovits[4], Siegfried Trattnig[1]
[1]MR Center, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Trauma and Orthopaedic Surgery, University Hospital of Erlangen, Erlangen, Germany; [3]Department of Orthopaedic Surgery, University of Basel, Basel, Switzerland; [4]Center for Joints and Cartilage, Department of Trauma Surgery, Medical University of Vienna, Vienna, Austria; [5]Siemens Healthcare, Erlangen, Germany

The aim of this study was to use a recently described double-echo at steady-state (DESS-T2d) approach in an initial study to assess the morphological Magnetic-resonance Observation of Cartilage Repair Tissue (MOCART) score as well as biochemical T2-values in patients after matrix-associated autologous chondrocyte transplantation of the knee by only one sequence. The results show a good correlation in between standard morphological and multi-echo spin-echo quantitative T2 and the new DESS-T2d approach. Hence the presented hybrid sequence provides the possibility to combine morphological and biochemical MRI in one fast 3D-sequence and thus may attract for the clinical use of biochemical MRI.

15:00 ***3171*. Evaluation of Articular Cartilage in Patients with Osteochondrosis Dissecans by Morphological MRI and Quantitative T2 and T2* Mapping at 3.0 Tesla**

Sebastian Apprich[1], Wolfgang Marik[1], Götz Hannes Welsch[1,2], Marius Mayerhhoefer[1], Klaus Friedrich[1], Siegfried Trattnig[1]
[1]Department of Radiology, MR Centre - Highfield MR, Vienna, Austria; [2]University Hospital of Erlangen, Department of Trauma Surgery, Germany

Objective was to compare T2/T2* relaxation times from patients with osteochondrosis disscans of the talus and healthy volunteers at 3T. The MR protocol consisted of a PD TSE sequence, and a 3D isotropic TrueFISP sequence. T2 relaxation times were obtained from a multi-echo spin-echo sequence, T2* maps were reconstructed from a sagittal GRE sequence. ROI analysis revealed significant higher T2/T2* values in patients with OCD compared to healthy volunteers. Quantitative T2/T2* mapping is a promising method to provide further information about the physiological status of the cartilage overlying an OCD and may improve the radiological staging.

Wednesday 13:30-15:30 Computer 1

13:30 ***3172*. ACRIN-PA 4001: Reproducibility of Cartilage MRI Biomarkers in a Multi-Center Trial**

Timothy John Mosher[1], Zheng Zhang[2], Ravinder Reddy[3], Sanna Boudhar[4], Barton Milestone[5], William Morrison[6], Kenneth Kwoh[7], Felix Eckstein[8], Walter Witschey[3], Ari Borthakur[3], Cynthia Olson[4]
[1]Radiology, Penn State University, Hershey, PA, United States; [2]Brown University; [3]University of Pennsylvania; [4]ACRIN; [5]Fox Chase Cancer Center; [6]Thomas Jefferson University; [7]University of Pittsburgh; [8]Paracelsus Private Medical University

Reproducibility of morphometric, T1rho, and T2 cartilage biomarkers was evaluated in a multi-site, multi vendor clinical trial. 53 subjects were evaluated during 4 separate MRI sessions to calculate intraclass correlation coefficient (ICC). MRI measurements of cartilage morphometry are highly reproducible in a multi-center/multi-vendor trial. Subregional T1rho analysis has poor reproducibility. Improved reliability is obtained when T1rho analysis is performed using data obtained using the full thickness of the cartilage, allowing analysis at the level of the cartilage plate. Cartilage T2 mapping is sufficiently reproducible to allow for subregional analysis based on depth from articular surface.

14:00 ***3173*. Sodium MRI: A Reproducibility Study in Subjects with Osteoarthritis of the Knee**

Laurence D. Toms[1], Rexford D. Newbold[1], Anil Rao[1], Sam R. Miller[2], Jeroen A. Tielbek[1], Mark D. Tanner[1], Ros M. Gordon[1], Robin K. Strachan[3], Paul M. Matthews[1], Andrew P. Brown[1]

[1]GlaxoSmithKline Clinical Imaging Centre, Imperial College, Hammersmith Hospital, London, United Kingdom; [2]Discovery Analytics, GlaxoSmithKline, Harlow, United Kingdom; [3]Department of Orthopaedic Surgery, Imperial College Healthcare NHS Trust, London

Sodium imaging in articular cartilage may be an indicator of osteoarthritis progression. In this work we sought to assess the reproducibility of this technique. Using a dual tuned 1H/23Na quadrature volume coil, 3D DESS proton images and 3D-cones short echo time sodium images were acquired in the same scan session, which was repeated for 11 subjects. DESS images were segmented, and the resulting ROIs were applied to the co-registered sodium images. The technique showed good repeatability: the interclass correlation coefficient for sodium was 0.88 (0.6 – 0.97) and the percent coefficient of variation was 4.2% (2.9%-7.3%).

14:30 ***3174*. Changes of Knee Cartilage T2 in Relation to Physical Activity: 24-Months Follow-Up Analysis of 182 Non Symptomatic Individuals from the Osteoarthritis Initiative**

Christoph Stehling[1,2], Benedikt J. Schwaiger[1], Christina Mueller-Hoecker[1], Roland Krug[1], Daniel Kuo[1], Nancy E. Lane[3], Michael C. Nevitt[4], John Lynch[4], Charles E. McCulloch[4], Thomas M. Link[1]

[1]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States; [2]Department of Clinical Radiology, University of Muenster, Muenster, Germany; [3]Center for Healthy Aging, University of California Davis, Sacramento, United States; [4]Department of Epidemiology and Biostatistics, University of California San Francisco, San Francisco, CA, United States

The aim was to study association of knee cartilage abnormalities and T2-relaxation-time-measurements at baseline and 24 months, using 3T MRI and physical activity levels obtained in 182 asymptomatic subjects aged 45-55 years from the Osteoarthritis Initiative. Cartilage T2 increased significantly over time. Subjects with cartilage abnormalities and higher physical activity had higher T2 at baseline and follow-up and higher increase in T2 over time compared to more sedentary subjects. Interestingly cartilage lesions and higher physical activity induced accelerated cartilage-matrix changes. These results suggest that T2 mapping may be an useful quantitative parameters to assess longitudinal changes in early OA.

15:00 ***3175*. Cartilage Morphology at 3.0T: Assessment of Three-Dimensional MR Imaging Techniques**

Christina A. Chen[1], Richard Kijowski[2], Lauren M. Shapiro[1], Michael J. Tuite[2], Kirkland W. Davis[2], Jessica L. Klaers[3], Walter F. Block[3], Scott B. Reeder[2,3], Garry E. Gold[1]

[1]Radiology, Stanford University, Stanford, CA, United States; [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [3]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States

We qualitatively and quantitatively compared 6 new three-dimensional (3D) magnetic resonance (MR) methods for evaluating knee cartilage at 3.0T: Fast-spin-echo Cube (FSE-Cube), Vastly undersampled isotropic projection reconstruction balanced steady-state free precession (VIPR-bSSFP), Iterative decomposition of water and fat with echo asymmetry and least-squares estimation combined with spoiled gradient echo (IDEAL-SPGR) and gradient echo (IDEAL-GRASS), Multi-echo in steady-state acquisition (MENSA), and Coherent Oscillatory State Acquisition for Manipulation of Image Contrast (COSMIC). Five-minute sequences were performed twice on 10 healthy volunteers, and once on 5 osteoarthritis (OA) patients. FSE-Cube and VIPR-bSSFP produced high image quality with accurate volume measurement of knee cartilage.

Thursday 13:30-15:30 Computer 1

13:30 ***3176*. Classification of Cartilage Degradation and Quantification of Matrix Composition Through Multiparametric Support Vector Machine Analysis**

Ping-Chang Lin[1], Onyi Irrechukwu[1], Remy Roque[1], Richard G. Spencer[1]

[1]National Institute on Aging, National Institutes of Health, Baltimore, MD, United States

Univariate classification, as is implicitly used in analyses of cartilage matrix using MRI parameters, exhibits limited ability to discriminate between control and degraded tissue. In view of these limitations, we undertook a multivariate support vector machine (SVM) analysis of bovine nasal cartilage (BNC) samples with pathomimetic degradation using trypsin and collagenase. Our current results, that the sets (T_1, k_m), (T_1, T_2, k_m) and (T_1, k_m, ADC) exhibit particularly favorable classification properties, are consistent with our previous study, indicating that these parameter combinations may emerge as particularly useful in multivariate cartilage matrix characterization

14:00 ***3177*. Dynamics of Contrast Agent Enhancement of Intact and Enzymatically Degraded Articular Cartilage**

Elli-Noora Salo[1], Mikko J. Nissi[1,2], Katariina Aino Maria Kulmala[1], Juha Töyräs[1,3], Miika T. Nieminen[4,5]

[1]Department of Physics, University of Kuopio, Kuopio, Finland; [2]Department of Clinical Radiology, Kuopio University Hospital, Kuopio, Finland; [3]Diagnostic Imaging Centre, Kuopio University Hospital, Kuopio, Finland; [4]Department of Medical Technology, University of Oulu, Oulu, Finland; [5]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland

The dGEMRIC method is sensitive in detecting proteoglycan depletion in cartilage. The aim of this study was to investigate the kinetics of gadopentetate contrast agent in intact and enzymatically degraded cartilage. Diffusion of gadopentetate was followed for 18 hours in bovine cartilage with T_1 mapping at 9.4 T. A relatively small difference in diffusion kinetics was observed between intact and degraded samples, although larger uptake of contrast agent was observed in degraded samples. Maximum contrast between intact and degraded superficial cartilage is reached at an early stage, suggesting that visualization of degenerative changes may be possible prior to full equilibration.

14:30 ***3178*. Collagen in Native, Undigested Human Patella Cartilage Is Predicted by a Combination of T2 and T1ρ Relaxation Times**

Kathryn E. Keenan[1], R L. Smith[2], Eric Han[3], Scott Delp, [1,4], Gary S. Beaupre, [1,5], Garry E. Gold, [4,6]

[1]Mechanical Engineering, Stanford University, Stanford, CA, United States; [2]Department of Orthopedic Surgery, Stanford University, Stanford, CA, United States; [3]Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [4]Bioengineering, Stanford University, Stanford, CA, United States; [5]Bone & Joint RR&D Center, VAHCS, Palo Alto, CA, United States; [6]Radiology, Stanford University, Stanford, CA, United States

T2 and $T1_\rho$ relaxation times are combined in a linear model to predict the naturally occurring collagen content variation in the patella of human cadaver specimens that were not chemically digested.

15:00 ***3179*. T2 Signal and Orientation Changes Are Early Indicators of Cartilage Degeneration.**

Kelsey Mairead Mountain[1,2], Tadeusz Foniok[3], Jeff Dunn, [1,3], John Robert Matyas, [2,4]

[1]Biomedical Engineering, University of Calgary, Calgary, Alberta, Canada; [2]McCaig Institute for Bone and Joint Health, Calgary, Alberta, Canada; [3]National Research Council Canada, Calgary, Alberta, Canada; [4]Faculty of Veterinary Medicine, University of Calgary, Calgary, Alberta, Canada

The superficial zone of articular cartilage is a dense network of ordered collagen fibres running parallel to the articular surface. The initial histopathological changes of osteoarthritis (OA) occur at this surface; and if detected, could provide insight into OA progression. High-field MRI can detect collagen organization based on changes in T2 relaxation. In this study, T2 was used to assess articular cartilage surface collagen in an animal model of osteoarthritis.

Meniscus & Cartilage

Hall B Monday 14:00-16:00 Computer 2

14:00 ***3180*. Infrastructure of Menisci with Mr Imaging**

Patrick Omoumi[1], Graeme Bydder[1], Richard M. Znamirowski[1], Jiang Du[1], Sheronda S. Statum[1], Christine B. Chung[1]

[1]University of California, San Diego, San Diego, CA, United States

The non-invasive MR imaging analysis of meniscal infrastructure has not yet been described due to the relatively short T2 properties of this tissue, resulting in lack of signal and contrast with conventional MR techniques. This infrastructure includes 5 different fiber orientations (circumferential, radial, tie, vertical and lamella fibers). Four functional and anatomical zones are also distinguished within meniscal substance: a central fibrocartilaginous portion, a peripheral fibrous portion, a central vascular white zone, and a peripheral vascularized red zone. We show that with the appropriate coil and parameters, MR imaging can show this on a clinical 3T scanner.

14:30 ***3181*. Optimization of Human Meniscus Imaging Using Minimal Phase RF Pulse**

Ping-Huei Tsai[1], Hsaio-Wen Chung[1], Teng-Yi Huang[2]

[1]Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan; [2]Department of Electrical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan

Human meniscus is one of the important tissues related to the maintenance of the performance of knee joint, which plays a critical role in the normal biomechanics. The purpose of this study is to improve the zonal image contrast of human meniscus via imaging at moderately short TE using minimal phase RF pulse with optimized rephasing gradient.

15:00 ***3182*. Comparison of Short Echo Time T2 and T1rho Measurements in Menisci from Subjects with Osteoarthritis**

Min-Sun Son[1], Weitian Chen[2], Eric Han[2], Atsushi Takahashi[2], Stuart Goodman[3], Marc Levenston[4], Garry Gold[5]
[1]Bioengineering, Stanford University, Stanford, CA, United States; [2]GE Healthcare; [3]Orthopaedic Surgery, Stanford University; [4]Mechanical Engineering, Stanford University; [5]Radiology, Stanford University

T1ρ and T2 measurements were taken in the anterior, body, and posterior part of degenerated meniscal specimens using 3D MAPSS sequence with short echo times. Consistent variations were observed; T1ρ and T2 values were significantly shorter in the central body than either the anterior or posterior horn in both medial and lateral menisci, with the lateral menisci exhibiting greater variations among regions. A strong, positive correlation between T1ρ and T2 was also found for all pooled regions. Determining such relationship between the two time constants and linking it to the degenerative state of the meniscus will be useful in early detection of osteoarthritis.

15:30 ***3183*. Towards a Dedicated DGEMRIC Protocol for Biochemical Imaging of the Menisci: Gd-DTPA(2-) Enhancement Kinetics in the Menisci of Asymptomatic Subjects**

Marius E. Mayerhoefer[1], Georg Riegler[1], Tallal C. Mamisch[2], Goetz H. Welsch[1], Michael Weber[1], Sebastian Apprich[1], Siegfried Trattnig[1]
[1]Department of Radiology, MR Center, Medical University of Vienna, Vienna, Austria; [2]Inselspital Bern, Switzerland

We investigated the Gd-DTPA(2-) enhancement kinetics within the menisci of the knee joint over a period of 9 hours in six healthy volunteers. T1-weighted spin-echo sequences were obtained in half-hour intervals at 3.0 Tesla. Menisci were divided into a peripheral zone (outer one-third; vascularized “red zone”), and a central zone (inner two-thirds; moderately vascularized “intermediate zone”, and avascular “white zone”). In the peripheral zones, the enhancement occurred more rapidly than in the central zones. We observed the strongest enhancement between 3 and 4 hours after contrast media application. This time interval may thus be suitable for dGEMRIC of the menisci.

Tuesday 13:30-15:30 Computer 2

13:30 ***3184*. Validation of Chevron-Like Deformations of Collagen Fiber Network in Articular Cartilage by Means of Load-Bearing µMRI**

Nikita Garnov[1,2], Wilfried Gründer[2]
[1]Diagnostic and Interventional Radiology, Leipzig University Hospital, Leipzig, Germany; [2]Institute of Medical Physics and Biophysics, Leipzig University, Leipzig, Germany

Deformations of collagen matrix in compressed articular cartilage have been well assessed by various microscopic studies. A crimping and a bending of collagen fibres were observed. However, the deformation behavior seems to be different in health compared to arthritic-altered cartilage because of destruction of the strain-limiting tangential layer. In particular, a chevron-type shear discontinuity in the samples with an intact surface layer was observed. In the present work we evaluated the pressure-dependent changes of collagen fiber orientation on the basis of T2-weighted MR images. In healthy sheep cartilage samples the chevron-like deformations were observed, indicating an intact articular surface.

14:00 ***3185*. A Dynamic Measurement Method for Knee Biomechanics**

Agnes G. d'Entremont[1,2], Jurek Nordmeyer-Massner[3], Clemens Bos[4], David R. Wilson, [2,5], Klaas Pruessmann[3]
[1]Mechanical Engineering, University of British Columbia, Vancouver, BC, Canada; [2]Centre for Hip Health and Mobility, Vancouver, BC, Canada; [3]Institute for Biomedical Engineering, ETH Zurich, Zurich, Switzerland; [4]MR Clinical Science, Philips Healthcare, Best, Netherlands; [5]Orthopaedics, University of British Columbia, Vancouver, BC, Canada

We developed and tested the feasibility of a new dynamic imaging method for kinematic measurement of the knee joint. One subject was scanned using a validated static method, as well as using modified (fast) static and dynamic methods under load and over a range of motion. Differences between the standard and fast static methods were within expected errors. The dynamic method provided more data in a shorter time, and produced similar results to the static scans. The results of this work indicates that this is a viable new method for measuring the kinematic rotations and translations of the knee bones.

14:30 ***3186*. Global and Regional Deformation of the Knee Cartilage After Kneeling and Squatting – Analysis of Size, Distribution and Pattern with HR-MRI at 3T**

Annie Horng[1], José Raya[1], Monika Zscharn[1], Ulrike Hoehne-Hückstädt[2], Ingo Hermanns[2], Ulrich Glitsch[2], Rolf Ellegast[2], Maximilian F. Reiser[1], Christian Glaser[1]
[1]Department of Clinical Radiology, University Hospitals LMU Munich Campus Grosshadern, Munich, Bavaria, Germany; [2]Fachbereich 4, BGIA – Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung, Sankt Augustin, Germany

Cartilage strain is discussed as potential cause for degeneration and osteoarthritis. Dimension of global/regional cartilage deformation and its distribution in knee cartilage after kneeling/squatting were evaluated. Detected small global cartilage deformation laid within the magnitude of change after common daily exercise/sports, consistent with biomechanical examinations. 3D-volumetry enable anatomy- and individuum-specific analysis by detailed depiction of regional deformation, while global parameters tend to average out

local changes leading to underestimation of changes. Data indicate areas of deformation across the joint surface and might serve as a base for comparison to degenerative changes in patients and for the development of biomechanical models.

15:00 ***3187*. Evaluation of Cartilage T2 Using Loading in Situ MRI in Patients with Knee Injuries**

Takashi Nishii[1], Toshiyuki Shiomi[2], Hisashi Tanaka[3], Ken Nakata[2], Kenya Murase[4], Youichi Yamazaki[4], Hideki Yoshikawa[2], Nobuhiko Sugano[1]

[1]Department of Orthopaedic Medical Engineering, Osaka University Medical School, Osaka, Japan; [2]Department of Orthopaedic Surgery, Osaka University Meidcal School; [3]Department of Radiology, Osaka University Meidcal School; [4]Department of Medical Physics & Engineering, Osaka University Meidcal School

Knee cartilage T2 with use of loading in situ MR imaging (50% of body weight) was evaluated in 9 patients with knee injuries and 4 normal volunteers, for evaluation of cartilage pressure distribution in vivo. There was significantly larger decrease of T2 by loading at the superficial zone of the medical femoral cartilage in knees without meniscus tear than knees with meniscus tear ($p<0.05$). Assuming that decrease of T2 is correlated with amount of compressive loading, loading in situ MR imaging with T2 assessment may allow biomechanical assessment of pathological conditions in the cartilage of patients with knee injuries.

Wednesday 13:30-15:30 Computer 2

13:30 ***3188*. Quantitative Reproducibility Initial Study of T1 Rho at 3T**

David W. Stanley[1], Kameron R. Shahid[2], Joel P. Felmlee[2], Kimberly K. Amrami[2], Eric T. Han[3], Dan W. Rettmann[4]

[1]MR, GE Healthcare, Proctor, MN, United States; [2]Radiology, Mayo Clinic, Rochester, MN, United States; [3]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [4]Applied Science Laboratory, GE Healthcare, Rochester , MN, United States

Osteoarthritis is a prevalent degenerative joint disease, with radiographic disease in 80% of people over the age of 75. High field-strength MRI and new techniques, such as T1ñ, may provide a more sensitive means of assessing the degree of early damage to cartilage than plain film radiography or conventional MRI. The goal of this study is to determine the initial reproducibility and reliability of T1r mapping at 3-Tesla and determine the feasibility as a clinical tool. Reproducibility was studied sequentially on one machine as well as over time on multiple machines. These data are important to assure that accurate measurements are obtained and to determine if an external reference must be routinely evaluated for scanner calibration purposes.

14:00 ***3189*. Age Dependent Modulation of Aggrecan in Human Knee Cartilage Measured Via Sodium MRI at 7T**

Victor Babu Kassey[1], Adam Shore[1], Hari Hariharan[1], Ganapathy Ramanathan[1], Sonia N. Vallespin[2], Thomas Connick[1], Anup Singh[1], Ravinder Reddy[1]

[1]Center for Magnetic Resonance and Optical Imaging, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Cardiovascular MR Unit, Royal Brompton and Harefield NHS Foundation Trust, Chelsea, London, United Kingdom

In the present work, we determined the age dependent variation of molecular changes in human knee cartilage via sodium MRI at ultrahigh fields. Aggrecan has been shown to undergo predominant change in early OA. More than 80% of population over 65 years of age experience pain due to knee OA. Using sodium MRI, we investigated the natural, age dependent molecular changes in the healthy human knee cartilage in vivo. These preliminary results demonstrate that it is feasible to obtain sodium maps of human knee in-vivo at 7T and quantify age dependent molecular changes in knee cartilage of healthy human subjects.

14:30 ***3190*. The Transport of Anionic and Nonionic MRI Contrast Agents Into Human Hip Cartilage**

Eveliina Lammentausta[1], Samo Lasic[2], Daniel Topgaard[2], Olle Söderman[2], Leif E. Dahlberg[3]

[1]Department of Clinical Sciences, Malmö, Joint and Soft Tissue Unit, University of Lund, Malmö, Sweden; [2]Department of Physical Chemistry, University of Lund, Lund, Sweden; [3]Department of Orthopaedics, Malmö University Hospital, Malmö, Sweden

The aim of the study was to investigate the distribution of ionic and non-ionic contrast agent in human hip cartilage. T1 relaxation time of osteochondral plugs were measured before and regularly after the exposure to the contrast agent until ten hours. Significant difference between the two contrast agents was observed. The amount of ionic contrast agent was considerably smaller compared to non-ionic, especially in deep cartilage. Ionic contrast agent reached equilibrium, whereas the amount of non-ionic contrast agent kept increasing even after ten hours. This suggests that maximum uptake of ionic contrast agent is controlled by the properties of cartilage.

15:00 ***3191*. The Application of Magnetization Transfer Ratios and T2 Relaxation Time to Patellar Articular Cartilage at 3T**

Shuji Nagata[1,2], Kimberly K. Amrami[2], David W. Stanley[3], Steven L. Williams[2], Marilyn M. Wood[2], Joel P. Felmlee[2], Masafumi Uchida[1], Naofumi Hayabuchi[1]
[1]Radiology, Kurume University Hospital, Kurume, Fukuoka, Japan; [2]Radiology, Mayo Clinic, Rochester, MN, United States; [3]GE Healthcare, Milwaukee, WI, United States

The aims of this study are to compare T2 relaxation time and MTR and determine whether MTR map is useful to depict degeneration of patellar articular cartilage as well as T2 map or not. There was a good negative correlation between T2 relaxation time and MTR. MTR map could be useful to depict early degeneration of cartilage as well as T2 mapping and has a potential as an adjunct to T2 relaxation time in early diagnosis of OA.

Thursday 13:30-15:30 Computer 2

13:30 ***3192*. Detecting Statistically Significant Changes in Cartilage Thickness with Sub-Voxel Precision**

José G. Raya[1], Annie Horng[2], Lorenz König[3], Maximilian F. Reiser[2], Christian Glaser[2]
[1]Josef Lissner Laboratory for Biomedial Imaging, , University of Munich, Munich, Germany; [2]Department of Clinical Radiology, University of Munich; [3]Technical University of Munich

MRI-based quantification of the cartilage thickness is a robust and well validated technique for the assessment of cartilage degradation in osteoarthritis, and for the analysis of cartilage deformations after exercise. Nowadays changes in cartilage thickness are evaluated by comparing averaged thickness over regions defined on an anatomical basis. In this work we demonstrate that working with a sub-voxel precision allow detecting statistically significant changes in the cartilage thickness between longitudinally acquired datasets with sub-voxel precision. The method has been tested on a small group of healthy volunteers by measuring them before and after 20 min squatting.

14:00 ***3193*. Semi-Automated Profile Generation for Functional Cartilage Imaging**

Daniel Ross Thedens[1], Noelle F. Klocke[2], Annunziato Amendola[2], Douglas R. Pedersen[2]
[1]Radiology, University of Iowa, Iowa City, IA, United States; [2]Orthopaedics and Rehabilitation, University of Iowa, Iowa City, IA, United States

A comprehensive assessment of cartilage function may use multiple quantitative techniques such as T2, T1ρ, and dGEMRIC, and may follow the subject over multiple time points. The purpose of this study was to develop a semi-automated technique to generate accurate and reproducible line profiles along the joint surface of the knee for T2, T1ρ, and dGEMRIC to permit direct registration, comparison, and correlation between functional cartilage imaging methods. This work demonstrates the feasibility of an edge-based line growing technique to generate anatomical correspondence between multiple modalities and time points to directly correlate and contrast the measurements from each.

14:30 ***3194*. Does Sub-Regional Analysis of DGEMRIC Allow for Improved Sensitivity?**

Wei Li[1], Pottumarthi V. Prasad[1]
[1]Radiology, NorthShore University HealthSystem, Evanston, IL, United States

A recent report suggested sub-regional differences in δR1 following Gd-DTPA2-. We have reanalyzed data from a previous report to compare sub-regional analysis against full thickness analysis. We found higher T1pre- and lower T1Gd in the superficial layer compared to full thickness analysis, resulting in a higher δR1. Our preliminary experience supports the use of superficial layer for routine use which potentially could improve the sensitivity, although the present data only showed a modest increase. It is not clear if there is a need to analyze the deep layer for routine use. Some technical limitations regarding sub-regional analysis are discussed.

15:00 ***3195*. The Improvement of Region-Of-Interest Statistics in Musculoskeletal MRI**

Vladimir Juras[1,2], Stefan Zbyn[1], Pavol Szomolanyi[1,2], Ivan Frollo[2], Siegfried Trattnig[1]
[1]MR Centre of Excellence, Medical University of Vienna, Vienna, Austria; [2]Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia

The advanced statistics in region-of-interest based cartilage MRI is introduced. Correction parameters were determined as the fitting errors estimates (R2, RMSE, MSE, MAE) from non-linear least square fitting calculation of T2. Functionality of improved statistics was tested on noise-simulated images. Using the error estimates as a weighting parameters in the ROI evaluation in musculoskeletal MRI may crucially improve the differentiation of native and transplant cartilage tissue even in images suffering of low SNR. This has a great potential to improve the non-invasive monitoring of the post-operative status of patients with cartilage transplants using MR systems with lower B0.

Bone, Bone & More Bone

Hall B Monday 14:00-16:00 Computer 3

14:00 ***3196*. Quantifying Proton Density in Cortical Bone In-Vivo by 3D Ultra-Short Echo-Time Imaging**

Hamidreza Saligheh Rad[1], Shing Chun Benny Lam[1], James Love[1], Jeremy F. Magland[1], Felix W. Wehrli[1]
[1]Laboratory for Structural NMR Imaging, Department of Radiology, University of Pennsylvania Health System, Philadelphia, PA, United States

The impaired strength of osteoporotic cortical bone is largely a consequence of increased porosity, which manifests in increased bone water fraction. Hence, knowledge of bone water (BW) content would provide an indirect measure of pore volume fraction. Surface interactions in the tight spaces of the lacuno-canalicular system shorten the lifetime of the BW proton signal to less than 1msec, therefore requiring solid-state imaging techniques for its capture and detection. In this work, we developed new ultra-short echo-time (UTE) radial imaging acquisition and processing capabilities for precise quantification of BW in cortical bone.

14:30 ***3197*. Osteoarthritis:Regional and Subregional Quantitative Assessment of Trabecular Bone Micro-Architecture Via 7T MRI**

Gregory Chang[1], Klaus M. Friedrich[2], Ligong Wang[3], Graham C. Wiggins[3], Michael Recht, Guoyuan Liang[4], Punam K. Saha[5], Ravinder R. Regatte[3]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Radiology, Medical University of Vienna, Austria; [3]Radiology, NYU Langone Medical Center, New York, United States; [4]Electrical and Computer Engineering, Iowa City, IA, United States; [5]Radiology and Electrical & Computer Engineering, Iowa City, IA, United States

In this study, we performed a regional and subregional quantitative assessment of trabecular bone micro-architecture of the knee in subjects with osteoarthritis (OA) using high spatial resolution MRI at 7 Tesla. OA subjects demonstrated decreases in numerous parameters of trabecular bone morphology and topology compared to healthy controls. Subregional analyses within the medial femoral condyle, lateral femoral condyle, medial tibial plateau, and lateral tibial plateau allowed the detection of smaller geographic areas of abnormal trabecular bone micro-architecture in OA subjects. This technique may allow more accurate characterization of the spatial distribution of the pathologic changes in the osteoarthritic knee.

15:00 ***3198*. Diffusion Tensor Imaging (DTI) as a Probe to Measure Trabecular Bone Orientation In-Vivo**

Bailiang Chen[1], Pierre-André Vuissoz[2,3], Amaka Offiah[4], Martin Fry[1], Andrew Todd-Pokropek[1]
[1]Medical Physics and Bioengineering, University College London, London, United Kingdom; [2]IADI, Nancy-Université, Nancy, France; [3]U947, INSERM , Nancy, France; [4]Academic Unit of Child Health, Sheffield Children's NHS Foundation Trust, Sheffield, United Kingdom

Trabecular bone orientation, together with bone mineral density, plays an important role in evaluating bone quality. This structural information is also a key parameter in bridging bone mechanical behaviour at a macro-scale and its functional adaptation at a cellular scale. Trabecular bone can be considered as a typical porous media. Through anisotropic diffusion within red marrow, DTI can be used as a probe of trabecular bone orientation in-vivo. Here, we present the current results of our in-vivo studies applying DTI to human tibia, its reproducibility and the technique's ability to reveal trabecular network orientation at a micro-scale.

15:30 ***3199*. T2 and T1p Quantification of Cortical Bone in Vivo Using Ultrashort TE (UTE) Pulse Sequences**

Jiang Du[1], Atsushi Takahashi[2], Michael Carl[2], Mark Bydder[1], Nikolaus Szeverenyi[1], Christine Chung[1], Graeme Bydder[1]
[1]Radiology, University of California, San Diego, CA, United States; [2]Global Applied Science Laboratory, GE Healthcare Technologies, Menlo Park, CA, United States

Conventional magnetic resonance sequences produce a signal void for cortical bone. By combining half pulse excitation, radial ramp sampling, and fast transmit receiver switching, an ultrashort TE of 8 μs can be achieved for bone imaging and quantification of T1 and T2*. Measurement of T2 and T1p relaxation times in cortical bone may help evaluate bone quality. Here we present techniques to quantify T2 and T1p relaxation times of the cortical bone in vivo on a clinical 3T MR system

Tuesday 13:30-15:30 Computer 3

13:30 ***3200*. Water Diffusion Behavior in Bone Marrow**

Silvia De Santis[1,2], Silvia Capuani[1,2]
[1]Physics Department, Sapienza University, Rome, Italy; [2]INFM-CNR SOFT, Sapienza University, Rome, Italy

Bone-Marrow is found in both diaphysis, where it is free, and in spongy bone, where it fills the pores of the bone-matrix. The diffusion of water contained in the bone-marrow can be investigated by means of the γ exponent, which quantifies the deviation from the ideal Gaussian diffusive conditions. The diffusion behaviour of water in free bone-marrow samples is characterized by γ very close

to unity. Conversely, in trabecular bone marrow the internal gradients at the interface between bone and bone-marrow affect the spin diffusion causing a deviation from the Gaussian behaviour, and γ values smaller than unity are observed.

14:00 ***3201***. **Assessment of Bone Marrow Oxygenation Based on T2* and T2 Changes Following Oxygen Inhalation**

David K W Yeung[1], James F. Griffith[1], Yi-xiang Wang[1], Jing Yuan[1], Queenie Chan[2], Heather T. Ma[1]

[1]Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong; [2]MR, Philips Healthcare, Wanchai, Hong Kong

Marrow mesenchymal stem cells can differentiate along osteoblastic, adipocytic or haematopoietic cell lines. Whether a shift occurs in stem cells differentiation in osteoporosis is unknown. Iron-rich red marrow influences T2* and fat-rich yellow marrow affects T2. Our goal was to verify whether breathing oxygen may reduce the amount of deoxyhemoglobin (paramagnetic) in marrow constituents thereby prolonging both T2* and T2. Our results showed that, for the first time, both T2* and T2 of bone marrow increased after oxygen inhalation. The larger δT2* compared to δT2 might reflects a higher oxygen demand in the red marrow than the yellow marrow.

14:30 ***3202***. **Kinetic Study of Bone Marrow Perfusion Using Arterial Spin Labeling**

Heather Ting Ma[1,2], Jing Yuan[1], David K. Yeung[1], Yi-Xiang Wang[1], James Francis Griffith[1]

[1]Department of Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong; [2]Electronic and Information Engineering Department, Harbin Institute of Technology Shenzhen Graduate Shool, Shenzhen, China

Varied bone marrow perfusion function in some bone diseases has been identified by dynamic contrast enhancement (DCE) MRI. This pilot study explored a non-invasive and quantitative method, combining kinetic model and arterial spine labeling (ASL) technique, to study bone marrow perfusion at lumbar spine. A turbo field echo (TFE) acquisition with STAR labeling (STAR-TFE) was developed for better imaging compared to STAR-EPI. A kinetic model was applied on the ASL signal to provide a quantitative measure of perfusion function. The result shows that ASL combined with kinetic modeling is promising for quantitative study the perfusion in bone marrow.

15:00 ***3203***. **Magnetisation Transfer Contrast of Bone Marrow Oedema in Arthritis**

Carole Burnett[1], Jill Halstead-Rastrick[2], Heidi Siddle, Robert Evans, Anthony Redmond[3], Richard Hodgson[3]

[1]LMBRU, Chapel Allerton Hospital, Leeds, United Kingdom; [2]Leeds University, United Kingdom; [3]University of Leeds

18 patients with arthritis and foot pain were imaged using T2 fat-saturated and SPGR sequences with and without Magnetisation transfer (MT). Regions-of-interest were placed on areas of normal and oedematous bone marrow on the T2 fat-saturated images and transferred to the MT images. MT ratios and the difference between images with and without MT were calculated. Contrast between oedematous and non oedematous bone was calculated. MT ratios and MT differences were significantly higher in oedematous bone. Contrast between oedematous and non oedematous bone was higher with MT. MT may be useful in assessing bone marrow oedema in arthritis.

Wednesday 13:30-15:30 Computer 3

13:30 ***3204***. **MR Perfusion Imaging and Spectroscopy Helps Predict Rate of Bone Loss**

James F. Griffith[1], David K. Yeung[1], Jason SC Leung[2], Timothy C. Kwok[3], Ping C. Leung[2]

[1]Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong; [2]Community & Family Medicine, The Chinese University of Hong Kong, Shatin, Hong Kong; [3]Department of Medicine & Therapeutics, The Chinese University of Hong Kong, Shatin, Hong Kong

It would be useful to have a reliable means of predicting bone loss. As reduced bone perfusion and increased marrow fat content are associated with osteoporosis, this longitudinal study was undertaken to determine how well MR perfusion indices and marrow fat content at baseline could predict bone loss. It showed that reduced bone perfusion indices or increased marrow fat content at baseline is associated with increased bone loss over the ensuring four years with a predictive capacity comparable to traditional risk factors. MR-based indices also reliably distinguished future fast from slow bone losers. MRI has potential in predicting bone loss.

14:00 ***3205*.** **Internal Gradient Evaluation in Spongy Bone Heel as a Potential Marker for Osteoporosis Disease**

Mauro Rebuzzi[1,2], Fabrizio Fasano[3], Vincenzo Vinicola[4], Gisela Hagberg[5], Marco Di Mario[6], Bruno Maraviglia[3,7], Silvia Capuani, [18]

[1]Physics, Sapienza University of Rome, Rome, Italy; [2]CNR-INFM SOFT, Rome, Italy; [3]IRCCS Santa Lucia Foundation, Rome, Italy; [4]Rehabilitation Hospital, IRCCS Santa Lucia Foundation, Rome, Italy; [5]Neuroimaging laboratory, IRCCS Santa Lucia Foundation, Rome, Italy; [6]Radiology, IRCCS Santa Lucia Foundation, Rome, Italy; [7]MARBILAB, Enrico Fermi Center, Rome, Italy; [8]Physics, CNR-INFM SOFT, Rome, Italy

Aim of this work was to assess, in vivo, the potential ability of the internal gradient Gi to describe the spongy bone status when applied to postmenopausal women, and to identify the most promising heel locations to assess the presence of osteoporosis. ADC and Gi were measured from different regions in talus and calcaneus of each subject. ADC and Gi were correlated with the correspondent bone-mineral-density (BMD) from each volunteer. Our preliminary data confirm the ST as the most suitable region to detect osteoporosis, and Gi as the most sensitive parameter for an early diagnosis of osteoporosis

14:30 ***3206*.** **Ultra Short TE MRI as a Quantitative Measure of Bone Density?**

Christina Messiou[1], David Collins[1], Matthew Robson[2], Veronica Morgan[1], Sharon Giles[1], Catherine Parry-Jones[1], Nandita deSouza[1]

[1]CRUK and EPSRC Cancer Imaging Centre, Department of Magnetic Resonace Imaging, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]Department of Cardiovascular Medicine, University of Oxford, Oxford, United Kingdom

UTE MRI allows detection of signal from very short T2 tissue that previously returned no signal on conventional MR sequences. Preliminary data from this ongoing study suggests that there is a significant linear relationship between % change in T2* measured by UTE MRI and CT Hounsfield Units of sclerotic bone metastases, hence UTE MRI has potential to quantify changes in the sclerotic components of bone metastases. If the relationship of T2* with HU can be extrapolated to electron density this would allow much sought after radiotherapy planning using MR data and may also be a novel approach to attenuation correction for PET/MR.

15:00 ***3207*.** **Pharmacokinetic Modeling Study on Bone Perfusion of Osteoporosis**

Heather Ting Ma[1,2], James Francis Griffith[1], David K. Yeung[1], Ping-Chung Leung[3]

[1]Department of Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong; [2]Electronic and Information Engineering Department, Harbin Institute of Technology Shenzhen Graduate Shool, Shenzhen, Guang Dong, China; [3]Jockey Club Centre for Osteoporosis Care and Control, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong

Pharmacokinetic model has been applied to the study of tumor angiogenesis providing meaningful parameters of tissue physiology. Recently studies have applied pharmokinetic principles to the study of marrow perfusion. This study used a modified Brix model to investigate bone perfusion in osteoporosis. Alternation in functional parameters related to bone perfusion has been observed in subjects with varying bone mineral density. This study provided quantitative data indicating a change in perfusion in osteoporosis. Further research on the pharmacokinetic modeling specific on bone marrow increases our understanding of the physiological and pathological changes in marrow perfusion occurring in osteoporosis and other bone diseases.

Thursday 13:30-15:30 Computer 3

13:30 ***3208*.** **Assessment of Benign and Malignant Vertebral Fractures Based on the Measurement of the Fat-Fraction**

Andreas Biffar[1], Gerwin Schmidt[2], Andrea Baur-Melnyk[2], Maximilian Reiser[2], Olaf Dietrich[1]

[1]Josef Lissner Laboratory for Biomedical Imaging, Munich, Germany; [2]Department of Clinical Radiology, Ludwig Maximilian University of Munich, Munich, Germany

Vertebral bone marrow consists of red and yellow marrow, and therefore in contrast to most other tissues of fractions of fat and water at the same order of magnitude. It is known that benign as well as malignant pathologies change this distribution pattern differently. In this study we determined the fat and water fractions in patients with benign and malignant vertebral compression fractures as well as in normal vertebral bone marrow. The analysis of the fat/water fraction shows the potential to be able to differentiate between benign and malignant lesions.

14:00 ***3209*.** **Value of Perfusion and Permeability Measurements in Distinguishing Between Benign and Malignant Vertebral Lesions**

Andreas Biffar[1], Gerwin Schmidt[2], Steven Sourbron[1], Olaf Dietrich[1], Maximilian Reiser[2], Andrea Baur-Melnyk[2]

[1]Josef Lissner Laboratory for Biomedical Imaging, Munich, Germany; [2]Department of Clinical Radiology, LMU University Hospital, Munich, Germany

Benign and malignant lesions of vertebral bodies modify their vascular structure and supply. Previous studies of dynamic contrast-enhanced MRI (DCE-MRI) in vertebral bone marrow, trying to assess these changes, were based on descriptive perfusion indices. These suffer from well-known limitations, like dependence on experimental variables and an ill-defined relation to hemodynamic parameters. To solve these problems, we performed a quantitative analysis using a two-compartment model, allowing for the separate

determination of perfusion and permeability. Perfusion parameters were determined in patients with benign and malignant vertebral compression fractures. Perfusion indices might have the potential to distinguish between osteoporotic and pathological fractures.

14:30 ***3210*. Comparison of a New Whole Body Continuous Table Movement Versus a Standard Whole Body MR Protocol for the Assessment of Multiple Myeloma**

Sabine Weckbach[1], Henrik J. Michaely[1], Alto Stemmer[2], Stefan O. Schoenberg[1], Dietmar J. Dinter[1]
[1]Department of Clinical Radiology and Nuclear Medicine, University Hospital Mannheim, Mannheim, Germany; [2]Imaging & IT Division, Magnetic Resonance, Siemens AG, Healthcare Sector, Erlangen, Germany

A new WB CTM protocol consisting of axial T2-w fs BLADE and T1-w GRE-sequences allows the assessment of patients with multiple myeloma with comparable image quality and identical ability to detect bone marrow and soft tissue lesions compared to a standard step-by-step-protocol with even better organ assessability. Scan time is reduced by 75%. Taking into account the limitations of the technique concerning vertebral fracture assessment this new protocol seems advantageous for patients with pain, allows a higher patient throughput in clinical routine and might facilitate the depiction of extramedullary lesions.

15:00 ***3211*. Follow-Up of Parametric Maps of the Tumoral Perfusion in Patients with Treated Bone Metastases of Prostate Cancer.**

Nicolas Michoux[1], Bertrand Tombal[2], Jean-Pascal Machiels[3], Frederic Lecouvet[1]
[1]RDGN, Université Catholique de Louvain, Brussels, Belgium; [2]FYCL, Université Catholique de Louvain, Brussels, Belgium; [3]ONCO, Université Catholique de Louvain, Brussels, Belgium

Using dynamic contrast-enhanced magnetic resonance imaging with a pharmacokinetic modeling of the data, the monitoring of the effects of anti-cancer therapy on bone metastases of prostate cancer during the course of the therapy becomes feasible. Ten patients scheduled to receive hormonotherapy or Taxotere therapy were imaged on a 1.5T MR scanner within one week before, 7 and 30 days after initial treatment. Perfusion maps based on Ktrans, ve and vp parameters were reconstructed. Complex changes reflecting either a decrease with a homogenization of the perfusion or an increase with a heterogenization of the perfusion, were observed in responders to therapy.

Disc, Disc, UTE, UTE

Hall B Monday 14:00-16:00 Computer 4

14:00 ***3212*. A Novel DTI-Histology Based 3D Model of the Annulus Fibrosus Microstructure Viewed in the Light of Evolutionary Medicine**

Dan Stein[1], Yaniv Assaf[2], Gali Dar[3], Israel Hershkovits[1]
[1]Department of Anatomy and Anthropology, Sackler faculty of medicine, Tel Aviv University, Tel-Aviv, Israel, Israel; [2]Department of Neurobiology, The George S. Wise Faculty of Life Sciences, Tel Aviv University, Israel; [3]Department of Physical Therapy, Faculty of Social Welfare & Health Studies, Haifa University, Mount Carmel, Haifa, Israel

This study utilizes the powerful tools of MRI diffusion in order to bring new understanding to the basic microstructure of the intervertebral disc’s annulus fibrosus. DTI images are presented of the anisotropic properties of the annulus fibrosus from which fiber tracking was extracted, revealing the disc’s collagen structure. Data was correlated with histological images. The architecture of this important structure is far from being fully understood hence viewing it here three dimensionally for the first time, is of extremely high importance for dealing with the very common pathology of low back pain.

14:30 ***3213*. in Vivo Quantification of Intervertebral Disc Collagen Content Using Magnetization Transfer Ratio Mapping**

Chenyang Wang[1,2], Walter Witschey[3], Ari Goldberg[4], Mark Elliott[2], Joseph Calabro[5], Ari Borthakur[2], Ravinder Reddy[2]
[1]Bioengineering, University of Pennsylvania, Philadelphia, PA, United States; [2]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [3]Biochemistry and Molecular Biophysics, University of Pennsylvania, Philadelphia, PA, United States; [4]Radiology, Hospital of the University of Pennsylvania, Philadelphia, PA, United States; [5]Siemens Medical Solutions

Magnetization transfer (MT) has previously been shown to be sensitive to collagen content in biological tissues. In this study, we quantified MT effect by computing the MT ratio of the intervertebral disc (IVD) on a pixel-by-pixel basis, from in vivo MT MR images. The resulting MT ratio map of healthy IVD showed significantly higher MT ratio in the collagen-rich annular fibrosis compared to the proteoglycan-rich nucleus pulposus. In contrast, the MT ratio of degenerated IVD nucleus pulposus appeared elevated, which suggests possible increase in collagen content in the otherwise proteoglycan-rich tissue as a result of degeneration.

15:00 ***3214***. **Parametric T2 and T2* Mapping Techniques to Visualize Intervertebral Discs in Patients with Low Back Pain - Initial Results on the Clinical Use with 3.0 Tesla MRI**

Goetz Hannes Welsch[1,2], David Stelzeneder[1], Friedrich Frank Hennig[2], Klaus Friedrich[1], Georg Scheurecker[1], Tatjana Paternostro-Sluga[3], Siegfried Trattnig[1], Tallal Charles Mamisch[4]

[1]MR Center, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Trauma and Orthopaedic Surgery, University Hospital of Erlangen, Erlangen, Germany; [3]Department of Physical Therapy, Medical University of Vienna, Vienna, Austria; [4]Department of Orthopaedic Surgery, University of Basel, Basel, Switzerland

Quantitative T2 provides information about the interaction of water molecules and the collagen-network within the intervertebral disc(IVD). T2*-mapping may theoretically provide comparable information of the IVD ultrastructure but with the additional benefit of three-dimensional-acquisition capability together with high signal and high spatial resolution in a short scan-time. Aim of the study was to compare and correlate T2- and T2*-relaxation in patients suffering from low back pain. Using T2 as well as T2*-relaxation mapping, all grades of IVD degeneration can be quantified and distinguished. Besides the established T2 methodology, T2* provides a fast and stable tool in the evaluation of IVDs.

15:30 ***3215***. **Lumbar Intervertebral Disc Pathology: Comparison of Quantitative T2 Mapping with Conventional MR at 3.0 Tesla**

Siegfried Trattnig[1], David Stelzeneder[1], Sabine Goed[1], Tatjana Paternostro-Sluga[2], Michael Reissegger[1], Tallal Charles Mamisch[3], Goetz Hannes Welsch[1,4]

[1]MR Centre - High field MR, Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]Department of Medical Physics and Rehabilitation, Medical University of Vienna, Vienna, Austria; [3]Department of Orthopedic Surgery, Inselspital, Bern, Switzerland; [4]Department of Trauma Surgery, University Hospital of Erlangen, Erlangen, Germany

The objective of our study was to assess the relationship of morphologically defined lumbar disc pathology with quantitative T2 mapping. Segmental evaluation of 265 discs of 53 patients with low back pain was performed and T2 values in different disc compartments were compared to different kinds of disc pathology. T2 mapping in the lumbar spine at 3 Tesla yields additional information about the disc matrix and is a promising noninvasive tool to assess water content and collagen fiber integrity in different disc pathologies.

Tuesday 13:30-15:30 Computer 4

13:30 ***3216***. **Quantitative In-Vivo Assessment of Intervertebral Disc Degeneration in Lumbar Spine Using ADC Measurements**

Hon Yu[1], Shadfar Bahri[1], Lutfi Tugan Muftuler[1], Orhan Nalcioglu[1], Vance Gardner[2]

[1]Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Orthopaedic Education and Research Institute of Southern California, Orange, CA, United States

Measurement of apparent diffusion coefficient (ADC) was investigated as means for in-vivo assessment of the degenerative states in lumbar discs. Pfirrmann grading, currently only-accepted means to assess disc-degeneration in vivo based on morphology, was utilized along with the signal-intensity ratio of disc to cerebral spinal fluid in T2w to classify the discs beyond the 5-level grades afforded by Pfirrmann grading and then to compare with the measured ADC values. The results indicate a strong negative linear correlation between the ADC values and the degenerative grades of discs demonstrating the potential value of ADC as means for in-vivo assessment of disc-degeneration.

14:00 ***3217***. **Study Population of Young Adults Using T1rho as a Marker to Detect Early Changes in Intervertebral Disc Degeneration**

Sofia Battisti[1], Riccardo Del Vescovo, Luigi Stellato, Ari Borthakur[2], Gianluca Vadala[3], Francesca Martina, Vincenzo Denaro[3], Bruno Beomonte Zobel

[1]Diagnostic Imaging, Campus Bio-Medico University of Rome, Rome, Italy; [2]University of Pennsylvania; [3]Orthopedy, Campus Bio-Medico University of Rome

MRI and T1rho-weighted sequences

14:30 ***3218***. **Ultrashort Time-To-Echo MRI of Human Intervertebral Disc Endplate: Association with Endplate Calcification**

Won C. Bae[1], Kelli Xu[2], Aseem R. Hemmad[3], Nozomu Inoue[4], Graeme M. Bydder[1], Christine B. Chung[1], Koichi Masuda[3]

[1]Radiology, University of California, San Diego, San Diego, CA, United States; [2]Bioengineering, University of California, San Diego, La Jolla, CA, United States; [3]Orthopaedic Surgery, University of California, San Diego, San Diego, CA, United States; [4]Orthopedic Surgery, Rush University Medical College, Chicago, IL, United States

UTE MR image of human lumbar spine reveals distinct linear signal near disc endplates, unlike signal voids seen in conventional MR images. Calcification of cartilaginous endplate occurs with aging, and it hinders transport across the region. Normal and abnormal (loss) UTE signals were identified and core samples harvested for micro CT. 3D reconstructed models were evaluated for endplate surface roughness and severity of calcium deposits, which were increased in UTE-abnormal samples. These results demonstrated

unique ability of UTE MRI to directly evaluate endplate region, and association of UTE MRI with calcification of endplate, which may lead to changed transport function.

15:00 ***3219*. Intervertebral Disc T1rho Relaxation Mapping with Spin-Lock 3D B-FFE Imaging at 3T**

Jing Yuan[1], Yi-Xiang Wang[1], James F. Griffith[1]
[1]Department of Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong

Quantitative T1rho imaging is a non-invasive MRI technique that has been shown to be sensitive to interactions between motionally restricted water molecules and their surrounding macromolecular environment. It should potentially be a clinical tool in identifying early interverterbral disc (IVD) degeneration. In this study, a spin-lock 3D balanced fast field echo imaging was developed for rapid in vivo IVD T1rho relaxation mapping at 3T. A significant reduction of T1rho relaxation was found to be an indication of early IVD degeneration.

Wednesday 13:30-15:30 Computer 4

13:30 ***3220*. Ultrashort TE (UTE) T1ρ Magic Angle Imaging of the Achilles Tendon**

Jiang Du[1], Nikolaus M. Szeverenyi[1], Sheronda Statum[1], Michael Carl[2], Richard Znamirowski[1], Atsushi Takahashi[2], Christine Chung[1], Graeme Bydder[1]
[1]Radiology, University of California, San Diego, CA, United States; [2]Global Applied Science Laboratory, GE Healthcare Technologies, Menlo Park, CA, United States

There are contradictory views on the T1rho relaxation mechanisms in the literatures. In one view proton exchange between chemically shifted NH and OH groups of PG and the tissue water might be an important relaxation mechanism. In another view the dominant T1rho and T2 relaxation mechanism is a dipolar interaction. Collagen fibers in tendons are highly ordered and subject to strong dipole interactions. We proposed to use a UTE-T1rho sequence to measure T1rho of the Achilles tendon at a series of angles and a series of B1rho fields to investigate the contribution of dipole interaction in T1rho relaxation mechanism.

14:00 ***3221*. Initial T_1 Measurements of the Human Achilles Tendon Using UTE Imaging at 3 T**

Peter Jonathan Wright[1], Richard Hodgson[2], Robert Evans[1], Carole Burnett[1], Matthew Robson[3]
[1]LMBRU, Leeds NHS, Leeds, West Yorkshire, United Kingdom; [2]University of Leeds, Leeds, United Kingdom; [3]University of Oxford, Oxford, United Kingdom

Conventional MRI of the Achilles tendon is limited by its short T_2. UTE imaging allows the tissues to be directly visualised, allowing quantification of tendon MR properties. In this study the feasibility of T_1 measurement using UTE saturation-recovery imaging was investigated. A UTE saturation-recovery sequence was implemented with clinically acceptable acquisition times and validated against phantoms. It was tested in the ankle of 6 healthy volunteers. Results for fat were comparable with known in vivo values while those for the Achilles tendon were higher than reported post mortem values. This technique may be useful for quantifying Achilles tendonopathy.

14:30 ***3222*. Quantitative Magnetization Transfer Ultrashort Echo Time Imaging of the Achilles Tendon.**

Richard Hodgson[1], Robert Evans[2], Peter Wright[2], Matthew Robson[3]
[1]Leeds Musculoskeletal Biomedical Research Unit, University of Leeds, Leeds, Yorks, United Kingdom; [2]Leeds Musculoskeletal Biomedical Research Unit, Chapel Allerton Hospital, Leeds, Yorks, United Kingdom; [3]Centre for Clinical Magnetic Resonance Research, Unversity of Oxford, Oxford, Oxfordshire, United Kingdom

Magnetization transfer in the Achilles tendon was investigated using ultrashort echo time imaging with off resonance saturation pulses (2-100kHz off resonance). The experimental data was fitted to a two-compartment model. Magnetization transfer effects were demonstrated which showed good agreement with the model. The bound water fraction from the model was consistently higher than that reported in white matter in the brain, reflecting the high collagen content in tendon. This technique appears feasible and and may be useful for assessing changes in collagen content which occur in tendonopathy.

15:00 ***3223*. Contrast Enhanced Short and Ultrashort Echo Time MRI of the Achilles Tendon in Spondyloarthritis**

Richard Hodgson[1], Robert Evans[2], Carole Burnett[2], Andrew Grainger[2], Philip O'Connor[2], Laura Coates, Philip Helliwell, Paul Emery, Dennis McGonagle, Matthew Robson[3]
[1]Leeds Musculoskeletal Biomedical Research Unit, University of Leeds, Leeds, Yorks, United Kingdom; [2]Chapel Allerton Hospital, United Kingdom; [3]Unversity of Oxford

The Achilles tendon was imaged in symptomatic spondyloarthritis patients and normal volunteers using a range of echo times from 0.07-14ms, with and without intravenous contrast. Images of normal tendons showed anterior reticular signal centred near the level of the superior calcaneum. Images of spondyloarthritis patients acquired with TE=2ms showed the most abnormal signal. Contrast enhancement was greatest on UTE images with TE=0.07ms. Abnormal signal on TE=2ms images was more extensive than contrast enhancement on UTE images. These results suggest 3D SPGR images with TE=2ms are useful for detecting tendon abnormality in spondyloarthritis.

Thursday 13:30-15:30 Computer 4

13:30 ***3224*. Merging UTE Imaging, Water-Fat Separation, and T_2^* Mapping in a Single 3D MSK Scan**

Jürgen Rahmer[1], Peter Börnert[1], Holger Eggers[1], Peter Koken[1], Jan P. Groen[2]
[1]Philips Technologie GmbH, Forschungslaboratorien, Hamburg, Germany; [2]Philips Healthcare, Best, Netherlands

The separation of water and fat signal contributions, e.g. be achieved by chemical shift encoding, is essential for a number of MSK applications to improve image contrast for clinical diagnosis. Also, ultrashort echo time (UTE) imaging was proposed for MSK MRI, yielding extra information about short T2 species. It is the idea to incorporate both approaches into a multi-echo imaging (ME) sequence, which samples the UTE signal in the first echo and simultaneously delivers water-fat separation, T2* mapping and short T2 contrast. An efficient 3D ME approach is presented which allows the generation of water-fat separated images containing short-T2* components while extending the T2* mapping range down to ~ 1 ms. The 3D approach eases planning and bears the potential to deliver comprehensive diagnostic information by means of a single scan. We apply the technique to imaging of the knee, where short-T2 components are found in tendons, ligaments, and menisci.

14:00 ***3225*. Water/Fat Separation of Short T_2* Tissue Using Multi-Echo Ultra-Short Echo Time (UTE) Imaging and IDEAL**

Kang Wang[1], Huanzhou Yu[2], Jean Brittain[3], Scott Reeder, [1,4], Jiang Du[5]
[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Applied Science Laboratory, GE Healthcare, Madison, WI, United States; [4]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [5]Radiology, University of California, San Diego, San Diego, CA, United States

An ultrashort TE (UTE) imaging technique has been developed for the visualization of tissues with short T2 or T2*, such as menisci and tendons. UTE methods typically utilize fat suppression to improve the contrast for tissues with short T2. However, conventional fat-saturation methods achieve limited success due to the broad short T2* water-peak and the complexity of the fat spectrum. In this work, we have combined a 2D multi-slice multi-echo UTE sequence with a water/fat separation technique (IDEAL), to obtain high contrast short T2 images without the use of any preparation pulse and within acceptable scan times.

14:30 ***3226*. Ultrashort TE 3D Gradient-Echo Imaging of Human Knee at 3T**

Jang-Yeon Park[1], Ute Goerke[1], Steen Moeller[1], Eddie Auerbach[1], Jutta Ellermann[1], Michael Garwood[1]
[1]Center for Magnetic Resonance Research and Department of Radiology, University of Minnesota, Minneapolis, MN, United States

Although UTE and SWIFT have the advantage in imaging ultrashort T2 species, it can be challenging to implement them on clinical scanners due to high technical demands. Recently, we proposed a new ultrashort TE 3D gradient-echo imaging that can effectively cover TE range of > ~0.2 ms, which was dubbed SWIFT-LiTE. It is renamed here UTE-GRE to emphasize that a conventional selective pulse like a sinc pulse can also be used for excitation. UTE-GRE was implemented on clinical 3T and human knee data were acquired focusing on menisci. White and red zones were differentiated without contrast agent or image subtraction.

15:00 ***3227*. Quantitative Evaluation of Human Cadaveric Posterior Cruciate Ligament: Effect of Trypsin Digestion on T1rho Values.**

Patrick Omoumi[1], Eric S. Diaz[1], Jiang Du[1], Sheronda S. Statum[1], Won C. Bae[1], Graeme Bydder[1], Christine B. Chung[1]
[1]University of California, San Diego, San Diego, CA, United States

Quantitative methods have been developed to probe early degenerative changes for the cartilage, and more recently applied to menisci. T2 values are thought to mainly be influenced by the organization and concentration of collagen fibers, whereas T1rho values are correlated with the concentration of glycosaminoglycans (GAG), the influence of collagen on T1rho values remaining controversial. As in cartilage and menisci, ligaments are mainly composed of collagen GAGs3,4. We sought to evaluate the feasibility of conventional and novel UTE quantitative techniques for T1rho measurements of the PCL, and study the effect of the selective removal of GAG molecules by an enzymatic digestion5,6.

Muscle

Hall B Monday 14:00-16:00 Computer 5

14:00 ***3228*. Muscle Energetics Changes Throughout Maturation: a Quantitative 31P-MRS Analysis**

Anne Tonson[1], Sébatsien Ratel[2], Yann Lefur[1], Patrick Cozzone[1], David Bendahan[1]
[1]CRMBM - UMR CNRS 6612, Marseille, France; [2]BAPS - EA3533, AUBIERE, France

In this study we investigated whether development quantitatively affected muscle energy production and proton handling during a standardized exercise in prepubescent boys and men using 31-Phosphorus Magnetic Resonance Spectroscopy. We mainly found that maturation significantly affects muscle energetics. We showed that although the total energy cost of contraction was unaffected throughout the maturation process, the relative contribution of each metabolic pathway to ATP production during a standardized exercise changed with respect to age. Children rely more on oxidative metabolism and less on creatine kinase reaction to meet energy demand during exercise whereas anaerobic glycolysis activity was unaffected by development.

14:30 ***3229*. Changes in Oxidative Metabolism of Skeletal Muscle Induced by Loaded Vibration Exercise Under Vascular Occlusion**

Susanne Heinzer-Schweizer[1], Flurin Item[2,3], Anke Henning[1], Michael Wyss[1], Jonas Denkinger[3], Roland Kreis[4], Marco Toigo[2,3], Urs Boutellier[2,3], Peter Boesiger[1]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Institute of Physiology and Zurich Center for Integrative Human Physiology, University of Zurich, Zurich, Switzerland; [3]Exercise Physiology, Institute for Human Movement Sciences, ETH Zurich, Zurich, Switzerland; [4]Department of Clinical Research, University Bern, Bern, Switzerland

“Strength” training has become a major component sports and rehabilitation. We have developed an exercise paradigm that combines three modalities known to positively influence “strength”. 21 female subjects were recruited, whereof 12 were trained. Before and after 5.5 weeks of training, oxygen consumption, lactate levels and body composition were determined, muscle biopsies were acquired, and dynamic 31P spectroscopy measurements were performed. Capillary-to-fiber-ratio, calf lean mass, peak power, resting pH, and resting inorganic phosphate and phosphocreatine concentrations changed significantly with training. A large increase in enhancement of metabolic parameters in a short time is therefore possible using this new exercise paradigm.

15:00 ***3230*. A Comparison of in Vivo and in Vitro Measurements of Skeletal Muscle Mitochondrial Capacity in Human Skeletal Muscle**

Ian R. Lanza[1], K S. Nair[2], John D. Port[3]

[1]Endocrinology, Mayo Clinic, Rochester, MN, United States; [2]Endocrinology, Mayo Clinic , Rochester, MN, United States; [3]Radiology, Mayo Clinic, Rochester, MN, United States

Muscle oxidative capacity can be determined by 31P-MRS from phosphocreatine kinetics. We compared this approach two independent measurements of oxidative capacity performed using mitochondria isolated from skeletal muscle biopsy tissue in 11 volunteers. 31P-MRS was used to monitor the depletion and recovery of phosphocreatine following a 30 second maximal knee extension exercise. Oxidative capacity was also determined from measurements of maximal ATP production and respiration in mitochondria isolated from muscle biopsies. Oxidative capacity measured in vivo was significantly associated with maximal state 3 respiration and ATP production rates. 31P-MRS is a valid tool for assessment of mitochondrial oxidative capacity.

15:30 ***3231*. Estimates of Mitochondrial Capacity Derived from Phosphocreatine Recovery Kinetics in Human Calf and Thigh Muscle Differ Systematically from Published Measurements Using Invasive Methods**

Elina Raja Ahmad[1], William Bimson[1], Graham Kemp[2]

[1]Magnetic Resonance and Image Analysis Research C, University of Liverpool, Liverpool, Merseyside, United Kingdom; [2]Magnetic Resonance and Image Analysis Research Centre , University of Liverpool, Liverpool, Merseyside, United Kingdom

Analysis of 31P MRS phosphocreatine recovery kinetics provides valuable information about muscle mitochondrial function in vivo. Correct analysis of the data in terms of ‘mitochondrial capacity’ (a function of mitochondrial numbers, function and substrate/O2 supply) depends on the underlying physiology. We compare the results of such analysis in quadriceps and calf muscle at 60% and 90% maximum voluntary contraction force, and with estimates inferred from some published measurements by invasive methods. Results differ little between the two muscles, but systematic quantitative differences between methods of assessing mitochondrial function in vivo remain unexplained.

Tuesday 13:30-15:30 Computer 5

13:30 ***3232*. The PH-Dependence of Post-Exercise PCr and ADP Recovery: A Simple Modelling Approach Reproduces Important Features of 31P MRS Data from Skeletal Muscle**

Graham Kemp[1], Nicole van den Broek[2], Klaas Nicolay[2], Jeanine Prompers[2]

[1]Magnetic Resonance and Image Analysis Research Centre , University of Liverpool, Liverpool, Merseyside, United Kingdom; [2]Biomedical NMR, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands

In 31P MRS studies of recovery from exercise the pH-sensitivities of acid efflux and PCr recovery time constant are correlated, suggesting that intersubject differences in the latter are related to differences in cellular pH control. A simple model of ADP-dependent oxidative ATP synthesis and pH-dependent acid efflux reproduces the pH-dependence of PCr recovery. Here we show that it directly predicts the effect of efflux on this, and indeed also individual values of the PCr and ADP time constants, but that this depends also on the relationship between end-exercise pH and [PCr], which is not under direct experimental control.

14:00 ***3233*. 31P MRS of the Biceps Brachii Muscle at 3T**

Jonathan W. Howard[1], Gregory Shields[1], Giulio Gambarota[1], Ros M. Gordon[1], Anil w. Rao[1], Rex D. Newbould[1]

[1]GlaxoSmithKline Clinical Imaging Center, London, United Kingdom

Phosphorous (31P) MR allows for non-invasive monitoring of muscle bioenergetics. The exercise device is one of the most critical components in the experiment. Typically, custom built devices, which require additional time and expertise for the set up, are used.

The aim of the present study was to investigate a simple isometric method for performing 31P spectroscopy on the biceps brachii muscle, and to determine its potential as a model for future 31P investigations.

14:30 *3234*. **^{31}P MRS of Resting Muscle at 7T: Differences in the Alkaline PH Compartment Between Different Muscles and Sedentary and Elite Trained Athletes**

Hermien E. Kan[1], Joep van Oorschot[2], Beatrijs H.A. Wokke[3], Maarten J. Versluis[1], Nadine B. Smith[1], Andrew G. Webb[1], Jeroen A.L. Jeneson[2]
[1]C.J. Gorter Center, department of radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Biomedical NMR Laboratory, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [3]Department of neurology, Leiden University Medical Center, Leiden, Netherlands

Non-invasive determination of mitochondrial content is an important objective in clinical and sports medicine. Previously, a peak 0.4 ppm downfield from the cytosolic Pi resonance (Pi_1) was found in resting skeletal muscle that was tentatively attributed to mitochondrial Pi (Pi_2). Here we show a consistently higher Pi_2 signal in soleus (SOL) versus tibialis anterior (TA) muscle, as well as in trained versus untrained subjects. Since these results are in quantitative agreement with known differences in oxidative capacity between SOL and TA and trained versus untrained subjects, they support our hypothesis that the Pi_2 resonance originates from the mitochondrial compartment in muscle.

15:00 *3235*. **The Effects of Statins on 31P MRS Measured Skeletal Muscle Metabolite Content and Function**

Jill M. Slade[1], Sean C. Forbes[2], George S. Abela[3], Robert McClowry[1], Ronald A. Meyer[1]
[1]Radiology, Michigan State University, East Lansing, MI, United States; [2]Physical Therapy, University of Florida; [3]Cardiology, Michigan State University

Skeletal muscle content and function may be affected by cholesterol lowering medications (statins). 31P MRS was used to quantify resting and exercise induced changes in muscle metabolism. Muscle aerobic capacity was reduced following 80-mg atorvastatin suggesting comprised skeletal muscle function with statin use.

Wednesday 13:30-15:30 Computer 5

13:30 *3236*. **Metabolic Assessment of Myositis with 1H Magnetic Resonance Spectroscopy**

Xin Wang[1], Antonio J. Machado[2], Peter B. Barker[3], John A. Carrino[2], Laura M. Fayad[2]
[1]Radiology, Johns Hopkins University, Baltimore, MD, United States; [2]Musculoskeletal Radiology, Johns Hopkins University; [3]Rad Neuro, Johns Hopkins University

This pilot study employed 1H magnetic resonance spectroscopy to identify potential metabolite alterations in the muscles of subjects with myositis. A significant difference in the choline concentration of subjects with myositis with elevated T2 muscle signal was found compared with those without signal abnormalities by conventional MR imaging. In addition, Choline to lipid ratios were found to be possibly different for subjects with myostitis compared with a healthy control group. These results indicate that 1H MRS may yield clues to the physiologic alterations in patients with myositis.

14:00 *3237*. **Proton MR Spectroscopy Measurements for Metabolomic Changes During Adipogenic Differentiation of Muscle Derived Stem Cells**

Song I. Chun[1], Moo Young Jang[1], Sun Young Lee[2], Dong Hwa Kim[1], Jee Hyun Cho[3], Jung Woog Shin[1], Young Il Yang[2], Chi Woong Mun[1,4]
[1]Biomedical Engineering, Inje University, Gimhae, Korea, Republic of; [2]Pathology, Paik Hospital, Inje University, Busan, Korea, Republic of; [3]Korea Basic Science Institute, Ochang, Korea, Republic of; [4]UHRC, Inje University, Gimhae, Korea, Republic of

The purpose of this study is to measure and establish the metabolite change when the Muscle Derived Stem Cells (MDSCs) were differentiated into adipocyte using the 1H MR Spectroscopy. The experiments are classified four groups: Group1-Adipogenic Media, Group2- Papain digested fibrin gel, Group3-Papain digested MDSCs, Group4-Papain digested adipogenic MDSCs. The spectrum from each group has been acquired by utilizing vertical-bore 14.1T NMR/MRI with PRESS pulse sequence. Compare to spectrums of each group, we analyzed metabolite peaks newly formed during the differentiation of the MDSCs. In the results, we can observe that 1H MR spectral peak intensity increases at 0.89/1.24/1.9/2.48/3.0 ~3.1ppm after 14 days of differentiation from MDSCs into adipocyte. In this study, therefore we could observe the metabolite change along with MDSCs differentiation and found the potential possibilities of MRS to evaluate the differentiations of stem cell.

14:30 *3238*. **1H-MRS to Evaluate Intramuscular Lipid Changes in HIV-Patients with Lipodystrophy Syndrome by LCmodel**

Ana Isabel Garcia[1], Ana Milinkovic[2], Iñaki Perez[3], Xavier Tomas, Sergi Vidal-Sicart[4], Carles Falcon[5], Jaume Pomes, Montserrat Del Amo, Josep Mallolas[2]
[1]Radiology, Hospital Clinic, Barcelona, Spain; [2]Infections and Immunology, Hospital Clinic; [3]Infections and Immunology. Statistical, Hospital Clinic; [4]Nuclear medicine, Hospital Clinic; [5]IDIBAPS, Hospital Clinic

1H-MR spectroscopy was performed to assess intramyocelullar lipids (IMCL) in a group of HIV-patients with lipodystrophy syndrome receiving stable antiretroviral therapy and their changes 6 months after switching the treatment. HIV-patients at baseline revealed higher IMCL than controls, although no significant. Statistical analysis revealed a significant reversal of peripheral lipoatrophy with decreased of the lean mass after switching the treatment, and it was related with IMCL decreased, although no significant. A probable migration of lipid content from intramyocellular to periphery can explain partially the peripheral fat gain and loss of peripheral lean mass, although other factors may participate.

15:00 *3239*. **Assessment of Acetylcarnitine in Individuals with Type 1 Diabetes After Exercise in Eu- And Hyperglycemia Using ^{1}H MR Spectroscopy in Skeletal Muscle**

Andreas Boss[1], Christoph Stettler[2,3], Michael Ith[1,4], Stefan Jenni[2,5], Chris Boesch[1], Roland Kreis[1]

[1]Department of Clinical Research, University of Bern, Bern, Switzerland; [2]Division of Endocrinology, Diabetes and Clinical Nutrition, Inselspital, Bern, University Hospital and University of Bern, Bern, Switzerland; [3]Institute of Social and Preventive Medicine, University of Bern, Bern, Switzerland; [4]Institute for Diagnostic, Interventional and Pediatric Radiology, University Hospital and University of Bern, Bern, Switzerland; [5]International Center for Circulatory Health, Imperial College, London, Switzerland

Differences in the exercise-induced production of acetylcarnitine, a buffer of acetyl-CoA, in eu- vs. hyperglycaemia have been analyzed by 1H-MR spectroscopy in thigh muscle. Spectra were obtained before and after exercise (120min. at 55 to 60% VO2max, with indirect calorimetry) in 7 physically active type 1 diabetic males. During both trials, insulinaemia was kept constant and the contribution of the various substrates was determined. Acetylcarnitine was elevated 1h after exercise ($p<0.0001$). This increase was significantly higher in euglycaemia ($p=0.0003$) and coincided with higher rates of fat oxidation in this condition. Conclusion: different substrate availability alters the production of acetylcarnitine significantly.

Thursday 13:30-15:30 Computer 5

13:30 *3240*. **Improvements in DTI and Muscle Fiber Tractography of the Human Forearm Using Rician Noise Supression and B0-Field Corrections**

Martijn Froeling[1,2], Dennis F. Heijtel[1], Arno Lataster[3], Maarten Drost[3], Klaas Nicolay[1], Aart J. Nederveen[2], Gustav J. Stijkers[1]

[1]Biomedical NMR, Department of Biomedical Engineering,, Eindhoven University of Technology, Eindhoven, Netherlands; [2]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands; [3]Department of Human Movement Sciences, Maastricht University, Maastricht, Netherlands

Diffusion tensor imaging with minimized scan time was preformed. The diffusion-weighted images were filtered using a recursive linear minimum mean-square-error estimator and field-inhomogeneity related deformations in the EPI images were corrected. This approach allows for accurate fiber tractography of human forearm muscles based on a single seeding ROI drawn in high resolution T1 weighted images.

14:00 *3241*. **Evaluation of the Skeletal Muscle Morphological Transformation by Stress**

Junichi Hata[1], Kazuo Yagi[1], Keigo Hikishima[2], Yuji Komaki[2], Keiichi Yano[3], Kyouhito Iida[3], Kazuo Mima[3], Kuni Ohtomo[3]

[1]Dept. of Radiological Science, Tokyo Metropolitan University, Arakawa, Tokyo, Japan; [2]Central Institute for experimental Animals, Kanagawa, Japan; [3]Dept. of Radiological Technology, University of Tokyo Hospital, Bunkyou, Tokyo, Japan

The focus was put on diffusion anisotropy obtained by Diffusion Tensor Imaging: DTI in this research, and it searched for the relation to skeletal muscle morphological transformation by stress. This research added stress to the thigh lower skeletal muscle. The change in muscle cell structure by stress was evaluated by water diffusion anisotropy. The relation between the skeletal muscle cell structure and diffusion anisotropy was shown by this research. And, the possibility of this structure analysis by this method was suggested.

14:30 *3242*. **Evidence of 3-D Fabric Structure in Skeletal Muscle Via In-Vivo DTI and Eigenspace Reconstruction**

Danchin Chen[1], Dimitrios C. Karampinos[1,2], Armen Gharibans[1], Kevin F. King[3], John G. Georgiadis[1,2]

[1]Mechanical Science and 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]GE Healthcare, Waukesha, WI, United States

Driven by the hypothesis that the secondary eigenvector field in DTI of skeletal muscle reflects the muscle ultrastructure transverse to fiber orientation, we superimpose the flow fields of the primary and secondary eigenvectors extracted from DTI data comprising axial slices of the mid-calf. V1 aligns with the local myofiber direction and the V2 field is topologically consistent with the putative orientation of the inter-myocellular force transmission. 3-D reconstruction of the eigenvector flow fields and consistency of the secondary eigenvector orientation in the proximodistal direction provide preliminary evidence of the presence of a woven fabric in skeletal muscle.

15:00 ***3243*.** **In Vivo Fiber Tracking of Muscle Anatomy in Rodents (Oryctolagus Cuniculus) on a Clinical 3T MRI System**

Daniel Güllmar[1], Tobias Siebert[2], Kay Leichsenring[2], Carolin Küpper[2], Reinhard Blickhan[2], Jürgen R. Reichenbach[1]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany; [2]Science of Motion, Institute of Sport Science, Friedrich-Schiller-University Jena, Jena, Germany

This work aims to facilitate diffusion tensor imaging on a clinical 3T MRI system in order to reconstruct the inner shank muscle architecture of rodents. Using a slightly modified EPI-DTI sequence and 3D anatomic scan, we were able to reconstruct the muscular structure within feasible scan time (approx. 45 min). The promising results will be validated by examining the myostructure using high-resolution (0.07 mm) 3D reconstruction techniques (Microscribe MLX) ex-vivo.

Muscle & Miscellaneous

Hall B Monday 14:00-16:00 Computer 6

14:00 ***3244*.** **Functional Assessment of Skeletal Muscle in Mice Lacking Myostatin by Multiparametric Functional (Mpf-) NMR *in Vivo***

Celine Baligand[1,2], Helene Gilson[3], Jacques C. Menard[1,2], Olivier Schakman[3], Claire Wary[1,2], Jean-Paul Thissen[3], Pierre Georges Carlier[1,2]
[1]NMR Laboratory, Institute of Myology, F-75651 Paris, France; [2]CEA, I²BM, MIRCen, IdM NMR Laboratory, F-75651 Paris, France; [3]Unite de Diabetologie et Nutrition, Universite Catholique de louvain, B-1200 Brussels, Belgium

Inhibiting myostatin (mstn) causes spectacular increase in muscle mass, and has opened the path to therapeutic approaches. Yet possible compromised force production have been reported in isolated muscle. We investigated vascular and metabolic response to exercise in vivo in mstn-/- and wild-type mice using interleaved arterial spin labeling NMR imaging and 31P spectroscopy. Specific force and maximum perfusion were identical. Mitochondrial oxidative capacities were reduced in mstn-/-, while hyperemia was prolonged. These integrated results formed coherent evidence of a non-pathologic shift towards a more glycolytic metabolism in this model as was confirmed by histology.

14:30 ***3245*.** **Effects of Resistance Trainging and β-Hydroxy-β-Methylbutyrate (HMB) on Muscle Fiber CSA and Lean Body Mass in Aged Rats: A DTI and DEXA Study**

Ihssan S. Masad[1,2], Y-M Park[3], S-R Lee[3], Jacob M. Wilson[3], Paul C. Henning[3], Bahram H. Arjmandi[3], Samuel Colles Grant[1,2], J-S Kim[3]
[1]Department of Chemical & Biomedical Engineering, The Florida State University, Tallahassee, FL, United States; [2]National High Magnetic field Laboratory, Tallahassee, FL, United States; [3]Department of Nutrition, Food & Exercise Sciences, The Florida State University, Tallahassee, FL, United States

SSarcopenia, age-related muscle wasting, has drastic medical and financial impacts on the elderly population. In this study, diffusion tensor imaging (DTI), which is sensitive to muscle architecture, is employed to assess the potential benefits of β-hydroxy-β-methylbutyrate (HMB) and resistance training (RT) in a pre-clinical model of aged rats. DTI was used to evaluate muscle cross sectional area (CSA) while dual energy X-ray absorptiometry was utilized to assess lean body mass (LBM). As well as increasing LBM, results demonstrate that RT caused hypertrophy in aged soleus muscle, as indicated by increased ADC as well as increased second and third eigenvalues.

15:00 ***3246*.** **Diffusion Tensor Imaging of the Calf Muscles at 1.5T: Diffusion Property Differences Between Athletes and Non-Athletes**

Yoshikazu Okamoto[1], Yuka Kujiraoka[2], Manabu Minami[3]
[1]Radiology, University of Tsukuba Hospital , Tsukuba, Ibaraki, Japan; [2]Radiology, Tsukuba Memorial Hopital, Japan; [3]University of Tsukuba hospital, Japan

We compared @FA, eigenvalues, and ADC for bilateral gastrocnemius medialis (GCM),gastrocnemius lateralis (GCL), soleus (SOL) and anterior tibial (AT) muscles between athletically trained and not-trained skeletal muscle. In all eight muscles, all three eigenvalues and ADC were lower in trained muscle than in not-trained one. There were significant differences in all muscles as for ƒÉ1 and ADC (P<0.01), all muscles (P<0.05) except for right AT in ƒÉ2 and left SOL in ƒÉ3.Our results indicated that chronic muscle hypertrophy due to training caused those differences as a result of decrease of the extracellular space of the muscle.

15:30 ***3247*.** **Change of MR Diffusion Property During Active Muscle Contraction in the Calf**

Yoshikazu Okamoto[1], Akira Kunimatsu[2], Manabu Minami[3]
[1]University of Tsukuba hospital, Tsukuba, Ibaraki, Japan; [2]Radiology, University of Tokyo hospital, Japan; [3]University of Tsukuba hospital, Japan

We obtained diffusion tensor images (b=500 s/mm²) of bilateral calves of ten volunteers in a 1.5T MR machine at resting and planter flexion states of the right ankle. In gastrocnemius medialis (GCM), the FA, ë1 and ë2 of right to left ratios were increased from 1.05,0,99, and 0.99 to 1.17 (P<0.05), 1.06 (P<0.01), and 1.07 (P<0.01) with statistically significant difference by Paired t-test. In anterior tibialis (AT), ë1 and ë2 ratios were decreased from 0.99 and 1.01 to 0.96 (P<0.05) and 0.94 (P<0.05). We suppose these changes mainly reflect changes of focal temperature and perfusion of each skeletal muscle.

Tuesday 13:30-15:30 Computer 6

13:30 ***3248***. **Ultra-High-Resolution Skin Imaging at 7 T with Motion Correction and Fat/Water Separation**

Joëlle Karine Barral[1], Mohammad Mehdi Khalighi[2], Ron D. Watkins[3], Michael Lustig[1,4], Bob S. Hu, [1,5], Dwight G. Nishimura[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Radiology, Stanford University, Stanford, CA, United States; [4]Electrical Engineering and Computer Sciences, UC Berkeley, Berkeley, CA, United States; [5]Palo Alto Medical Foundation, Palo Alto, CA, United States

When high field strengths and small transmit-receive coils are used, SNR is no longer the sole limit to high-resolution imaging. Chemical shift and motion artifacts become major concerns. To address these concerns, a Cartesian gradient echo pulse sequence was designed with interleaved echoes for fat/water separation and interleaved navigators for motion correction. In vivo skin images with 100 µm isotropic resolution (1 nL) are presented. Fat/water separation allows the clear delineation of the different skin layers while motion correction effectively removes blurring.

14:00 ***3249***. **Potential of MRI Relaxometry in the Study of Cisplatin Induced Cell Death in Squamous Cell Carcinoma of Skin**

Ashok Sharma[1], Uma Sharma[2], N R. Jagannathan[2], Moganty R. Rajeswari[1]

[1]Department of Biochemistry, All India Institute of Medical Sciences, New Delhi, Delhi, India; [2]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India

MR relaxometry offers the potential for investigating the microstructural tissue properties and the ability to detect early changes of water mobility resulting from therapy-induced changes. In this study we report the cisplatin induced cell death with the duration of treatment by MR relaxometry in an animal model of squamous cell carcinoma of skin. Our MR data correlated with the findings of histology and biochemical parameters i.e proliferation index and apoptotic index. Results indicate that MR relaxometry measurements are useful to monitor cell death in response that could help selection of proper therapeutic regimen, dose, or duration of drug.

14:30 ***3250***. **Diffusion Tensor Imaging of Sural Nerves**

Boklye Kim[1], T. L. Chenevert[1], Ashok Srinivasan[1], B. Sabb[1], Rodica Pop-Busui[1]

[1]University of Michigan, Ann Arbor, MI, United States

Diffusion tensor imaging (DTI) is a promising clinical modality for early detection of nerve damage. The aim of this study is to develop an optimal DTI protocol for quantitative analysis of the sural nerves in the lower legs and ankles, which has been problematic due to its small size and limited SNR. While strongly facilitated along the elongated fiber in healthy subjects, the diffusion of tissue water loses directionality in diabetic patients due to the loss of fiber density. We present the anatomical localization and nerve fractional anisotropy measurements of the sural nerve to determine the integrity of nerve myelination.

15:00 ***3251***. **Evaluation of Intraneural Ganglion Cysts Using 3D FSE-Cube**

Kameron Robert Shahid[1], Robert J. Spinner[1], John A. Skinner[1], David W. Stanley[2], Jeffrey R. Bond[1], Joel P. Felmlee[1], Kimberly K. Amrami[1]

[1]Radiology, Mayo Clinic, Rochester, Rochester, MN, United States; [2]GE Healthcare, Proctor, MN, United States

It is often difficult to definitively diagnose intraneural ganglion cysts with conventional MR imaging and to identify the origin of the cyst in a joint via what may often be a subtle connection. The ideal acquisition for imaging these cysts would be a 3D acquisition with isotropic spatial resolution that would achieve optimum reformatting in all areas within a reasonable scan time. It is the purpose of this study to demonstrate the clinical utility of 3D FSE-Cube in the evaluation of intraneural ganglion cysts and the important joint connection.

Wednesday 13:30-15:30 Computer 6

13:30 ***3252***. **High Resolution MRI of Asymptomatic Plantar Plate Under Flexion and Extension: Implications for Understanding Normal Structure and Diagnosing Tears**

Heidi J. Siddle[1], Anthony C. Redmond[1], Philip S. Helliwell[1], Richard J. Wakefield[1], Philip J. O'Connor[2], Richard J. Hodgson[3]

[1]Section of Musculoskeletal Disease, University of Leeds, Leeds, United Kingdom; [2]Leeds Musculoskeletal Biomedical Research Unit, Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom; [3]Leeds Musculoskeletal Biomedical Research Unit, University of Leeds, Leeds, United Kingdom

MRI is widely used to image the plantar plates of the metarsophalangeal joints. High signal at the insertion is routinely interpreted as a tear; however this is controversial. In this study 3T MRI images consistently demonstrated high signal at the plantar plate insertion centrally in asymptomatic subjects. The high signal did not extend to the medial and lateral borders and is not seen on T2 weighted images. Dorsiflexion of the joint demonstrates bands connecting the body of the plantar plate to the proximal phalanx. High signal centrally in the plantar plate is not indicative of a tear in asymptomatic subjects.

14:00 *3253*. **High Resolution MRI of the Plantar Plates in Patients with Rheumatoid Arthritis**

Heidi J. Siddle[1], Andrew J. Grainger[2], Anthony C. Redmond[1], Philip S. Helliwell[1], Richard J. Wakefield[1], Richard J. Hodgson[3]
[1]Section of Musculoskeletal Disease, University of Leeds, Leeds, United Kingdom; [2]Department of Radiology, Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom; [3]Leeds Musculoskeletal Biomedical Research Unit, University of Leeds, Leeds, United Kingdom

Damage to the plantar plates of the metatarsophalangeal joints has been suggested as a cause of forefoot pain and deformity in patients with rheumatoid arthritis (RA). This study looked at 68 plantar plates in patients with RA and forefoot pain using high resolution 3T MRI. Plantar plate pathology was revealed in all patients. However, high signal at the insertion on T2-weighted images (often interpreted as a tear) is not indicative of a tear in patients with RA.

14:30 *3254*. **Dynamic Contrast Enhanced MRI of Bone Marrow in Rheumatoid Arthritis and the Response to Treatment.**

David A. King[1], Edward M. Vital[1], Jane E. Freeston[1], Philip O'Connor[2], Robert Evans, [2,3], Peter Wright, [2,3], Paul Emery[1], Richard Hodgson, [1,3]
[1]University of Leeds, Leeds, Yorkshire, United Kingdom; [2]Chapel Allerton Hospital, Leeds, United Kingdom; [3]Leeds Musculoskeletal Biomedical Research Unit, Leeds, United Kingdom

This study uses dynamic contrast enhanced MRI to study the response of bone marrow to therapy. 30 patients with long-standing, active rheumatoid arthritis were imaged before and at 12 and 24 weeks after starting biologic treatment. 3D SPGR images of the wrist were acquired every 19 seconds and the relative early enhancement rate of bone marrow calculated from a carpal bone. There was a statistically significant decrease in the RER at both 12 and 24 weeks after starting treatment. This suggests DCE-MRI of bone marrow may be useful for assessing the response to treatment in rheumatoid arthritis.

15:00 *3255*. **The Value of Dce-Mri in the Differential Diagnosis of Psoriatic Arthritis and Erosive Osteoarthritis of the Hand**

Christina Schraml[1], Nina F. Schwenzer[1], Ina Kötter[2], Jörg C. Henes[2], Fritz Schick[3], Claus D. Claussen[1], Marius Horger[1]
[1]Department of Diagnostic and Interventional Radiology, University Hospital of Tübingen, Tübingen, BW, Germany; [2]Department of Internal Medicine II, University Hospital of Tübingen, Tübingen, BW, Germany; [3]Section on Experimental Radiology, University Hospital of Tübignen, Tübingen, BW, Germany

In the present 3T study, DCE-MRI was evaluated in the differential diagnosis of psoriatic arthritis (PsA) and erosive arthritis (EOA) of the hand in 26 patients. Significantly higher late enhancement was observed in EOA patients 15 minutes after contrast injection. Results suggest that analysis of synovial membrane inflammation by DCE-MRI could be useful in the differentiation of these two arthritis types which is often difficult based on clinical and laboratory findings alone. As new treatment approaches are particularly adapted for each arthritis entity DCE-MRI could provide additional diagnostic information in differentiating PsA from EOA in clinical routine.

Thursday 13:30-15:30 Computer 6

13:30 *3256*. **Improving Isotropic 3D FSE Methods for Imaging the Knee**

Charles Qingchuan Li[1], Weitian Chen[2], Jarrett K. Rosenberg[1], Philip J. Beatty[2], Anja C. Brau[2], Richard X. Kijowski[3], Brian A. Hargreaves[1], Reed F. Busse[4], Garry E. Gold[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Global Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Radiology, University of Wisconsin, Madison, WI, United States; [4]Global Applied Science Laboratory, GE Healthcare, Madison, WI, United States

A new isotropic 3D FSE sequence, 3D-FSE-Cube, is currently being developed for multiple structural imaging applications as an improvement to traditional 2D-FSE methods. This study aimed to optimize 3D-FSE-Cube for musculoskeletal evaluation of the knee at 3T. 146 scans from 7 healthy volunteers were acquired with systematically varied acquisition parameters and evaluated for SNR, CNR and image quality in comparison to a single reference standard. Regression analysis suggests that current clinical acquisition parameters produce close to optimal image quality.

14:00 *3257*. **3D-Imaging of the Knee with an Optimized 3D-TSE Sequence and a 15 Channel Knee-Coil at 3T**

Mike Notohamiprodjo[1], Annie Horng[2], Bernhard Kuschel[2], Peter Bär[3], Maximilian F. Reiser, Christian Glaser
[1]Institute for Clinical Radiology, University Hospitals Munich, Munich, Bavaria, Germany; [2]University Hospitals Munich, Insitute for Clinical Radiology; [3]Siemens Sector Healthcare

The purpose of this study was to evaluate a 3D-TSE-sequence with optimized acquisition strategies for improved tissue-contrast. Fifteen volunteers and 50 patients were examined at 3T (Magnetom VERIO, Siemens Sector Healtcare) with the PDfs-weighted 3D-TSE-sequence SPACE. Relevant SNR and CNR, i.e. fluid and Cartilage, of the isotropic 3D-TSE-sequence were significantly higher than of conventional 2D-TSE-sequences. Depiction of the femoral trochlea and small structures was significantly better. Small lesions could be better detected with the 3D-TSE-sequence. Diagnostic confidence was not significantly different. This technique hold high potential for further knee-MRI-protocols with excellent image quality and clinical performance compared to current 2D-protocols.

14:30 ***3258*. 3D-FSE-Cube of the Foot at 3TMRI: Comparison with 2D-FSE Images.**

Mai Hanamiya[1], Takatoshi Aoki[1], Yoshiko Yamashita[1], Yoshiko Hayashida[1], Toru Sato[2], Shigeru Hibino[3], Atsushi Nozaki[3], Yukunori Korogi[1]
[1]Radiology, University of Occupational and Environmental Health School of Medicine, Kitakyushu, Fukuoka, Japan; [2]Clinical Radiology Service, University of Occupational and Environmental Health Hospital; [3]GE Healthcare Japan

Our purpose is to compare 3D-FSE-Cube with 2D-FSE sequence for MR imaging of the ankle at 3.0T MR system. Eight healthy volunteers were examined with 3D-FSE Cube (6 minutes 50 seconds) and 2D-FSE (axial, sagittal and coronal planes, total imaging time; 11minutes 24 seconds), and 3D-FSE-Cube images were reformatted into images of same planes as 2D-FSE. Bone, cartilage, fluid, and tendon SNRs and bone-tendon CNR were significantly higher with the 3D-FSE-Cube. The 3D-FSE-Cube sequence with parallel imaging at 3.0T MR enables to reduce examination time preserving image quality and evaluate complex anatomy of the ankle on multiple arbitrary planes.

15:00 ***3259*. 3D-TSE-Imaging of the Ankle - A New Perspective?**

Mike Notohamiprodjo[1], Annie Horng[2], Bernhard Kuschel[2], Peter Bär[3], Maximilian F. Reiser, Christian Glaser
[1]Institute for Clinical Radiology, University Hospitals Munich, Munich, Bavaria, Germany; [2]University Hospitals Munich, Insitute for Clinical Radiology; [3]Siemens Sector Healthcare

The purpose of this study was to evaluate an optimized 3D-TSE-sequence for ankle-MRI at 3T. Fifteen volunteers and 25 patients were examined at 3T with a dedicated 8-channel-ankle coil and the isotropic PDfs-weigthed 3D-TSE-sequence SPACE featuring optimized variable flip angles, elliptical scanning and radial k-space readout for improved contrast and time efficient acquisition. In comparison to current 2D-TSE-sequences, relevant SNR and CNR were significantly higher. The 3D-reconstruction capabilities provided better visualization of small structures, ligaments and lesions. Diagnostic confidence was not significantly different in the 3D-TSE-sequence. This technique holds high potential for future ankle-MRI protocols.

Hyperpolarized Carbon-13 & Other Nuclei I

Hall B Monday 14:00-16:00 Computer 7

14:00 ***3260*. A DNP Polarizer Designed for Clinical Use**

Andrew M. Leach[1], John Urbahn[1], Denise Anderson[1], Neil Clarke[2], Timothy Skloss[3], Jan Henrik Ardenkjaer-Larsen[2]
[1]GE Global Research, Niskayuna, NY, United States; [2]GE Healthcare, Amersham, United Kingdom; [3]GE Healthcare, Waukesha, WI, United States

Provides a description of a novel hyperpolarizer design that incorporates specific characteristics required for clinical application including: 1) the ability to simultaneously process multiple doses; 2) no cryogen consumption; 3) a sterile product contained within a disposable fluid path; and 4) an integrated quality control system that rapidly measures six product characteristics to ensure agent safety and efficacy. The system has been demonstrated as a robust means to generate high volume doses for imaging studies. Device functionality and process capability will be discussed.

14:30 ***3261*. Potential for Polarization Measurement of Pre-Polarized [1-^{13}C] Pyruvate *in Vivo* Using Jcc Spectral Pattern**

Albert P. Chen[1], Charles H. Cunningham[2], James Tropp[3], Kayvan Keshari[4], Mark VanCriekinge[4], John Kurhanewicz[4], Ralph E. Hurd[5]
[1]GE Healthcare, Toronto, ON, Canada; [2]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [3]GE Healthcare, Fremont, CA, United States; [4]Radiology, UCSF, San Francisco, CA, United States; [5]GE Healthcare, Menlo Park, CA, United States

The ability to accurately measure or predict the polarization of hyperpolarized 13C metabolic imaging substrates at the time of the MR experiment is necessary for quantitative kinetics data or metabolite concentrations. In this study, the feasibility of using asymmetry of the pyruvate C2 resonance (from 1% natural abundance of [1,2-$^{13}C_2$] pyruvate) to estimate the polarization of the [1-^{13}C] pyruvate in vivo is demonstrated.

15:00 ***3262*. Non-Fourier Spatial Encoding for Improved Point-Spread-Functions in Hyperpolarized 13C CSI Acquisitions**

Albert P. Chen[1], Ralph E. Hurd[2], Charles H. Cunningham[3,4]
[1]GE Healthcare, Toronto, ON, Canada; [2]GE Healthcare, Menlo Park, CA, United States; [3]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [4]Medical Biophysics, University of Toronto, Toronto, ON, Canada

Metabolic imaging using pre-polarized substrates labeled with a 13C nucleus has proven to be a promising new tool. Often, chemical-shift imaging (CSI) acquisitions are used to map the 13C resonances over 2D or 3D volumes so that 13C metabolic data from various tissues can be compared. Due to the time constraints imposed by the relatively short lifetime of the hyperpolarized state, the spatial dimensions of these acquisitions are often encoded with small matrix sizes (e.g. 8 x 8 x 16), resulting in a relatively poor point-spread function (PSF). In this abstract, we have explored the use of non-Fourier spatial encoding to improve the PSF in both in-plane

dimensions of hyperpolarized 13C CSI acquisitions. Phantom experiments showed an improved point-spread function and a rat study showed the feasibility of using the method for in vivo data acquisition.

15:30 ***3263*.** **The Effects of Contrast Agents on Hyperpolarised [1-^{13}C]-Pyruvic Acid**

Lanette Friesen Waldner[1,2], Timothy Scholl[3], Albert Chen[4], Brian Rutt, [1,5], Charles McKenzie, [12]

[1]Imaging Research Laboratories, Robarts Research Institute, London, ON, Canada; [2]Medical Biophysics, The University of Western Ontario, London, ON, Canada; [3]Physics and Astronomy, The University of Western Ontario, London, ON, Canada; [4]GE Healthcare, Toronto, ON, Canada; [5]Diagnostic Radiology and Richard M Lucas Center for Imaging, Stanford University, Stanford, CA, United States

The addition of small quantities of gadolinium based contrast agents (GBCA) to ^{13}C-enriched samples containing trityl radical significantly increases the hyperpolarisation that can be obtained via dynamic nuclear polarisation. This study examined the effects of several contrast agents on T_1 in solution and on relative hyperpolarisation in the solid state in [1-^{13}C]-labeled pyruvic acid. T_1 decreased with increasing contrast agent concentration with all contrast agents except Teslascan. Dotarem and ProHance showed a slight decrease in T_1. MultiHance showed the largest increase in hyperpolarisation and the largest decrease in T_1. The choice of contrast agent may depend on the application.

Tuesday 13:30-15:30 Computer 7

13:30 ***3264*.** **Simulation Tool for Modeling of Hyperpolarized ^{13}C Metabolic Imaging: Application to Optimizing ^{13}C-Fructose Acquisitions**

Peter J. Shin[1,2], Simon Hu[2], Peder E. Z. Larson[2], Kayvan R. Keshari[2], John Kurhanewicz[1,2], Daniel B. Vigneron[1,2]

[1]Joint Graduate Group in Bioengineering, University of California at San Francisco & Berkeley, San Francisco, CA, United States; [2]Department of Radiology and Biomedical Imaging, University of California at San Francisco, San Francisco, CA, United States

^{13}C-fructose has been recently proposed as a novel hyperpolarized ^{13}C probe. The short T_1 of ^{13}C-fructose could impose additional challenges in designing data acquisition strategies. Here, we have optimized an acquisition scheme using a specialized simulation tool and showed that a T_1 compensated RF excitation scheme together with compressed sensing can yield minimized spatial blurring with high SNR enough for *in vivo* ^{13}C-fructose metabolic imaging.

14:00 ***3265*.** **Bloch Equation Simulations for BSSFP, Spin Echo, and SPGR Sequences When Using Hyperpolarized Carbon-13**

Eric Peterson[1], Kang Wang[2], Sean Fain[2,3]

[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

Current hyperpolarized carbon protocols call for all of the scans to be performed in series, including the proton localizer and carbon metabolic image. The localizer image is typically acquired at a higher resolution than the carbon image, and eventually serves as an anatomical reference for the later carbon acquisition. By performing a simultaneous proton and carbon acquisition, several potential applications are possible such as continuous localization, motion tracking and compensation, or targeted excitation.

14:30 ***3266*.** **View-Order Consideration for Hyperpolarized C-13 Imaging with Radial Acquisition and Projection Reconstruction**

Kang Wang[1], Eric Peterson[2], Jeremy Gordon[1], Krishna Kurpad[3], Ian Rowland[3], Matthew Erickson[3], Sean Fain[1,3]

[1]Medical Physics, 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

Since hyperpolarized (HP) C-13 compounds exhibit non-equilibrium T1 decay and rapidly evolving spectral dynamics, fast imaging techniques such as radial acquisition have favorable characteristics which allow them to be combined with spectral imaging methods and thus follow the spectral dynamics. Due to the non-equilibrium of the magnetization, the acquired k-space will be modulated and the projection order needs to be designed to minimize spatial artifacts. In this work, we investigated, qualitatively and quantitatively, three different view-order schemes for 2D radial acquisitions. A superior scheme for minimizing artifacts in HP C-13 radial imaging was found.

15:00 **_3267_. Dynamic Hyperpolarized C-13 Spectroscopic Imaging Using Radial Acquisition and HYPR Reconstruction**

Kang Wang[1], Eric Peterson[2], Jeremy Gordon[1], Krishna Kurpad[3], Ian Rowland[3], Matthew Erickson[3], Sean Fain[1]

[1]Medical Physics, 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

Hyperpolarized (HP) C-13 compounds exhibit non-equilibrium T1 decay and rapidly evolving spectral dynamics, and it is highly desirable to develop pulse sequences to image C-13 compounds in the spatial-spectral-time domain with high resolution in all dimensions. Non-Cartesian sampling methods, such as radial acquisition, are very attractive in this application due to their resistance to under-sampling artifacts. In this work, we proposed a radial acquisition method that is designed for HP C-13 time-resolved spectroscopic imaging and combined with HighlY constrained backPRojection reconstruction (HYPR).

Wednesday 13:30-15:30 Computer 7

13:30 **_3268_. Single Shot, Chemical Shift Specific Imaging Methods for Hyperpolarized Carbon-13 Studies at 14T**

Subramaniam Sukumar[1], Peder E.Z. Larson[1], Kayvan R. Keshari[1], John Kurhanewicz[1], Daniel B. Vigneron[1]

[1]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States

Single shot, chemical shift specific, images are demonstrated using EPI and spiral acquisition techniques at 14T. These methods address some of the problems encountered with hyperpolarized 13C MRSI at high fields related to wide spectral dispersion. Spectral-spatial pulses are designed to selectively excite only the resonances of interest. The fast, single shot acquisition methods provide high temporal resolution on the order of 50-200msec and will be applicable to time course studies involving hyperpolarized 13C.

14:00 **_3269_. Influence of Injected Pyruvate Concentration on Metabolism Using Hyperpolarized ^{13}C**

Martin Janich[1,2], Eliane Weidl[3], Florian Wiesinger[4], Marion I. Menzel[4], Jan Henrik Ardenkjaer-Larsen[5], Steffen J. Glaser[1], Rolf F. Schulte[4], Markus Schwaiger[3]

[1]Department of Chemistry, Technische Universität München, Munich, Germany; [2]Imaging Technologies, GE Global Research , Munich, Germany; [3]Institute for Nuclear Medicine, Technische Universität München, Munich, Germany; [4]Imaging Technologies, GE Global Research, Munich, Germany; [5]MST-ASL MR, GE Healthcare, Copenhagen,, Denmark

The aim of this study is to investigate the influence of injected hyperpolarized ^{13}C pyruvate concentration on its cellular uptake and enzymatic conversion in rats. A 5 mL/kg rat mass solution was injected at concentration levels of 40 mM and 80 mM hyperpolarized ^{13}C pyruvate. Concentration time curves of the metabolites pyruvate, lactate, alanine, and bicarbonate were measured with FID signals in slices through the heart, liver, and kidneys. A significant dependency of observed metabolite concentrations on injected pyruvate concentration was recognized in all slices.

14:30 **_3270_. Visualizing Regional Changes in Metabolism in a Rat Model of Acute Myocardial Infarction Using Hyperpolarized 13C MR**

Mette Hauge Lauritzen[1], Peter Magnusson[1], Sadia Asghar Butt[1], Jan Henrik Ardenkjær-Larsen[2], Lise Vejby Søgaard[1], Per Åkeson[1]

[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital, Hvidovre, Denmark; [2]GE Health Care, Hillerød, Denmark

Magnetic resonance spectroscopy (MRS) using hyperpolarized 13C[pyruvate] was tested in a experimental rat model of acute myocardial infarction. MRS-images and dynamic time series was acquired before and after infarction to evaluate metabolic changes in the myocardium. After infarction the signal from lactate, alanine, and bicarbonate were absent in the infarcted region, whereas, in the region not affected by infarction, the signal levels were comparable to the levels in the MRS-images acquired before infarction. This study demonstrates that hyperpolarized 13C MRS can be used to visualize regional changes in cardiac metabolism in rats after myocardial infarction.

15:00 **_3271_. Monitoring Response of Tumors to Anti-Glycolytic Therapies Using Hyperpolarized Pyruvate**

Aaron Keith Grant[1], Pankaj K. Seth[1], Elena Vinogradov[1], Xiaoen Wang[1], Robert E. Lenkinski[1], Vikas P. Sukhatme[1]

[1]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States

Many cancers preferentially metabolize glucose via fermentative glycolysis (conversion of pyruvate into lactate) rather than oxidative metabolism, even when sufficient oxygen is available to support the TCA cycle. This phenomenon, known as the Warburg effect, may confer a survival advantage on tumor cells. It may be possible to selectively harm cancer cells using metabolic therapies that reverse this effect. Dichloroacetate (DCA) is a drug that up-regulates the activity of pyruvate dehydrogenase and hence may reduce the rate of fermentative glycolysis in cancer. Here we report on the use of hyperpolarized pyruvate to assess the response of tumors to DCA administration.

Thursday 13:30-15:30 Computer 7

13:30 *3272*. **Detection of Early Response to Temozolomide Treatment in Brain Tumors Using Hyperpolarized ^{13}C MR Metabolic Imaging**

Ilwoo Park[1,2], Myriam Chaumeil[2], Tomoko Ozawa[3], Sabrina M. Ronen[1,2], Daniel B. Vigneron[1,2], C. David James[3], Sarah J. Nelson[1,2]
[1]Joint Graduate group in Bioengineering, University of California San Francisco/Berkeley, 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]Brain Tumor Research Center, Department of Neurological Surgery, University of California San Francisco, San Francisco, CA, United States

We have demonstrated the feasibility of using DNP hyperpolarized $^{13}C_1$-pyruvate to detect early response to Temozolomide treatment in an orthotopic human glioblastoma xenograft model in rat brain. The ^{13}C data from the treated rats showed the ability to detect altered tumor metabolism as early as one day after TMZ treatment initiation, while the tumor volume from T1 post-Gd imaging showed the first sign of reduction at the 8th day after the initiation of treatment.

14:00 *3273*. **MR Technical Developments for Clinical Hyperpolarized ^{13}C-Pyruvate Studies in Prostate Cancer Patients**

Peder E. Z. Larson[1], James Tropp[2], Albert P. Chen[3], Paul Calderon[2], Simon Hu[1], Galen Reed[1], Sarah J. Nelson[1], John Kurhanewicz[1], Ralph Hurd[2], Daniel B. Vigneron[1]
[1]Radiology and Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States; [2]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Applied Science Laboratory, GE Healthcare, Toronto, Ontario, Canada

We have developed and tested custom hardware and methods for future prostate cancer patient studies with hyperpolarized ^{13}C-pyruvate, including ^{13}C coils for prostate imaging, clean room dissolution DNP system, and hyperpolarized ^{13}C pulse sequences.

14:30 *3274*. **Detection of Pentose Phosphate Pathway Flux Using Hyperpolarized [1-^{13}C]Gluconolactone in Mouse Livers**

Karlos X. Moreno[1], Crystal E. Harrison[1], Matthew E. Merritt[1], Zoltan Kovacs[1], Zengdun Shi[2], Don C. Rockey[2], A Dean Sherry[1], Craig R. Malloy[1,2]
[1]Advanced Imaging Research Center, Univ of TX Southwestern Med Ctr, Dallas, TX, United States; [2]Internal Medicine, Univ of TX Southwestern Med Ctr, Dallas, TX, United States

Pentose phosphate pathway flux was studied using hyperpolarized δ-[1-^{13}C]gluconolactone injected into an isolated perfused mouse liver. Control livers produced a significant amount of $H^{13}CO_3^-$, a product indicative of pentose phosphate pathway flux and [1-^{13}C]gluconate. Hydrogen peroxide damaged livers also produced $H^{13}CO_3^-$ and [1-^{13}C]gluconate, though the bicarbonate was at lower amounts than the control. CCl_4 treated livers did not produce any observable $H^{13}CO_3^-$, but [1-^{13}C]gluconate was produced. These studies show that the lactone is incorporated within the hepatocyte, phosphorylated and metabolized through the pentose phosphate pathway.

15:00 *3275*. **Effect of the Monocarboxylate Transporter Inhibitor α-Cyano-4-Hydroxy-Cinnamate on *In Vivo* Hyperpolarized MR Spectroscopic Imaging with [1-^{13}C]Pyruvate**

Simon Hu[1], Robert Bok[1], Asha Balakrishnan[2], Andrei Goga[2], John Kurhanewicz[1], Daniel B. Vigneron[1]
[1]Dept. of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]Dept. of Medicine, Division of Hematology/Oncology, University of California, San Francisco, San Francisco, CA, United States

Development of hyperpolarized technology utilizing dynamic nuclear polarization has enabled the measurement of ^{13}C metabolism *in vivo* at very high SNR. The most researched agent for in vivo applications has been [1-^{13}C]pyruvate. In this project, the role of cell membrane transport on the conversion of [1-^{13}C]pyruvate to [1-^{13}C]lactate and [1-^{13}C]alanine *in vivo* was investigated by using the monocarboxylate transporter inhibitor α-cyano-4-hydroxy-cinnamate. Reduced hyperpolarized alanine and lactate were detected after α-cyano-4-hydroxy-cinnamate administration, indicating that this inhibitor approach can be used *in vivo* to investigate the transport and intracellular conversion of [1-^{13}C]pyruvate.

Hyperpolarized Carbon-13 & Other Nuclei II

Hall B Monday 14:00-16:00 Computer 8

14:00 ***3276***. **Improved Temporal Resolution for Hyperpolarized ^{13}C 3D Dynamic MRSI with Compressed Sensing**

Peder E. Z. Larson[1], Simon Hu[1], Michael Lustig[2], Adam B. Kerr[2], Sarah J. Nelson[1], John Kurhanewicz[1], John M. Pauly[2], Daniel B. Vigneron[1]
[1]Radiology and Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States

In this project, we developed improved sampling and reconstruction strategies to provide finer temporal resolution for hyperpolarized carbon-13 3D time-resolved MRSI with compressed sensing and multiband excitation pulses. These improved compressed sensing strategies better exploit the temporal redundancy. Results are shown with a 32-fold acceleration for a 2 sec temporal resolution, 3D dynamic MRSI acquisition.

14:30 ***3277***. **Time Resolved Metabolic 13C MRS Using Hyperpolarised [1-13C]pyruvate in a Transgenic Mammary Cancer Model**

Sadia Asghar Butt[1], Lise Vejby Søgaard[1], Mette Hauge Lauritzen[1], Jan Henrik Ardenkjær-Larsen[2], Lars H. Engelholm[3], Susanne Holck[4], Peter Magnusson[1], Per Åkeson[1]
[1]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital, Hvidovre, Denmark; [2]GE Healthcare, Hillerød, Denmark; [3]Bartholin Institute, Copenhagen Biocenter; [4]Department of pathology, Copenhagen University Hospital Hvidovre

There is a need for monitoring of disease progression and treatment response in breast cancer using metabolic biomarkers. We have applied the technique of time resolved hyperpolarised 13C metabolic MRS to the transgenic mammary cancer mouse model, MMTV-PymT. We use measurements of the lactate dehydrogenase (LDH) rate constant reflecting the conversion of hyperpolarized [1-13C]pyruvate to [1-13C]lactate in vivo to extract information about the metabolic the status of the tissue Our initial results show that we are able to monitor the changes in LDH kinetics during tumour development and indicate that the enzyme activity correlate to disease progression.

15:00 ***3278***. **In Vivo Detection of Rat Brain Metabolism Using Hyperpolarized Acetate**

Mor Mishkovsky[1,2], Arnaud Comment[1,2], Rolf Gruetter[1,3]
[1]Laboratory for Functional and Metabolic Imaging , Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Department of Radiology, Université de Lausanne, Lausanne, Switzerland; [3]Departments of Radiology, Universités de Lausanne et Genève, Lausanne and Genève, Switzerland

In vivo localized ^{13}C MRS of a rat brain was performed in a 9.4T animal scanner after infusion of a hyperpolarized 1-^{13}C and $^{13}C_2$ sodium acetate solution. It is demonstrated that hyperpolarized ^{13}C-labeled acetate rapidly enters the brain and its metabolism can be detected within the time window defined by the lifetime of the carboxyl carbon hyperpolarized spin state. We present a new sequence designed to transfer the carboxyl nuclear polarization onto the methyl carbon spin of $^{13}C_2$ acetate in order to assign the metabolic peaks observed *in vivo*.

15:30 ***3279***. **Toward Microtesla MRI of Hyperpolarized Carbon-13 for Real-Time Metabolic Imaging**

Vadim S. Zotev[1], Tuba Owens[1], Igor M. Savukov[1], Andrei N. Matlashov[1], John J. Gomez[1], Michelle A. Espy[1]
[1]Applied Modern Physics Group, Los Alamos National Laboratory, Los Alamos, NM, United States

Hyperpolarization of C-13 has enabled real-time metabolic imaging of C-13 labeled substances with unprecedented signal-to-noise levels. Because hyperpolarization is performed outside an MRI scanner, high magnetic fields of conventional MRI offer little advantage in terms of C-13 polarization. We propose an ultimate low-field MRI scanner for imaging hyperpolarized C-13. It uses only microtesla-range magnetic fields and employs SQUID sensors to measure MRI signals. We present the first images acquired by SQUID-based microtesla MRI with dynamic nuclear polarization. We also report the first NMR spectra of C-13 at microtesla fields. Our results demonstrate feasibility and potential of the proposed imaging approach.

Tuesday 13:30-15:30 Computer 8

13:30 ***3280***. **A Bayesian Approach to Modeling the Delivery of a Hyperpolarized Substrate**

Matthew E. Merritt[1,2], Crystal Harrison[3], A Dean Sherry[4,5], Craig R. Malloy[4,6], G Larry Bretthorst[7]
[1]Advance Imaging Research Center, UT Southwestern Med. Center, Dallas, TX, United States; [2]Radiology, UTSW Medical Center, Dallas, TX, United States; [3]Physics, University of Texas at Dallas, Richardson, TX, United States; [4]AIRC, UTSW Medical Center, Dallas, TX, United States; [5]Chemistry, University of Texas at Dallas, Richardson, TX, United States; [6]Cardiology, North Texas VA Hospital, Dallas, TX, United States; [7]Radiology, Washington University in St. Louis, St. Louis, MO, United Kingdom

A primary challenge to extracting quantitative metabolic fluxes from metabolism of a hyperpolarized substrate is modeling the delivery of the molecular imaging agent itself. Here, a tracer is co-infused with [1-^{13}C] pyruvate. A model of the delivery and decay of the magnetization is analyzed with a Bayesian approach, yielding a delivery rate with the standard deviation. Such models are a necessary precursor to correct modeling of fluxes *in vivo*.

14:00 **3281. Cerebral Dynamics and Metabolism of Hyperpolarized [1-13C] Pyruvate Using Time Resolved Spiral-Spectroscopic Imaging**

Ralph E. Hurd[1], Dirk Mayer[2,3], Yi-Fen Yen[1], James Tropp[1], Adolf Pfefferbaum[2,4], Daniel Spielman[3]

[1]Applied Sciences Laboratory, GE Healthcare, Menlo Park, CA, United States; [2]SRI International; [3]Radiology, Stanford; [4]Psychiatry and Behavioral Sciences, Stanford

Dynamic hyperpolarized [1-13C]- pyruvate metabolic imaging in normal anesthetized rat brain is demonstrated on a clinical 3T MRI scanner. A 12 s bolus injection of hyperpolarized [1-13C]-pyruvate is imaged at a 3 s temporal resolution using 125 msec spiral spectroscopic images. The observed dynamics are evaluated with respect to cerebral blood volume, flow, transport, and metabolic exchange with the cerebral lactate pool.

14:30 **3282. Metabolic Rate Constant Mapping of Hyperpolarized 13C Pyruvate**

Florian Wiesinger[1], Isabelle Miederer[2], Marion I. Menzel[1], Eliane Weidl[2], Martin Janich[1,3], Jan-Henrik Ardenkjaer-Larsen[4], Markus Schwaiger[2], Rolf F. Schulte[1]

[1]Imaging Technologies, GE Global Research, Munich, Germany; [2]Institute for Nuclear Medicine, Technical University Munich, Munich, Germany; [3]Department of Chemistry, Technical University Munich, Munich, Germany; [4]MST-ASL MR, GE Healthcare, Copenhagen, Denmark

In this work, the two-side, kinetic exchange model is applied for hyperpolarized 13C pyruvate in a way such that it does not involve the pyruvate input function. In combination with time-resolved IDEAL spiral CSI, the method is demonstrated to generate spatially-resolved rate constant maps. Ultimately, the method might be particularly useful for the non-invasive localization and characterization of tumors and their response to therapy.

15:00 **3283. *In Vivo* Dynamic Cardiac Magnetic Resonance Spectroscopy with Hyperpolarized [2-^{13}C] Pyruvate in Pigs**

Albert P. Chen[1], Angus Z. Lau[2], Wilfred L. Lam[2], Nilesh R. Ghugre[2], Graham A. Wright[2], Charles H. Cunningham[2]

[1]GE Healthcare, Toronto, ON, Canada; [2]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, ON, Canada

It has recently been shown that pre-polarized [2-^{13}C] pyruvate can be used to monitor TCA cycle metabolism in vitro and *in vivo* in rat hearts. In this study, the feasibility of obtaining dynamic cardiac MR spectroscopic data *in vivo* using hyperpolarized [2-^{13}C] pyruvate in pigs on a clinical 3T MR system is demonstrated.

Wednesday 13:30-15:30 Computer 8

13:30 **3284. Quantitation of In-Vivo Metabolic Kinetics of Pyruvate Using Hyperpolarized 13C MRSI**

Tao Xu[1], Dirk Mayer[2,3], Meng Gu[2], Yi-Fen Yen[4], Sonal Josan[2,3], Edvin Johansson[5], Jim Tropp[6], Ralph Hurd[4], Daniel Spielman, [12]

[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Department of Radiology, Stanford University, Stanford, CA, United States; [3]Neuroscience Program, SRI International, Menlo Park, CA, United States; [4]Global Applied Sciences Laboratory, GE Healthcare, Menlo Park, CA, United States; [5]Medical Diagnostics R&D, GE Healthcare, Oslo, Norway; [6]Global Applied Sciences Laboratory, GE Healthcare, Fremont, CA, United States

Hyperpolarized MRSI of metabolically active substrates allows the study of both the injected substrate and downstream metabolic products in vivo. Although hyperpolarized 13C-pyruvate has been used to demonstrate metabolic activity, robust quantitation remains an important area of investigation. Most metrics proposed to date fail to capture enzyme saturation effects. In addition, the widely used small flip-angle excitation approach doesn't model the inflow of fresh spins correctly. We developed a quantitative 90-excitation dynamic spectroscopic imaging approach, and demonstrated that the in-vivo conversion of pyruvate is well approximated by Michaelis-Menten kinetics with resulting estimated parameters being unbiased with respect to experimental conditions.

14:00 **3285. Hyperpolarized [2-^{13}C] Fructose: A Hemiketal Substrate for in Vivo Metabolic Imaging**

Kayvan R. Keshari[1], David M. Wilson, Albert P. Chen[2], Robert Bok, Peder E.Z. Larson, Simon Hu, Mark Van Criekinge, Jeffrey M. Macdonald[3], Daniel B. Vigneron, John Kurhanewicz

[1]University of California, San Francisco, San Francisco, Ca, United States; [2]GE Healthcare; [3]University of North Carolina, Chapel Hill

In this study, [2-^{13}C]-fructose was hyperpolarized using the DNP method and shown to have sufficiently long T1's (≈ 14 sec) and polarizations (≈ 12%) for in vivo hyperpolarized ^{13}C MRSI studies. After injection of [2-^{13}C]-fructose in the TRAMP prostate cancer model, the resonance corresponding to the composite β-fructofuranose and β-fructofuranose-6-phosphate was higher in the regions of tumor as compared to the contralateral benign prostate. The hemiketal C2 of fructose demonstrates the first non-carbonyl to be

hyperpolarized for use as a metabolic probe, providing the potential to measure changes in carbohydrate metabolism that occur with human disease.

14:30 *3286*. **^{19}F-MRI Using Hyperpolarized Substrates and Field Cycling**

Thomas Trantzschel[1], Ute Bommerich[2], Joachim Bargon[3], Johannes Bernarding[1]
[1]Dept. of Biometrics and Medical Informatics, Otto-von-Guericke-University, Magdeburg, Germany; [2]Leibniz Institute for Neurobiology, Magdeburg, Germany; [3]Institute of Physical and Theoretical Chemistry, University of Bonn, Bonn, Germany

The lack of natural background signal in body tissues qualifies fluorinated substrates as excellent reporter molecules for MRI and MRS investigations. As a further advantage many pharmaceuticals contain ^{19}F allowing for detection of pharmacokinetics and metabolism as well as to investigate anatomical and physiological features, e.g. lung volume. However, due to the restricted in vivo substrate concentration the ^{19}F-signals often remain weak. To overcome these restrictions we enhanced the ^{19}F signal via ParaHydrogen Induced Polarization. Additionally, we increased the efficiency of the spin polarization transfer to this nucleus by applying a field cycling procedure which improves the SNR in ^{19}F-MRI.

15:00 *3287*. **Parallel MRI Acceleration of Dynamic and High Resolution Hyperpolarized ^{13}C MRI**

Lanette Friesen Waldner[1,2], Jian X. Wang[3], Albert Chen[4], Alexei Oriadov[1], Matthew Fox[1,5], Brian Rutt, [1,6], Timothy Scholl[5], Giles Santyr[1,7], Charles McKenzie, [12]
[1]Imaging Research Laboratories, Robarts Research Institute, London, ON, Canada; [2]Medical Biophysics, The University of Western Ontario, London, ON, Canada; [3]Global Applied Science Laboratory, GE Healthcare, London, ON, Canada; [4]GE Healthcare, Toronto, ON, Canada; [5]Physics and Astronomy, The University of Western Ontario, London, ON, Canada; [6]Diagnostic Radiology and Richard M Lucas Center for Imaging, Stanford University, Stanford, CA, United States; [7]Medical Imaging, The University of Western Ontario, London, ON, Canada

Imaging with hyperpolarized agents requires extremely fast imaging techniques as the hyperpolarized state only lasts for tens of seconds. Parallel MRI reduces image encoding time, allowing hyperpolarized images to be acquired faster, or at higher spatial resolution than would otherwise be possible. Using a custom eight-element ^{13}C array to acquire images of a rat following injection of hyperpolarized ^{13}C enriched pyruvic acid, we demonstrate accelerated imaging, using self calibrated PMRI to achieve high spatial and temporal resolutions. These results represent the first hyperpolarized ^{13}C PMRI experiments conducted with a receive array with more than 4 elements.

Thursday 13:30-15:30 Computer 8

13:30 *3288*. **The Metabolic Effects of Pyruvate Infusion During Hyperpolarized Magnetic Resonance Experiments**

Helen Jennifer Atherton[1], Michael S. Dodd[1], Emma E. Carter[1], Marie A. Schroeder[1], Simon Nagel[2], Nicola R. Sibson[3], Kieran Clarke[1], George K. Radda[1], Damian J. Tyler[1]
[1]Physiology, Anatomy and Genetics, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]Nuffield Department of Clinical Medicine, University of Oxford, Oxford, Oxfordshire, United Kingdom; [3]CRUK-MRC Gray Institute for Radiation Oncology and Biology, University of Oxford, Oxford, Oxfordshire, United Kingdom

Hyperpolarized 13C-magnetic resonance spectroscopy (MRS) represents a powerful technique for studying metabolism in vivo. To assess pyruvate metabolism in rats, 1ml 80mM [1-13C]pyruvate is injected. This study investigated the metabolic effects of injecting supraphysiological pyruvate concentrations and found that circulating pyruvate concentration peaked 1min post infusion at ~250μM, equivalent to levels reached naturally within the body e.g. during exercise. The plasma concentration of glucose, insulin, triacylglycerides and NEFAs did not alter significantly up to 30min post infusion, however lactate and beta-hydroxybutyrate levels increased significantly 30min post infusion ($p<0.01$) and may be formed from excess circulating pyruvate and acetyl CoA respectively.

14:00 *3289*. **Cerebral Perfusion Imaging with a Hyperpolarized Freely Diffusible Contrast Agent**

Aaron Keith Grant[1], Elena Vinogradov[1], Xiaoen Wang[1], David C. Alsop[1]
[1]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States

Hyperpolarized contrast agents have a number of attractive features for application to perfusion imaging. Indeed, these agents provide high signal strength with virtually no endogenous background signal and therefore make excellent tracers for monitoring blood flow. Moreover, agents that can freely penetrate the blood-brain barrier are expected to have long tissue residence times and hence enable robust quantification of perfusion. Here we show that carbon-13 labeled tertiary butanol can be hyperpolarized using dynamic nuclear polarization and present in vivo images acquired in rat brain.

14:30 **3290. Minimum-Norm IDEAL Spiral CSI for Efficient Hyperpolarized 13C Metabolic Imaging**

Florian Wiesinger[1], Marion I. Menzel[1], Eliane Weidl[2], Martin Janich[1,3], Markus Schwaiger[2], Rolf F. Schulte[1]
[1]Imaging Technologies, GE Global Research, Munich, Germany; [2]Institute for Nuclear Medicine, Technical University Munich, Munich, Germany; [3]Department of Chemistry, Technical University Munich, Munich, Germany

Hyperpolarized [1-13C]pyruvate has demonstrated significant potential for metabolic MR imaging. In-vivo metabolism converts pyruvate into a limited number of 13C detectable downstream metabolites (including lactate, alanine, bicarbonate) with singlet resonant peaks of known chemical shifts. With an in-vivo T1 of ~30s, it provides MR detectable signal only for a very limited time span. The relevant information is spread over five dimensions including chemical-shift (CS), three spatial dimensions and time.
In this work, echo time shifted, single-shot spiral encoding is combined with spectrally-preconditioned, minimum-norm CS inversion (minimum-norm IDEAL spiral CSI) to efficiently master this encoding challenge.

15:00 **3291. Saturation-Recovery Metabolic Imaging of Hyperpolarised 13C Pyruvate**

Rolf F. Schulte[1], Marion I. Menzel[1], Eliane Weidl[2], Martin Janich[1,3], Markus Schwaiger[2], Florian Wiesinger[1]
[1]GE Global Research, Munich, Germany; [2]Nuclear Medicine, Technische Universität München, Munich, Germany; [3]Chemistry, Technische Universität München, Munich, Germany

Mapping metabolic rate constants is of high physiological relevance, as for instance the metabolic activity is increased in tumours. In this work, spectral-spatial excitation is used to selectively excite, image and crush the downstream metabolites lactate and alanine. A small tip angle selective imaging of the injected [1-13C]pyruvate then gives the necessary reference for turnover images.

Spectroscopy Methodology I

Hall B Monday 14:00-16:00 Computer 9

14:00 **3292. A New Volume Selective Sequence for Single-Shot Diffusion-Weighting by the Trace of the Diffusion Tensor**

Julien Valette[1,2], Mohamed Ahmed Ghaly[2], Denis Le Bihan[2], Franck Lethimonnier[2]
[1]CEA-MIRCen, Fontenay-aux-Roses, France; [2]CEA-NeuroSpin, Gif-sur-Yvette, France

Diffusion-weighted (DW) spectroscopy is a unique tool for exploring the intracellular micro-environment in vivo. In living systems, diffusion is generally anisotropic, since biological membranes may exhibit anisotropic orientation. In this work, a volume selective DW-sequence is proposed, allowing single-shot measurement of the trace of the diffusion tensor (which does not depend on the gradient orientation relative to the cells). Cross-terms between diffusion gradients and other gradients are cancelled out. In addition, an adiabatic version (similar to the LASER sequence, with diffusion gradients) is derived. Proof of concept is performed on anisotropic tissues by varying tissue orientation and intra-voxel shim.

14:30 **3293. Muscle Group Specific Quantification of Unsaturated Fatty Acids by Localized DEPT-Enhanced 13C MRS and ERETIC**

Xing Chen[1], Anke Henning[1], Susanne Heinzer-Schweizer[1], Matteo Pavan[1], Peter Bösiger[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

The quantification of metabolite concentrations of spatially specific 13C NMR spectra is questionable due to the low sensitivity. We propose a combined SNR enhancement by proton decoupling and ISIS-localized DEPT, aiming at muscle-group specific detection of unsaturated fatty acid in the calf muscle. Comparative measurements of four localized SNR enhancement sequences were performed with a 13C/1H dual-tune volume calf coil equipped with ERETIC. ERETIC signal intensity with and without proton decoupling as determined with TDFDfit was identical. This ISIS-localized DEPT combined with proton decoupling and the ERETIC reference standard technique can be easily extended to other muscle metabolites of interest.

15:00 **3294. Enhancing Spectral Resolution in Proton MRSI of Human Calf Muscles Using SPREAD**

Zhengchao Dong[1,2], Feng Liu[1,2], Yunsuo Duan[1,2], Alayar Kangarlu[1,2], Bradley Peterson[1,2]
[1]Columbia University, New York, NY, United States; [2]New York State Psychiatric Institute, New York, NY, United States

In vivo proton magnetic resonance spectroscopy and spectroscopic imaging have been employed to assess extramyocellular lipid (EMCL) and intramyocellular lipid (IMCL) stores in human and animals, based on the effect of “bulk magnetic susceptibility” of EMCL. However, the inhomogeneities of the magnetic fields caused by the spatial variations of B0 lead to spectral line broadening and lineshape distortion that will decrease spectral resolution and hamper the separation of IMCL and EMCL. In this study, we applied the SPREAD method (Spectral Resolution Amelioration by Deconvolution) to improve the spectral resolution of proton MRSI data measured on human calf muscle at 3T.

15:30 *3295*. **[1]H Decoupled [13]C MRS in Human Muscle at 7T**

Douglas E. Befroy[1], Peter B. Brown[1], Kitt F. Petersen[1], Gerald I. Shulman[1], Douglas L. Rothman[1]
[1]Yale University, New Haven, CT, United States

MRS at increasing B_0 field strengths is accompanied by an enhancement in signal/noise and spectral resolution. However, the concomitant increase in RF power mitigates these effects for J-coupled metabolites in-vivo since decoupling schemes tend to be prohibited by SAR restrictions. By taking advantage of the higher SAR limits for peripheral tissues and by using relatively small coil geometries to maximize the efficiency of RF transmission, we demonstrate that ^{1}H decoupled ^{13}C-MRS is feasible in superficial human skeletal muscles at 7T.

Tuesday 13:30-15:30 Computer 9

13:30 *3296*. **Improving the Imaging Quality in Magnetic Particle Imaging by a Traveling Phase Trajectory**

Sven Biederer[1], Timo Frederik Sattel[1], Tobias Knopp[1], Marlitt Erbe[1], Thorsten M. Buzug[1]
[1]Institute of Medical Engineering, University of Luebeck, Luebeck, Germany

Magnetic Particle Imaging is a new tomographic imaging technique. For spatial encoding a field free point is moved along a trajectory, as for instance a Lissajous curve. Due to tuning of the transmit coils the density and repetition time are currently fixed. In this contribution a method is presented, which allows for changing the density or the repetition time, respectively. This is realized by using shorter trajectories with different relative phases. By combining multiple shorter trajectories various densities can be achieved. Thus, less dense trajectories or high dense trajectories can be used without retuning the system coils.

14:00 *3297*. **Magnetic Field Generation for Multi-Dimensional Single-Sided Magnetic Particle Imaging**

Timo Frederik Sattel[1], Sven Biederer[1], Tobias Knopp[1], Thorsten M. Buzug[1]
[1]Institute of Medical Engineering, University, Luebeck, Germany

Magnetic particle imaging is a method capable of determining the spatial distribution of super-paramagnetic iron oxide particles. For field generation and particle signal reception, a single-sided coil arrangement exists where the object of interest is positioned in front of a scanner head and not inside a scanning chamber. So far, a 1D-imaging device has been implemented which allows only for scanning a single line in space. In this contribution, different coil arrangements are shown, which extend the existing setup for 2D-imaging. Multi-dimensional single-sided MPI is the next step in development for small, hand-held or larger in-table MPI devices offering a broad field of applications.

14:30 *3298*. **An MR Compatible Fluorescence Tomography System**

Yuting Lin[1], Orhan Nalcioglu[1], Gultekin Gulsen[1]
[1]Center for Functional Onco-Imaging, University of California, Irvine, CA, United States

Multi-modality imaging is becoming a trend in developing new generation in vivo imaging techniques. Fluorescence tomography (FT) is becoming an important molecular imaging tool in recent years. It has been shown that the anatomical information provided by MRI can be used to improve the quantitative accuracy of FT. However, most of the current FT system design utilizes CCD as the detector, which is incompatible with MRI. To be able to build a hybrid MRI-FDOT system, it requires new hardware compatible with each other. In this work, a development toward an MR compatible fluorescence tomography system is presented.

15:00 *3299*. **Development of Dual Modality MRI and SPECT for Pre-Clinical Molecular Imaging**

Dirk Meier[1], Douglas J. Wagenaar[2], Gunnar Maehlum[1], Bjoern Sundal[1], Bradley E. Patt[2], Si Chen[3], Jingyan Xu[3], Jianhua Yu[3], Benjamin M.W. Tsui[3], Mark J. Hamamura[4], Seunghoon Ha[4], W. W. Roeck[4], Orhan Nalcioglu[4]
[1]Gamma Medica - Ideas, Fornebu, Norway; [2]Gamma Medica - Ideas, Northridge, CA, United States; [3]Johns Hopkins University, MD, United States; [4]University of California at Irvine, CA, United States

We experimentally demonstrate the feasibility of operating a small animal SPECT system outside and inside a 3 Tesla MRI system with simultaneous data acquisition of both modalities. Unlike traditional SPECT systems, which are based on photomultiplier tubes, our SPECT system is based on MR-compatible semiconductor radiation detectors. The detectors surround the field-of-view and do not rotate. In the present study we acquired images from mice using the SPECT and the MRI. We investigate the performance of the SPECT system with and without the MRI. We believe that the combined SPECT/MRI system will open new opportunities in molecular imaging.

Wednesday 13:30-15:30 Computer 9

13:30 ***3300*****. Grid-Free Interactive and Automated Data Processing for MR Chemical Shift Imaging Data**

Yann Le Fur[1], Maxime Guye[1], Sylviane Confort-Gouny[1], Patrick J. Cozzone[1], Frank Kober[1]
[1]Centre de Résonance Magnétique Biologique et Médicale (CRMBM) UMR CNRS 6612, Université de la Méditérranée, Marseille, France

We propose real-time voxel shift for grid-free computer resource-efficient analysis of CSI data as an alternative to spatial Fourier-interpolation prior to analysis. Spectral information is extracted from CSI data at every mouse click at any location of the object to study with accurate display of the voxel shape and size. Voxel-shift applied sequentially has also permitted extraction of spectra from arbitrarily shaped compartments as well as calculation of B0-corrected metabolite maps using AMARES time-domain fitting.

14:00 ***3301*****. Investigation of Metabolic Changes in Human Visual Cortex During Neuronal Activity Using Functional Proton Magnetic Resonance Spectroscopy at 7T**

Yan Lin[1], Mary Charlotte Stephenson[1], Samuel James Wharton[1], Olivier Mougin[1], Antonio Napolitano[2], Peter G. Morris[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Academic Radiology, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

The purpose of the present study was to use the improved SNR and spectral resolution available at 7T to study changes in ^{1}H metabolite levels in the visual cortex on visual stimulation. Specifically, the aim was to confirm and quantify the increase in glutamate/glutamine levels suggested by others, and to investigate further any lactate response to visual stimulation. We found a significant increase in glutamate of 6.13%¡À4.6% on visual stimulation, similar to that reported by Mangia et al (2007). However, we do not find evidence for the increase in glutamine and lactate, or a decrease in aspartate, as previously reported.

14:30 ***3302*****. PRESS Difference Spectroscopy Optimization Applied to GABA and Tau at 3 T**

Jeff Snyder[1], Thomas Lange[1], Jürgen Hennig[1], Maxim Zaitsev[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

A method to detect coupled spins is presented based on PRESS difference spectroscopy with variable refocusing flip angles at 3 T. The technique is optimized by numerical simulations of sixteen metabolite signals at multiple echo times and flip angles, with the end result of reduction of overlap with adjacent signals for the target metabolite while maintaining adequate yield. The procedure is demonstrated for gamma-aminobutyric acid and taurine.

15:00 ***3303*****. GABA and Gamma: GABA MRS Correlates with Gamma Oscillations Recorded with MEG in Visual and Motor Cortex**

Timothy P.L. Roberts[1], William Gaetz[1], D J. Wang[1], Nouha Salibi[2], James Christopher Edgar[1]
[1]Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States; [2]Siemens Medical Solutions

GABA (gamma-aminobutyric acid) is a significant inhibitory neurotransmitter in the human brain. Its presence can be revealed using a spectral editing MR spectroscopy technique (MEGAPRESS), allowing it to be resolved from the overlapping Cr resonance. In this study GABA signal from visual and motor cortex was shown to correlate with gamma oscillation frequency determined by MEG and originating from the corresponding region. Further, both GABA magnitude and gamma frequency were shown to correlate negatively with subject age. This multimodal approach accesses the neurobiology underlying brain function.

Thursday 13:30-15:30 Computer 9

13:30 ***3304*****. Full 1H to 31P Polarization Transfer on 7 Tesla.**

Wybe van der Kemp[1], Vincent Boer[1], Peter Luijten[1], Dennis Klomp[1]
[1]Department of Radiology, University Medical Center, Utrecht, Netherlands

Full 1H to 31P polarization transfer was shown for phosphocholine and phosphoethanolamine, using the sRINEPT sequence. The sRINEPT sequence is a RINEPT in which the first inversion pulse on the proton channel is a selective inversion pulse, thus preventing polarization transfer losses caused by inter-proton coupling. Quantum chemical simulations on these compounds and their glycerol-derivatives shows that polarization transfer is at a maximum within an offset frequency range of 0.2 ppm for the selective pulse. Measurements on a phosphocholine phantom agree well with the simulations. Implementation of (segmented) BIR4 pulses on the 31P channel enhances the signal further.

14:00 ***3305*****. High B1-Field, High Bandwidth and Short TE 31P and 1H MR Spectroscopy at 7T Using a Dedicated Surface Coil Setup**

Bart Lowie van de Bank[1], Vincent Oltman Boer[1], Peter R. Luijten[1], Dennis W.J. Klomp[1]
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands

A dedicated double-tuned double-channel transmit receive surface coil setup is developed that enables the use of high B1+-fields in multi nuclei MRS of the human brain at 7T. The available B1+ field of up to 40 ìT and 100 ìT for respectively 1H and 31P allowed the

use of short and high bandwidth adiabatic RF pulses, which are insensitive to the inhomogeneous nature of the B1+-field. Therefore accurately localized 1H and 31P MR spectra with high sensitivity could be obtained at 7T.

14:30 ***3306*****.** **A New Paradigm for High Sensitivity ^{19}F MRI of Perfluorooctylbromide**

Céline Giraudeau[1], Julien Flament[1], Benjamin Marty[1], Fawzi Boumezbeur[1], Sébastien Mériaux[1], Caroline Robic[2], Marc Port[2], Nicolas Tsapis[3], Elias Fattal[3], Eric Giacomini[1], Franck Lethimonnier[1], Denis Le Bihan[1], Julien Valette[1]

[1]NeuroSpin, I2BM, Commissariat à l'Energie Atomique, Gif-sur-Yvette, France; [2]Guerbet, Research Division, Aulnay-sous-Bois, France; [3]Université Paris Sud, UMR CNRS 8612, Faculté de Pharmacie, Châtenay-Malabry, France

The NMR properties of perfluorooctylbromide (PFOB) are revisited to derive a high sensitivity MRI strategy. Relevance of the bandwidth of the 180° pulses in a spin echo sequence is evidenced to obviate harmful effects of J-coupling. The T_2 of the CF_3 resonance of PFOB is measured using a multi spin echo (MSE) sequence and shown to dramatically depend on TE. An optimized MSE imaging sequence is therefore derived and compared with short TE/TR gradient echo and chemical shift imaging sequences. The unparalleled sensitivity yielded by the MSE sequence is promising for future applications, particularly for targeted PFOB nanoparticles.

15:00 ***3307*****.** **Multi-Dimension Random Phase Encoding for Chemical Shift Imaging**

Cao Peng[1,2], Condon Lau[1,2], 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

This study aims to employ random phase encoding in MR Chemical Shift Imaging (CSI) to reduce measurement time without significantly sacrificing image quality. CSI is a good candidate because the 2D-CSI sequence has the freedom to independently set the two directions of phase encoding. Simulations show efficient suppression of intervoxel contamination at undersampling factors up to 65% while maintaining image quality at undersampling factors up to 50%. This results show that CSI can significantly reduce measurement time.

Spectroscopy Methodology II

Hall B Monday 14:00-16:00 Computer 10

14:00 ***3308*****.** **Motion Artefact Correction in Spectroscopic Imaging Using an EPI Navigator and Reacquisition**

Aaron Timothy Hess[1], Ovidiu C. Andronesi[2], Matthew Dylan Tisdall[2], A Gregory Sorensen[2,3], Andre J. van der Kouwe[2], Ernesta M. Meintjes[1]

[1]University of Cape Town, Cape Town, South Africa; [2]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, MA; [3]Department of Radiology, Harvard Medical School, MA

Motion in spectroscopy and spectroscopic imaging introduces three categories of artefacts: i) a localising error; ii) a phase error arising from the excitation process; and iii) the disruption of the B0 field. We present a method to correct localisation and remove motion-induced phase errors by using an EPI navigator for motion correction in a spectroscopic imaging, LASER sequence. We show that by reacquiring scans where motion was detected the phase error artefacts can be removed.

14:30 ***3309*****.** **Metabolite T_2 Relaxation Times of Coupled ^{1}H Spin Systems in Human Brain at 7T**

Ralf Mekle[1,2], Giulio Gambarota[3], Lijing Xin[1], Rolf Gruetter[1,4]

[1]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Federale de Lausanne, Lausanne, Vaud, Switzerland; [2]Department of Radiology, University of Lausanne, Lausanne, Vaud, Switzerland; [3]GlaxoSmithKline Clinical Imaging Center, London, United Kingdom; [4]Departments of Radiology, Universities of Lausanne and Geneva, Lausanne and Geneva, Vaud and Geneve, Switzerland

The knowledge of the proton T2 relaxation time of coupled metabolites is valuable for improving spectral quantification not only in long TE MRS, but also in a number of MRS editing techniques, which are typically performed at moderate TEs. At the field strength of 7T, the T2 of singlets has already been reported, but not the systematic measurement of the T2s of coupled metabolites. In this study, measurement of the T2 of coupled spin resonances of metabolites in human brain at 7T using the spin echo full intensity acquired localized (SPECIAL) MRS technique is described for the first time.

15:00 ***3310*****.** **Extending the Sensitivity Volume of Surface Coils for Spectroscopy at 7T by Using Deuterium Water Bags**

Deborah Diane Douglas[1], Ivan Dimitrov[1,2], Jimin Ren[1], A. Dean Sherry[1], Craig R. Malloy[1]

[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Philips Medical Systems, Cleveland, OH, United States

Highly inhomogeneous B_1 pose challenges in 7T MRS, even more so when surface coils are used. Still, the high sensitivity of surface coils makes them a valuable tool in MRS. While the idea of B_1-shimming with dielectric pads for imaging is well-known, their use in spectroscopy has not been evaluated. We demonstrate the use of D_2O bags in directed extending the sensitivity volume of surface

coils: using a coil under the calf of volunteers the SNR of tibial bone spectra was increased 4-fold when a D_2O bag was put on top of the leg vs. when no bag was present.

15:30 ***3311*.** **Characterization and Correction of Modulation Sidebands in 1H MRS Without Water Suppression by Spatiotemporal Field Monitoring**

Anke Henning[1], Christoph Barmet[1], Alexander Fuchs[1], Johanna Vannesjö[1], Peter Boesiger[1], Klaas Paul Pruessmann[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

It is investigated whether calibration data acquired using a recently proposed ultra-fast 3D B0 field monitoring camera allows for observation and direct correction of the modulation sideband artefact caused by gradient vibrations in 1H MRS data acquired without water suppression.

Tuesday 13:30-15:30 Computer 10

13:30 ***3312*.** **SNR Enhancement of Intermolecular Double-Quantum Coherence MRS in Inhomogeneous Fields with Phased Array Coils**

Yanqin Lin[1,2], Zhong Chen[1], Jianhui Zhong[2]
[1]Physics, Xiamen University, Xiamen, Fujian, China; [2]Imaging Sciences, University of Rochester, Rochester, NY, United States

In human brains, intermolecular double-quantum coherences (iDQCs) can be used to acquire high-resolution localized magnetic resonance spectra (MRS) in the presence of large field inhomogeneity where conventional MRS methods fail. However, an intrinsic low SNR limits their practical applications. Here, we show that the SNR of iDQC MRS can be greatly improved through use of phased array coils. iDQC signal from a 32-channel phased array head coil was combined together using a nonparametric singular value decomposition algorithm. The results indicate that the iDQC spectra from the 32-channel coil have the SNR 1.6~2.5 times of that from a CP birdcage head coil.

14:00 ***3313*.** **Simultaneous MSC-SelMQC Mapping of Polyunsaturated Fatty Acids (PUFA), Lactate and Choline in Tissues Containing High Concentration of Mobile Lipid**

Qiuhong He[1,2]
[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States; [2]Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States

The Selective Multiple Quantum Coherence transfer (Sel-MQC) method is modified for simultaneous mapping of polyunsaturated fatty acids (PUFA), lactate and choline in three unique Molecular Specific Coherence (MSC) transfer pathways with complete lipid and water suppression in a single scan. Choline signal is also detectable in a second spin echo to enhance lipid suppression. The method can be applied to study animal tumor models and human breast cancer or other extracranial cancers.

14:30 ***3314*.** **High-Resolution GABA Detection With/without J Decoupling Using 2D Multiple-Quantum Coherence Spectroscopy**

Xi Chen[1,2], Shaolin Yang[1], Laura Rowland[2], Yihong Yang[1]
[1]Neuroimaging Research Branch, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States; [2]Maryland Psychiatric Research Center, University of Maryland School of Medicine, Baltimore, MD, United States

A modified 2D multiple-quantum coherence sequence is proposed to achieve high-resolution selective GABA detection under inhomogeneous fields. The edited spectra of GABA with and without J splittings can be obtained from the sequence. Sparse sampling in the indirect dimension is utilized to reduce the entire acquisition time. A phantom experiment was performed to demonstrate the feasibility of the proposed method and its potential applications for in vivo studies.

15:00 ***3315*.** **Ultra High-Resolution Absorption Intermolecular Multiple-Quantum NMR Spectroscopy Without Strong Coupling Artifacts Under Inhomogeneous Fields**

Xi Chen[1], Meijin Lin[1], Zhong Chen[1]
[1]Physics Department, Fujian Key Laboratory of Plasma and Magnetic Resonance, Xiamen University, Xiamen, Fujian, China

A pulse sequence termed CT-iDH, which combines intermolecular double-quantum filtered sequence for efficient solvent suppression with a modified constant-time (CT) scheme, is designed to achieve fast acquisition of high-resolution intermolecular zero-quantum coherences (iZQCs) and intermolecular double-quantum coherences (iDQCs) spectra without strong coupling artifacts. Furthermore, double-absorption lineshapes are first realized in 2D intermolecular multi-quantum coherences spectra under inhomogeneous fields through a combination of iZQC and iDQC signals to double the resolution without loss of sensitivity. Experiments were performed to test the feasibility of the new method. The study suggests potential applications for in vivo spectroscopy.

Wednesday 13:30-15:30 Computer 10

13:30 ***3316*. An Open-Source Platform for Routine Clinical 1H Magnetic Resonance Spectroscopy Processing**

Frederick Shic[1], Alexander P. Lin[2], J. Bob Brown[3], Stefan Bluml[4], Brian D. Ross[5]
[1]Yale Child Study Center, Yale University School of Medicine, New Haven, CT, United States; [2]Radiology, Brigham and Women's Hospital, Boston, MA, United States; [3]Alcor Consulting, Inc., Fremont, CA, United States; [4]Radiology, Keck School of Medicine of USC, Los Angeles, CA, United States; [5]Huntington Medical Research Institutes, Pasadena, CA, United States

1H MRS data analysis research traditionally emphasizes novel and powerful, but complex, methods for quantifying spectroscopic data, creating barriers for less technical users. At the other extreme, many everyday users of MRS simply adopt manufacturer's standards for data processing, resulting in widespread incompatibilities in cross-institutional comparability. Here, we emphasize the critical need for usability in MRS data processing and present an open-source platform which is intuitive, easy-to-use, yet complete, flexible, and powerful. We show that in vitro and in vivo variability is low, and suggest that this platform may serve to provide accessible, widespread, and consistent MRS data processing.

14:00 ***3317*. Long-Term Reproducibility of MRS System**

Agnieszka Polnik[1], Magdalena Wicher[2], Tomasz Banasik[2], Aleksandra Kieltyka[2], Marek Konopka[3], Maria Sokó³[4]
[1]Department of Medical Physics, Maria Sk³odowska-Curie Memorial Cancer cenetr and Institute of Oncology, Gliwice, Poland; [2]Helimed Diagnostic Imaging, Katowice, Poland; [3]Helimed Diagnosic Imaging, Katowice, Poland; [4]Maria Sk³odowska-Curie Memorial Cancer Center and Institute of Oncology, Gliwice, Poland

The puropse of this work was to assess long-term variability of magnetic resonance spectroscopy in vivo using a standard brain phantom. The measurements were performed from April 2006 to September 2009. Short and long echo time spectra were acquired from the volume of interest located in the isocentre. The total number of spectra measured for short echo time was equal to 99, while for long echo time – 96. LCModel software was used for estimation of the metabolite levels. Coefficients of variation did not exceed the value of 6% for any metabolite over three years of the experiment.

14:30 ***3318*. Simple Correction of Chemical Shift Changes in Quantitation**

Andrii Lazariev[1], Florence Fauvelle[2], Martial Piotto[3,4], Karim Elbayed[4], Jacques Namer[5], Dirk van Ormondt[6], Danielle Graveron-Demilly[1]
[1]Laboratoire Creatis-LRMN; CNRS UMR 5220; INSERM U630; INSA de Lyon, Université Claude Bernard Lyon 1, Villeurbanne, France; [2]CRSSA/BCM, Grenoble, France; [3]Bruker BioSpin, Wissembourg, France; [4]Institut de Chimie, Strasbourg, France; [5]Department of Biophysics and Nuclear Medicine, University Hospitals of Strasbourg, Strasbourg, France; [6]Delft University of Technology, Delft, Netherlands

High-resolution magic angle spinning (HRMAS) 1H spectroscopy is playing an increasingly important role for diagnosis. This technique enables setting up metabolite profiles of ex vivo pathological and healthy tissue. Automatic quantitation of HRMAS signals will provide reliable reference profiles to monitor diseases and pharmaceutical follow-up. Nevertheless, for several metabolites chemical shifts often slightly differ according to the microenvironment in the tissue or cells, in particular with its pH. This hampers accurate estimation of the metabolite concentrations mainly when using quantitation algorithms based on a metabolite basis-set. In this work, a very simple method to circumvent this problem is proposed.

15:00 ***3319*. Classification on Ex-Vivo MRS Signals of Glioma Samples**

Bernd Merkel[1], Frauke Nehen[2], Yasemin Oezdemir[1], Markus Thorsten Harz[1], Dieter Leibfritz[2], Rudolf Fahlbusch[3], Horst Karl Hahn[1]
[1]Fraunhofer MEVIS, Bremen, Germany; [2]Institute of Organic Chemistry, University of Bremen, Bremen, Germany; [3]International Neuroscience Institute, Hannover, Germany

The goal of this work is the automated classification of glioma samples with high-resolution ex-vivo MR-spectroscopy. HR-MRS is a sensitive method to detect metabolite changes in different tumor and tissue types. Altogether 47 biopsates of healthy, tumor margin and tumor center tissue, measured on a 600 Mhz spectrometer, were analyzed. For further analysis, the lipophilic compounds were omitted and only the hydrophilic ones were analyzed. By the application of ICA and further classification and feature reduction techniques, we show that the tumor margin is distinctively different from the tumor center.

Thursday 13:30-15:30 Computer 10

13:30 ***3320*. Clinical Evaluation of a Fully Automated Computer Aid Decision System (CADS) for Brain Tumour Supported Diagnosis. ETUMOUR Project FP6-2002-LSH-503094**

Bernardo Celda[1,2], Juan Manuel Gil Cano[1], MCarmen Martinez-Bisbal[2], Beatriz Martinez-Granados[1], eTUMOUR eTUMOUR-partners
[1]Physical Chemistry, University of Valencia, Burjassot, Valencia, Spain; [2]Physical Chemistry, CIBER-BBN, Burjassot, Valencia, Spain

The clinical evaluation of a Computer Aid Decision System (CADS) for brain tumours classification is presented. The fully automated CADS has been evaluated and excellent results from the users opinion about applicability and accuracy and final classification for meningioma, low grade and high grade glial brain tumours will be discussed.

14:00 ***3321*. Dynamic Metabolic Modeling of Glucose Transport and Utilization in the Human Brain**

Alexander A. Shestov[1], Uzay E. Emir[1], Anjali Kumar[1], Pierre-Gilles Henry[1], Elizabeth R. Seaquist[1], Gulin Oz[1]
[1]University of Minnesota, Minneapolis, MN, United States

Determining the kinetics of cerebral glucose transport and utilization is critical for quantifying cerebral energy metabolism. We report kinetic parameters for glucose transport and utilization by fitting both dynamic and steady-state data with a reversible, non-steady-state Michaelis-Menten model. Dynamic data were obtained by measuring brain and plasma glucose time courses during glucose infusions in 5 healthy volunteers. Steady-state plasma vs. brain glucose concentrations were taken from literature. Maximum transport capacity for glucose through the BBB was nearly two-fold higher than maximum cerebral glucose utilization. The glucose transport and utilization parameters were consistent with previously published values for human brain.

14:30 ***3322*. Refocused Double Quantum Filter**

Vincent O. Boer[1], Peter R. Luijten[1], Dennis W J Klomp[1]
[1]radiology, UMC Utrecht, Utrecht, Netherlands

Double Quantum (DQ) filters provide a means to acquire signal of coupled spin systems with a superb suppression of (overlapping) non-coupled spin systems. Lactate detection in the presence of macromolecules and lipids is therefore possible. However, the DQ filters are associated with severe signal loss of the metabolite of interest. In this work we propose a refocused DQ filter with a higher detection sensitivity compared to previously proposed filters while suppression quality of overlapping resonances is even increased. Detection of lactate in low concentrations and in lipid rich environments therefore becomes possible. Baseline brain-lactate measurements are shown with suppression of all other resonances.

15:00 ***3323*. Localized *in Vivo* ^{13}C MRS of Brain Glycogen at 9.4 and 14.1 T: A Comparison**

Ruud B. van Heeswijk[1], Yves Pilloud[1], Florence D. Morgenthaler[1], Rolf Gruetter[1,2]
[1]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, VD, Switzerland; [2]Radiology, Universities of Lausanne & Geneva, Lausanne & Geneva, Switzerland

Localized ^{13}C MR spectroscopy of rat brain glycogen at 9.4 and 14.1 T are compared. After pre-labeling at the C1 position and absolute quantification of the concentrations, the signal-to-noise ratio (SNR) of the glycogen and glucose C1 resonances are compared at the two field strengths. The T_1 relaxation time and effective linewidth are also determined, and an overall comparison of the spectral quality is made.

Spectroscopic Quantification Methodology I

Hall B Monday 14:00-16:00 Computer 11

14:00 ***3324*. Imaging Glutamine Synthesis Rates in the Hyperammonemic Rat Brain**

Cristina Cudalbu[1], Vladimír Mlynárik[2], Bernard Lanz[2], Hanne Frenkel[2], Nicolas Costers[2,3], Rolf Gruetter[2,4]
[1]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne (EPFL) , Lausanne, Switzerland; [2]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland; [3]Katholieke Universiteit Leuven, Leuven, Belgium; [4]Departments of Radiology, Universities of Lausanne and Geneva, Switzerland

The aim of the study was to image for the first time the in vivo effect of hyperammonemia per se on 12 brain metabolites using short TE 1H SI . We also mapped the net glutamine synthesis rates during hyperammonemia. Contrary to other models of hyperammonemia associated with experimental acute liver failures, no changes in spatial distribution of metabolites were observed except of Gln increase (higher in cortex than in hippocampus). We imaged for the first time the net glutamine accumulation in vivo, and showed that the rates were significantly higher in the cortex than in the hippocampus.

14:30 *3325*. **Modeling of 3-Dimensional MR Spectra of Human Brain: Simultaneous Determination of T_1, T_2, and Concentrations Based on Combined 2DJ Inversion-Recovery Spectroscopy**

Christine Sandra Bolliger[1], Daniel Guo Quae Chong[1], Johannes Slotboom[2], Chris Boesch[1], Roland Kreis[1]
[1]Department of Clinical Research, University Bern, Bern, Switzerland; [2]Departement Radiologie, Neuroradiologie, Nuklearmedizin (DRNN), Inselspital, Bern, Switzerland

In addition to peak areas, full quantitation of in vivo MR spectra requires the measurement of individual metabolite T1's, T2's, and of the macromolecular baseline. Since this is time-consuming, these influences are mostly ignored in a clinical setting, leading to systematic inaccuracies. We propose simultaneous modeling of a combined dataset, called 2DJ-IR, consisting of a 2DJ series and a set of inversion recovery (IR) spectra. Since this allows a determination of relaxation effects and macromolecule baseline in reasonable time, the areas as determined by this method are inherently relaxation-corrected and can be directly interpreted as concentration ratios.

15:00 *3326*. **Evaluation of Minimum Scan Time for High Quality Quantitative *in Vivo* ^{1}H MR Spectroscopy at 16.4T**

Sung-Tak Hong[1], Dávid Zsolt Balla[1], Changho Choi[2], Rolf Pohmann[1]
[1]High-Field Magnetic Resonance Center , Max-Planck Institute for Biological Cybernetics, Tuebingen, Baden-Wuerttemberg, Germany; [2]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

Localized in vivo 1H NMR spectroscopy requires significantly high number of averages compared to other MR imaging techniques. Precise analysis on spectra obtained at 16.4T was performed to determine the minimal number of averages, necessary for quantifying nineteen metabolites with average CRLBs of below 20%. The results demonstrated that 64 averages were sufficient to quantify most metabolites reliably except weakly represented metabolites such as alanine, glycine and phosphorylcholine.

15:30 *3327*. **Quantitative Lithium Spectroscopy in the Normal Human Brain on a 3T Clinical Scanner**

Fiona Smith[1], David Cousins[2], Peter E. Thelwall[1], I Nicol Ferrier[2], Andrew M. Blamire[1]
[1]Newcastle MR Centre & Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, United Kingdom; [2]Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom

A quantitative protocol for localised ^{7}Li of the human brain at 3T was developed. T1 relaxation of Li in healthy human brain was measured to be 2.0±0.4s. Brain Li concentration was measured to be 70% of plasma concentration.

Tuesday 13:30-15:30 Computer 11

13:30 *3328*. **Assessment of Lipids in Skeletal Muscle by LCModel and AMARES**

Jan Weis[1], Lars Johansson[1,2], Francisco Ortiz-Nieto[1], Håkan Ahlström[1]
[1]Department of Radiology, University Hospital, Uppsala, Sweden; [2]Astra Zeneca R&D

Single-voxel MRS was used to obtain the spectra of the calf muscles. Unsuppressed water line was used as a concentration reference. A new prior knowledge for AMARES was proposed to estimate the absolute concentrations of extra- and intramyocellular lipids. The results were compared with the values estimated by LCModel. Very good correlation of the total fat and intramyocellular concentrations was achieved between both data processing approaches. Assessment of the absolute concentrations of muscular lipids by AMARES and LCModel can be performed with similar reliability.

14:00 *3329*. **Measurement of Glycine in the Human Brain by 1H-MRS at 3T**

Changho Choi[1], Deborah Douglas[1], Aditya Patel[1], Elizabeth Maher[2], Ivan Dimitrov[1,3]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Internal Medicine and Neurology, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Philips Medical Systems, Cleveland, OH, United States

Glycine (Gly) in human brain was measured using an optimized PRESS (point-resolved spectroscopy) sequence at 3T. Echo time dependence of the coupled resonances of myo-inositol (mIns) was investigated, with numerical analyses, for TE1 and TE2 between 20 and 200 ms. The numerical simulation indicated that a pair of subecho times, (TE1, TE2) = (60, 100) ms, suppresses the mIns resonances at 3.5 – 3.6 ppm, providing an effective tool for measuring Gly and mIns simultaneously. In vivo tests of the method were carried out on six subjects. With LCModel fitting, [Gly]/[Cr] and [mIns]/[Cr] were estimated to be 0.08±0.01 and 0.70±0.07 (mean±SD, N = 3) for the occipital lobe, and 0.07±0.01 and 0.81±0.21 (N = 3) for the parietal lobe, respectively. The Cramér-Rao lower bounds (CRLB) of Gly were 9±1% (N = 6).

14:30 *3330*. **Proton T2 Measurement and Quantitation of Coupled-Spin Metabolites in Human Brain by PRESS at 3T in Vivo**

Changho Choi[1], Aditya Patel[1], Deborah Douglas[1], Ivan Dimitrov[1,2]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Philips Medical Systems, Cleveland, OH, United States

Proton T2 measurement and quantification of brain coupled-spin metabolites in the human brain, at 3T, is reported. Four pairs of PRESS (point resolved spectroscopy) subecho times, which were obtained with numerical analyses of the sequence for optimal separation between glutamate (Glu) and glutamine (Gln), were used for T2 measurement. Single-voxel measurements were carried out

on the occipital cortex of five healthy volunteers. Spectra were analyzed with LCModel fitting. From monoexponential fitting of the LCModel estimates at the selected TE¡¯s, apparent T2¡¯s of Glu, Gln, and myo-inositol (mIns) were measured to be 160 - 170 ms. Further, the signal strengths measured with TR = 8 s were extrapolated to zero TE using the estimated T2 values. The concentration ratio with respect to creatine was estimated to be 8.2¡¾1.3, 4.6¡¾0.6, 9.5¡¾0.8, and 1.1¡¾0.1 (mean¡¾SD, N = 5) for Glu, mIns, NAA, and GPC+PC, respectively.

15:00 ***3331*. Measurement of Proton T2 of Coupled-Spin Metabolites in Gray and White Matter in Human Brain at 3T**

Changho Choi[1], Aditya Patel[1], Deborah Douglas[1], Ivan Dimitrov[1,2]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Philips Medical Systems, Cleveland, OH, United States

Measurement of the transverse relaxation times of brain metabolites including coupled-spin metabolites such as glutamate (Glu) and myo-inositol (mIns) in gray and white matter, at 3T, is reported. Four pairs of PRESS (point resolved spectroscopy) subecho times, which were obtained with numerical analyses of the sequence for optimal selectivity of Glu and mIns, were used for T2 measurement. Single-voxel measurements were carried out on the gray-matter (GM) and white-matter (WM) dominant regions in the occipital lobe of five healthy adult brains. The Glu T2 was measured to be similar between GM and WM (161±18 and 169±22 ms, respectively). Myo-inositol, creatine, and choline also exhibited similar T2 between GM and WM, but the T2 of N-acetylaspartate (2.01 ppm) was significantly different between GM and WM (262±16 and 326±21 ms, respectively), with $p = 0.001$.

Wednesday 13:30-15:30 Computer 11

13:30 ***3332*. In Vivo Detection of Serine in Human Brain by Constant-TE Difference Editing at 3T**

Changho Choi[1], Deborah Douglas[1], Aditya Patel[1], Ivan Dimitrov[1,2]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Philips Medical Systems, Dallas, OH, United States

A proton MRS strategy for detection of serine (Ser) in human brain at 3T is proposed. Spectral difference of multiplet at different subecho times of triple refocusing at a constant total echo time was utilized to measure Ser and cancel the overlapping creatine (Cr) 3.92-ppm singlet via subtraction. A 50-ms non-spatially selective 180° RF pulse was applied between the 180° pulses of a PRESS sequence. A pair of subecho time sets, (TE1, TE2, TE3) = (70, 50, 135) and (35, 135, 85) ms, was obtained from density-matrix simulations. An in vivo test of this difference editing was conducted on the occipital cortex of a healthy adult brain. From spectral fitting of sub- and difference-spectra by LCModel, the serine to N-acetylaspartate concentration ratio was estimated as 0.05.

14:00 ***3333*. Regional Difference in Glycine Concentrations in Human Brain as Measured by 1H-MRS at 7T in Vivo**

Changho Choi[1], Ivan Dimitrov[1,2], Deborah Douglas[1], Aditya Patel[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]Philips Medical Systems, Cleveland, OH, United States

Measurement of glycine (Gly) in the human brain by 1H-MRS at 7T is reported. A point-resolved spectroscopy (PRESS) sequence with subecho times optimized for differentiation between Gly and myo-inositol was applied for measuring the metabolites in the prefrontal and left frontal cortices of a healthy adult brain, which are gray and white matter dominant, respectively. The Gly-to-creatine concentration ratios were observed to be approximately 2-fold higher in prefrontal than in left frontal. This result suggests that Gly may be present predominantly in gray matter compared to white matter.

14:30 ***3334*. J Refocused Coherence Transfer Spectroscopic Imaging at 7T**

Jullie W. Pan[1], Nikolai Avdievich[1], Hoby P. Hetherington[1]
[1]Yale University School of Medicine, New Haven, CT, United States

The detection of amino acids at ultra high field is enhanced due to improved spectral resolution in comparison to 3T. However, due to J-modulation and T2 losses short spin echo acquisitions are typically used at 7T. Unfortunately, broad macromolecule resonances, visible at short TE, can make accurate detection of the metabolites difficult. J refocused coherence transfer spectroscopy is known to suppress J-modulation of coupled spin systems, thereby allowing longer echo times and suppressing macromolecule contamination. We describe simulation and implementation of a J-refocused transfer sequence for spectroscopic imaging of glutamate and glutamine in the human brain at 7T.

15:00 ***3335*. Correction of Cerebral Metabolite Concentrations for Brain Tissue in Proton Spectroscopic Imaging**

Kuan-Ting Wu[1], Chen-Shuan Huang[1], Stefan Posse[2,3], Shang-Yueh Tsai[1]
[1]Department of Electrical Engineering, Chang Gung University, Tao Yuan, Taiwan; [2]Department of Neurology, University of New Mexico School of Medicine, Alberquerque, NM, United States; [3]Department of Electrical & Computer Engineering, University of New Mexico , Alberquerque, NM, United States

A processing procedure is proposed to do the tissue type correction for metabolite concentrations on spectroscopic imaging. Tissue segmentation is first done on 3D high resolution T1 images (MPRAGE). Image registration provided by SPM8 software is then applied to generate GM, WM and CSF probability maps at corresponding slice of spectroscopic imaging for the correction of metabolite concentrations. Our results showed that concentration correction can be done well on two segmentation methods and integration of SPM into tissue type correction is useful for future application of MRSI at different locations and slice orientations.

Thursday 13:30-15:30 Computer 11

13:30 ***3336*. Absolute Metabolite Quantification in Human Brain Using Short Echo-Time CSI and a Phased-Array Headcoil.**

Petra Pouwels[1], Marjan Steenweg[2], Frederik Barkhof[3], Marjo van der Knaap[2]
[1]Physics & Medical Technology, VU University Medical Center, Amsterdam, Netherlands; [2]Child Neurology, VU University Medical Center, Amsterdam, Netherlands; [3]Radiology, VU University Medical Center, Amsterdam, Netherlands

Absolute metabolite concentrations in human brain were obtained from short echo-time CSI (TR/TE 3000/30 ms, 6 averages, 19 minutes) using a phased-array headcoil. A voxel-wise calibration was based on a combination of transmitter amplitude and water reference scans obtained with both body- and headcoil (<1 minute each). This provided a reproducible and homogeneous quantification as demonstrated in a phantom. In vivo, high quality spectra were obtained in 37 subjects between 2 and 19 years. Metabolite concentrations showed similar regional distributions and age-related variations as previously observed with quantitative single-voxel MRS, demonstrating the applicability of CSI for quantitative MRS at high spatial resolution.

14:00 ***3337*. Relaxometry-Based Spectroscopic Differentiation of Gray and White Matter in the Human Brain: On the Stability of Tissue Water as an Internal Reference**

Jack Knight-Scott[1]
[1]Radiology, Children's Healthcare of Atlanta, Atlanta, GA, United States

The spectroscopic relaxation model for brain tissue is different from the imaging relaxation model. As many as three water compartments have been detected in imaging. Here we examine the sensitivity and stability of a fast spectroscopic relaxometry technique. Specifically, we explore the stability of the spectroscopy relaxation model of human brain tissue by examining its results when applied across an aging population and across different brain regions.

14:30 ***3338*. Improved Metabolite Quantification Using VAPOR Water Suppression**

Yan Li[1], Janine M. Lupo[1], Duan Xu[1], Douglas A.C. Kelley[2], Sarah J. Nelson[1,3]
[1]Department of Radiology and Biomedical Imaging, University of California, San Francisco, CA, United States; [2]Applied Science Laboratory, GE Healthcare, San Francisco, CA, United States; [3]Department of Bioengineering & Therapeutic Sciences, University of California, San Francisco, CA, United States

The availability of whole body MR scanners with field strengths of 7 Tesla offers the potential of higher SNR and better spectral resolution, but also introduces complications, such as the presence of increased sidebands from unsuppressed water. The purpose of this study was to evaluate the efficacy of VAPOR water suppression and to assess the improvements in the accuracy of metabolite quantification compared to conventional water suppression with CHESS. The data acquired using VAPOR water suppression have smaller residual water signals, less gradient-induced water sidebands, lower CRLB and coefficients of variance compared to that acquired using CHESS. VAPOR suppression is therefore a valuable tool for improving the accuracy of metabolite quantification.

15:00 ***3339*. Neurotransmitter Profiling at 3T Using GABA Optimized PRESS Sequence**

Antonio Napolitano[1], Walter Kockenberger[2], Dorothee P. Auer[1]
[1]Academic Radiology, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]SPMMRC, University of Nottingham, United Kingdom

The spectroscopic detection of GABA is still challenging due to its low concentration, and the fact that all GABA peaks are overlapped by much stronger metabolite resonances at the field strength accessible for clinical studies. This study aims to simultaneously detect GABA as well as Glu, Gln pools using a standard PRESS localization pulse sequence with optimized timing parameters.

Spectroscopic Quantification Methodology II

Hall B Monday 14:00-16:00 Computer 12

14:00 ***3340*. Quantification of Glutamate and Glutamine Using CT-PRESS at 3T**

Meng Gu[1], Natalie M. Zahr[2,3], Daniel M. Spielman[1], Edith V. Sullivan[2,3], Adolf Pfefferbaum[2,3], Dirk Mayer[1,3]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Psychiatry & Behavioral Sciences, Stanford University, Stanford, CA, United States; [3]Neuroscience Program, SRI International, Menlo Park, CA, United States

Quantifying and separating glutamate (Glu) and glutamine (Gln) using conventional magnetic resonance spectroscopy on clinical scanners is challenging. Constant-time point-resolved spectroscopy was developed at 3T to detect Glu but does not resolve Gln. To quantify Glu and Gln separately, a time-domain basis set was constructed taking into account T2 relaxation and dephasing from B0 inhomogeneity. Metabolite concentrations were estimated by fitting the basis magnitude spectrum to the measured spectrum. This method was validated using phantoms with different Glu and Gln concentrations. When applied to in vivo data, ethanol-exposed but not control rats showed increased Gln after exposure.

14:30 ***3341*. LCModel Accuracy Testing for N-Acetyl Aspartyl Glutamate Measurement Using Phantom Study**

Namkug Kim[1], Young-Hoon Sung[1], Nivedita Agarwal[1], Eric Jensen[2], In Kyoon Lyoo[3], Brent P. Forester[2], Perry F. Renshaw[1]

[1]The Brain Institute, University of Utah, Salt Lake City, UT, United States; [2]Department of Psychiatry, Harvard Medical School, Belmont, MA, United States; [3]Department of Psychiatry, Seoul National University, Seoul, Korea, Republic of

It is typically difficult to differentiate NAAG directly from NAA of standard MRS due to the low concentration of NAAG and overlap with other metabolites. Five repetitive scan trials of five phantom cases in which all the phantoms were scanned using CSI at one-day intervals to figure out the reproducibility and the accuracy of the measurement. The phantom cases contained a range of concentrations of Glu, NAAG, and constant concentrations of other ten metabolites. It was found that as the concentration of NAAG becomes smaller (especially below 1mmol/kg), the overestimation bias in measuring the NAAG gets stronger.

15:00 ***3342*. Reliability of in Vivo Glutamate Detection with MRS at 3T**

Ruth L. O'Gorman[1,2], Jonathan Noble[3], James M. Stone[4], David J. Lythgoe[5], Mary A. McLean[6], Fahmida A. Chowdhury[7], Philip K. McGuire[4], Mark P. Richardson[7], Gareth J. Barker[5]

[1]Neuroradiology, King's College Hospital, London, United Kingdom; [2]MR-Zentrum, University Children's Hospital, Zurich, Switzerland; [3]Medical Engineering and Physics, King's College Hospital, London, United Kingdom; [4]Psychological Medicine and Psychiatry, Institute of Psychiatry, London, United Kingdom; [5]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, United Kingdom; [6]Institute of Neurology, London, United Kingdom; [7]Epilepsy Research Group, Institute of Psychiatry, London, United Kingdom

This study investigated the precision of glutamate (Glu) measurements for a PRESS protocol optimised for Glu/Gln separation (echo time (TE) =80 ms) and a standard short TE (30 ms) PRESS protocol, quantified using both frequency domain and time domain analysis methods. The longer TE improved Glu precision when time-domain fitting methods (AMARES/jMRUI) were used for quantitation, but offered little improvement when frequency-domain methods (LCModel) were used. The TE80 spectra processed with jMRUI offered the best precision for NAA and Choline, while the TE30 spectra processed with LCModel offered the best precision for Glu and Cr.

15:30 ***3343*. Diurnal Stability of MEGA-PRESS Measurements of GABA Concentration**

Richard AE Edden[1,2], C John J. Evans[3,4], David J. McGonigle[3,5]

[1]Russell H Morgan Department of Radiology and Radiological Sciences, The Johns Hopkins University, Baltimore, MD, United States; [2]FM Kirby Research Center for Functional MRI, Kennedy Krieger Institute, Baltimore, MD, United States; [3]CUBRIC, School of Psychology, Cardiff University, United Kingdom; [4]GE HealthCare, Slough, United Kingdom; [5]School of Biosciences, Cardiff University, United Kingdom

Edited MRS measurements of GABA are being widely applied in clinical and basic neuroscience studies. GABA concentration is known to vary with the menstrual cycle, and GABA is key to the suprachiasmatic nuclei's circadian 'clock', but no study has addressed diurnal GABA variation in cortical regions. In spite of this, it is rare to control for time-of-day in designing studies. This study measures GABA in visual and sensorimotor cortex in 8 individuals at 5 timepoints in a day, and concludes that methods are insensitive to any diurnal variation in GABA concentration, but that regional and inter-individual differences can be seen.

Tuesday 13:30-15:30 Computer 12

13:30 ***3344*. An Improved Magnetization Saturation Transfer Approach---T_1^{nom} for Rapidly Measuring and Quantifying CK Activity in the Rat Brain**

Fei Du[1,2], Qiang Xiong[3], Xiao-Hong Zhu[1], Wei Chen[1]

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The chemical exchange reactions (PCr↔ATP↔Pi) catalyzed by the creatine kinase (CK) and ATPase enzymes play key roles in maintaining brain function. In vivo 31P-MRS combined with magnetization saturation transfer (ST) provides a unique tool for assessing the reaction rate constants (kf). The accurate quantification of kf usually requires a long repetition time (tr) for approaching a steady-state saturation condition, however, suffers from limited sensitivity for biomedical application. This problem could be partially solved by shortening tr and allowing more signal averages. However, the partial saturation effect independent of kf makes kf quantification more complicate. Therefore, it is crucial to develop different approaches able to rapidly measuring and quantifying CK and ATPase enzyme activities in vivo. In this work, we present an improved magnetization ST approach, i.e.T1nom approach, for correcting the partial saturation effect with short tr. The results indicate a simple, linear relation between kf and the magnetization ratio of control and saturated 31P spectra. This approach was tested in the rat brain.

14:00 *3345*. **An Optimized T1nom Approach for Super Fast Measuring Enzyme Kinetics in Vivo Using Saturation Transfer Technique**

Qiang Xiong[1], Fei Du[1], Xiao-hong Zhu[1], Jianyi Zhang[1,2], Wei Chen[1]
[1]Center for Magnetic Resonance Research, Univ. of Minnesota, Minneapolis, MN, United States; [2]Medicine, Lillehei Heart Institute, Univ. of Minnesota, Minneapolis, MN, United States

A novel approach (T1nom) is presented for saturation transfer (ST) technique that is suitable for super fast measuring and quantifying enzyme kinetics in vivo. The T1nom approach features with arbitrarily repetition time, saturation time and flip angle while maintaining simple quantification algorithm that can be only achieved with very long TR and saturation time in the case of conventional ST approach. The T1nom approach was optimized by using numerical simulations. The results gave the guidelines for finding TR/flip angle pairs that can give rise to be most accurate measurements of kinetic rate constants within a given scan time. Finally, a practical procedure is given for intervention/stimulation experiments where changes of compound pool size ratios may be encountered.

14:30 *3346*. **Probabilistic Averaging: An Instinctive Method of Averaging According to Data Confidence Applied to Cardiac 31P MRS**

Lowri E. Cochlin[1], Kieran Clarke[1]
[1]Cardiac Metabolism Research Group, University of Oxford, Department of Physiology, Anatomy and Genetics, Oxford, United Kingdom

This work demonstrates an intuitive approach to weighting data according to precision achieved during quantification. Cardiac 31P-MRS is used as an example of data whose accurate fitting is often challenged by low SNR. The 1:1:1 ratio of á:â:ã-ATP peaks (excited uniformly with optimized RF-pulse, NAD and T1 corrected) constitutes three measures of the same molecule. Probability density functions generated for each integrated peak therefore combine as a ‘weighted’ average representing a maximum likelihood estimate of the true value. Data from 11 healthy volunteers processed probabilistically demonstrated reduced variance in every PCr/ATP, and reduced inter-subject PCr/ATP spread, compared to standard weighting.

15:00 *3347*. **Decreased Energy Metabolism in Patients with Migraine Without Aura: A ^{31}P MRS Study**

Harmen Reyngoudt[1,2], Benedicte Descamps[1,2], Yves De Deene[3], Koen Paemeleire[4,5], Eric Achten[1,2]
[1]Radiology, Ghent University, Ghent, Belgium; [2]Ghent Institute for Functional and Metabolic Imaging, Ghent University, Ghent, Belgium; [3]Radiotherapy, Ghent University, Ghent, Belgium; [4]Basic Medical Sciences, Ghent University, Ghent, Belgium; [5]Neurology, Ghent University Hospital, Ghent, Belgium

Most studies emphasized on the quantification of phosphorus metabolites in migraine with aura patients. We re-evaluated the phosphorus metabolism, and its possible basal deficiencies, in a homogeneous migraine without aura (MwoA) patient group between attacks (interictally). We compared 22 MwoA patients with 22 controls. Spectra were acquired in the visual cortex. Absolute quantification was performed by using an external reference. The metabolic shifts found in this study point to a basal metabolic deficiency in MwoA patients

Wednesday 13:30-15:30 Computer 12

13:30 *3348*. **Determination of Cut-Off Value of Total Choline Concentration (TCho) for the Differentiation of Malignant, Benign and Normal Breast Tissues by In-Vivo Proton MR Spectroscopy at 1.5 T in a Large Cohort of Women.**

Rani G. Sah[1], Uma Sharma[1], Rajinder Parshad[2], Naranamangalam R. Jagannathan[1]
[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India;
[2]Department of Surgery, All India Institute of Medical Sciences, New Delhi, Delhi, India

The concentration of choline containing compounds (tCho) was calculated using in-vivo proton MRS in 155 women. tCho was observed in 96/101 malignant, 22/25 benign lesions and 16/29 normal volunteers. The mean concentration of tCho for malignant tissues (4.0 ± 2.9 mmol/kg) was significantly higher compared to benign (1.45 ± 0.92 mmol/kg) and normal breast tissues (0.57 ± 0.37 mmol/kg). Using ROC analysis, cut-off values of 2.24 mmol/kg and 1.02 mmol/kg were obtained for the differentiation of malignant from benign tissues and malignant versus normal tissues, respectively, suggesting that quantitative measurements provide unambiguous diagnosis of breast lesions.

14:00 *3349*. **Determination of the in Vitro Limit of Detection for Pulmonary Surfactant Using Proton Magnetic Resonance Spectroscopy at 1.5T**

Michael James Reeves[1], Alice E. Oates[1], David A. Capener[1], Janet E. Morris[1], Jim M. Wild[1], Martyn NJ Paley[1], Elspeth H. Whitby[1]
[1]Academic Unit of Radiology, University of Sheffield, Sheffield, South Yorkshire, United Kingdom

This study examines the technical feasibility of measuring the concentration of fetal pulmonary surfactant (lecithin) by proton magnetic resonance spectroscopy using a 1.5T clinical imaging system. The lower limit of detection of lecithin in vitro was found to be around 0.5mM using typical clinical sequence parameters. This is well above the physiological concentrations found in amniotic fluid samples. Non-invasive measurement of amniotic fluid lecithin concentration by 1.5T proton magnetic resonance spectroscopy using current clinical imaging parameters is therefore not considered to be practicable.

14:30 *3350*. **ERETIC-Based Glycogen Quantification Using SNR-Enhanced and Localized 13C MRS**

Xing Chen[1], Anke Henning[1], Matteo Pavan[1], Susanne Heinzer-Schweizer[1], Marco Toigo[2,3], Peter Bösiger[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Institute of Physiology and Zurich Center for Integrative Human Physiology (ZIHP), University of Zurich, Switzerland; [3]Exercise Physiology, Institute of Human Movement Sciences, ETH Zurich, Switzerland

13C MRS glycogen was detected by combined ISIS-localized NOE and proton decoupling in human calf muscle, with the ERETIC signal as a synthetic reference standard for quantification. Reproducibility tests were performed regarding the quantified signal intensities, SNR enhancement factors and ERETIC signal stability. In conclusion, the combination of NOE and decoupling can enhance the glycogen signal at a reproducible level and enables higher fitting and thus quantification reliability. As ERETIC signal stability proved to be unaffected by SNT enhancement, it is promising to use the ERETIC signal as reference for absolute quantification among different subjects and experiments.

15:00 *3351*. **T_2 Determination of the J-Coupled Methyl Protons of Tibial Bone Marrow Lipids at 3 T**

Atiyah Yahya[1,2], B. Gino Fallone[1,2]
[1]Department of Medical Physics, Cross Cancer Institute, Edmonton, Alberta, Canada; [2]Department of Oncology, University of Alberta, Edmonton, Alberta, Canada

Magnetic resonance spectroscopy of lipids has provided insight into a number of diseases. The methylene (CH2) to methyl (CH3) lipid proton ratio is a useful quantity. For accurate calculations of this ratio, reliable estimates of the T2 values of the protons are required. Determining a representative T2 for the methyl protons is challenging because of J-coupling contributions. In this work, we show how the T2 of the methyl protons of lipids can be measured at 3 T with minimal contributions from J-coupling evolutions. The efficacy of the technique was verified on tibial bone marrow of four healthy volunteers.

Thursday 13:30-15:30 Computer 12

13:30 *3352*. **3D High Spatial Resolution Short TE Proton-Echo-Planar-Spectroscopic-Imaging (PEPSI) at 3T in Clinically Feasible Measurement Times**

Ernesto Akio Yoshimoto Ninamango[1], Chenguang Zhao[2], Kaung-Ti Yung[2], Weili Zheng[2], Elena Ackley[2], Stephen Dager[3], John vanMeter[4], Ulrike Dydak[5,6], Keith Heberlein[7], Shang-Yueh Tsai[8], Fa-Hsuan Lin[9,10], Lawrence Wald[11], Andre Van Der Kouwe[11], Juan Bustilo[12], Stefan Posse[1,3]
[1]Electrical Engineering, University of New Mexico, Albuquerque, NM, United States; [2]Department of Neurology, University of New Mexico, Albuquerque, NM, United States; [3]Department of Radiology, University of Washington, Seattle, WA, United States; [4]Department of Neurology, Georgetown University, Washington, DC, United States; [5]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States; [6]School of Health Sciences, Purdue University, West Lafayette, IN, United States; [7]Siemens Medical Solutions, Siemens, Erlangen, Germany; [8]Department of Electrical Engineering, Chang Gung University, Tau Yuan, Taiwan; [9]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan; [10]A. A. Martinos Center, Massachusetts General Hospital, MA, United States; [11]MGH-HMS-MIT Athinoula A. Martinos Center for Biomedical Imaging; [12]Department of Psychiatry, University of New Mexico, Albuquerque, NM, United States; [13]Electrical and Computer Engineering Department, University of New Mexico

This multicenter MRSI study presents the results of 3D metabolite mapping in the brain of healthy subjects at high-spatial resolution (voxels as small as 0.14 cc) and measurement times of less than 11 min. Data were acquired with short-TE PEPSI on 3T scanners equipped with large-scale head array coils (8 to 32 channels). The resolution of this method provides consistent spectral quality with narrow spectral width throughout the VOI and enables delineation of anatomical brain structures in metabolite maps. The short measurement times (as short as 7 min for 64x64x8 spatial matrix) makes this method attractive for clinical research studies.

14:00 *3353*. **Cerebrospinal Fluid Partial Volume Correction in Quantitative Short TE Magnetic Resonance Spectroscopic Imaging**

Ernesto Akio Yoshimoto Ninamango[1], Andre Van Der Kouwe[2], Fa-Hsuan Lin, [2,3], Lawrence Wald[2], Stefan Posse, [1,4]
[1]Department of Electrical and Computer Engineering, University of New Mexico, Albuquerque, NM, United States; [2]A. A. Martinos Center, Massachusetts General Hospital, Charlestown, MA, United States; [3]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan; [4]Department of Neurology, University of New Mexico, Albuquerque, NM, United States

In this study we investigate the effects of CSF fraction on absolute quantification as a function of spatial resolution for voxel sizes of 0.3, 1.2 and 4.8 cc in data acquired with short TE (15 ms) PEPSI high-speed MRSI on a 3 T scanner equipped with 32 channel head array coil. Bias in pure GM and WM concentration estimates is shown to increase with increasing CSF fraction and voxel size.

Increasing spatial resolution is advantageous for clinical studies, reducing sensitivity to partial volume correction when assessing metabolic changes in focal brain lesions and in normal appearing WM and GM.

14:30 ***3354*.** **SIVIC: An Extensible Open-Source DICOM MR Spectroscopy Software Framework and Application Suite**

Jason C. Crane[1], Marram P. Olson[1], Sarah J. Nelson[1,2]
[1]Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]Department of Bioengineering and Therapeutic Sciences, University of California, San Francisco, San Francisco, CA, United States

We present SIVIC (Spectroscopic Imaging, VIsualization and Computing), which is an open-source, cross-platform, DICOM MR spectroscopy software package. It provides an extensible framework for reading, processing, and visualizing MRS data from various non-DICOM sources, simplifying MRS workflows in multi-center environments. SIVIC's open-source algorithm interface supports sharing and evaluation of new MRS methodologies. This standards-based framework enables clinicians and researchers to leverage PACS and other standard DICOM tools for storage, communication and discovery of spectroscopic data. Plug-ins for OsiriX and Slicer were developed using SIVIC to facilitate integration and visualization of MRS data within these commonly used software packages.

15:00 ***3355*.** **Spectral Prototype Extraction for the Discrimination of Glioblastomas from Metastases in a SV 1H-MRS Brain Tumour Database**

Sandra Ortega-Martorell[1,2], Iván Olier[3], Alfredo Vellido[4], Margarida Julià-Sapé[2,5], Carles Arús[1,2]
[1]Grup d'Aplicacions Biomèdiques de la RMN (GABRMN), Departament de Bioquímica i Biologia Molecular, Universitat Autònoma de Barcelona (UAB), Cerdanyola del Vallès, Barcelona, Spain; [2]Centro de Investigación Biomédica en Red en Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN), Zaragoza, Spain; [3]Institut de Neurociències (INc), Universitat Autònoma de Barcelona (UAB), Cerdanyola del Vallès, Barcelona, Spain; [4]Departament de Llenguatges i Sistemes Informàtics (LSI), Universitat Politècnica de Catalunya (UPC), Barcelona, Spain; [5]Grup d'Aplicacions Biomèdiques de la RMN (GABRMN), Departament de Bioquímica i Biologia Molecular , Universitat Autònoma de Barcelona (UAB), Cerdanyola del Vallès, Barcelona, Spain

Spectral Prototype Extraction (SPE) is a novel feature extraction technique, offering the capability of creating spectral prototypes which correspond to known metabolites or groups of metabolites. Experimental results for discriminating glioblastomas from metastases in a SV 1H-MRS brain tumour database, for long and short echo times shows the following: 1) Most of the prototypes describing the dataset can be used as readily interpretable input features in classifiers and 2) SPE-based classification yields results that are comparable to those of PCA-based classification.

MR Spectroscopy of Cells, Body Fluids, etc.

Hall B Monday 14:00-16:00 Computer 13

14:00 ***3356*.** **NMR Investigations of Neuronal and Astroglial Metabolism in Nicotine Addiction**

Anant Bahadur Patel[1], Mohammad Shameem[1]
[1]NMR Microimaging and Spectroscopy, Centre for Cellular and Molecular Biology, Hyderabad, Andhra Pradesh, India

In this study we have used a novel approach of co-infusion of [U-$^{13}C_6$]glucose and [2-^{13}C]acetate to investigate neuronal and astroglial metabolism in nicotine addiction. C57BL6 mice were injected (s.c.) with nicotine three times a day for a month. Measurements were carried out 2 days after the last treatment by infusing [2-^{13}C]acetate and [U-$^{13}C_6$]glucose for 20 min. ^{13}C Labeling of amino acids were measured with ^{1}H-[^{13}C]- and ^{13}C-[^{1}H]-NMR spectroscopy at 14T NMR spectrometer. Nicotine treatment did not alter the cerebral metabolites levels in the different brain regions. However, glutamatergic and GABAergic rate were increased in cortex with chronic nicotine treatment.

14:30 ***3357*.** **Simultaneous Measurement of Neuronal and Astroglial Metabolism in Mouse Brain**

Anant Bahadur Patel[1], Puneet Bagga[1], K.S. Varadarajan[1], T.V. Rohith[1]
[1]NMR Microimaging and Spectroscopy, Centre for Cellular and Molecular Biology, Hyderabad, Andhra Pradesh, India

In this study we have used a novel approach of co-infusion of [U-$^{13}C_6$]glucose and [2-^{13}C]acetate in mice to study neuronal and astroglial metabolism simultaneously. ^{1}H-[^{13}C]- and ^{13}C-[^{1}H]-NMR spectroscopy were used to analyze the neurotransmitter turnover from labeled substrates in different brain regions. Half time for Glu_{C4} and $GABA_{C2}$ increased in the order; Cortex-SubCortex-Cerebellum while that of Gln_{C4} from [2-^{13}C]acetate is in the order; SubCortex-Cortex-Cerebellum. Further, the initial synthesis rate of glutamate and GABA from glucose decreased in the order: Cortex-SubCortex-Cerebellum while that of glutamine from acetate increased in the order: Cortex-SubCortex-Cerebellum.

15:00 ***3358***. **Is Alanine a Biomarker for Differentiating Single Vessel, Double Vessel and Triple Vessel Coronary Artery Disease? - An In-Vitro Proton MR Study.**

Anu Malik[1], Uma Sharma[1], R Lakshmy[2], Rajiv Narang[3], Naranamangalam R. Jagannathan[1]

[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India; [2]Department of Cardiac Biochemistry, All India Institute of Medical Sciences, New Delhi, Delhi, India; [3]Department of Cardiology, All India Institute of Medical Sciences, New Delhi, Delhi, India

We explored the possibility of biomarkers using NMR spectroscopy to differentiate among different forms of coronary artery disease (CAD) like single vessel (SVD), double vessel (DVD) and triple vessel disease (TVD). Elevated levels of LDL/VLDL, Isoleucine/Leucine /Valine, Alanine and alpha-1 glycoprotein were observed in CAD patients (n=112) compared to controls (n=30). Levels of Alanine were significantly different between the three forms of CAD indicating that the chronic bouts of myocardial ischemia may induce alterations in myocardial amino acid metabolism and measurement of myocardial exchange of Glutamate; Alanine and Lactate can be suggested as a sensitive biochemical test.

15:30 ***3359***. **Metabolic Profile of Pericardial Fluid of Congenital and Acquired Heart Disease Patients and Their Comparison with Serum Using 1H NMR Spectroscopy**

Pratima Tripathi[1], Nirmal Gupta[2], Raja Roy[1], C.L. Khetrapal[1]

[1]CBMR, Centre of Biomedical Magnetic Resonance, Lucknow, Uttar Pradesh, India; [2]Department of Cardiovascular and Thoracic Surgery, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

The study focuses on first application of 1H-NMR spectroscopy to human PCF obtained from patients undergoing open-heart surgeries, aiming at identifying metabolites under normal conditions. Total 107 patients were included of which 62 were adults and 45 pediatric patients. The differences in the concentrations of metabolites between adult and pediatric patients are discussed. PCF were also compared with the serum of these patients. Concentrations of lipid resonances were lesser in PCF as compared to serum while small molecular weight metabolites were more in PCF. This analysis may provide a baseline for better understanding of pericardial fluid physiology in diseased conditions. < >

Tuesday 13:30-15:30 Computer 13

13:30 ***3360***. **[1]H NMR Spectroscopy Analysis of Isolated Intracellular Lipid Droplets from a Human Cancer Cell Line, BE(2)M17**

Xiaoyan Pan[1], Martin Wilson[1], Carmel McConville[1], Marie-Anne Brundler[2], Theodoros Arvanitis[3], Risto Kauppinen[4], Andrew Peet[1,5]

[1]School of Cancer Sciences, University of Birmingham, Birmingham, West Midlands, United Kingdom; [2]Histology, Birmingham Children's Hospital NHS, Birmingham, West Midlands, United Kingdom; [3]School of Electronic, Electrical and Computer Engineering, University of Birmingham, Birmingham, West Midlands, United Kingdom; [4]Radiology, Dartmouth College, Dartmouth, NH, United States; [5]Oncology, Birmingham Children's Hospital NHS, Birmingham, West Midlands, United Kingdom

Lipid droplets (LDs) have been associated with several important cellular processes. Previous NMR studies of extracted lipids have been performed on whole cells, which are dominated by membrane lipids. In this study, density-gradient ultracentrifugation was used to isolate LDs from other sub-cellular structures. 1H NMR was performed on whole cells, whole cell extracts and isolated LDs. An excellent agreement was observed between the lipid resonances present in the whole cell and isolated LD spectra supporting the claim that NMR-visible lipids originate from LDs. Spectra of the isolated LDs and whole cell extracts revealed differences between the ratio of cholesteryl compounds.

14:00 ***3361***. **1H NMR Spectroscopic Studies on Human Seminal Plasma: A Probative Discriminate Function Analysis Classification Model**

ashish gupta[1], Abbas Ali Mahdi[1], Kaleem Ahmad[1], Kamla Kant Shukla[1], S P. Jaiswar[2], S N. Shankhwar[3]

[1]Department of Biochemistry, King George's Medical University, Lucknow, UP, India; [2]Department of Obstetric & Gynecology, King George's Medical University, Lucknow, UP, India; [3]Department of Urology, King George's Medical University, Lucknow, UP, India

Quantitative analysis of seminal plasma (n=175) profile was carried out using 1H NMR spectroscopy and clinical symptoms were also observed in same samples with standard laboratory method. Multivariate discriminant function analysis (DFA) was carried out for the NMR observed metabolites and clinical symptoms data of the infertile and control cases, to find out important signature descriptors for classification. A new "INFERTIX" classification model was developed and proposed which is based on the results obtained from DFA for the different classes of infertile patients, with very high sensitivity and specificity values.

14:30 ***3362*. NMR Plasma Profiling of Newborns with Low Weight at Birth**

Jose Manuel Morales[1], Carmen Ivorra[2], Javier Chaves[3], Consuelo Garcia-Vicent[2], Maria Isabel Torro[2], Jose Redon[4], Empar Lurbe[2], Daniel Monleon[3]
[1]Universitat de Valencia, Valencia, Spain; [2]Hospital General Universitario de Valencia, Valencia, Spain; [3]Fundacion Investigacion Hospital Clinico Valencia, Valencia, Spain; [4]Hospital Clinico Universitario de Valencia, Valencia, Spain

Blood pressure is significantly lower in those children with low birth at weight as compared to those in the other groups. In this communication we present a study of blood plasma NMR spectra for detecting the metabolic differences between low and normal weighted newborns. NMR spectra were obtained for plasma from 51 newborns, of which 20 exhibit weight at birth below 2800 g. Metabolic profiling of newborn blood plasma reveals statistically significant differences between low and normal weighted subjects including phenylalanine, citrulline, glutamine, glycerol and glucose. Interestingly, some of these metabolites are present in breast milk.

15:00 ***3363*. Simultaneous Quantification of Glycine- And Taurine-Conjugated Bile Acids, Total Bile Acids and Phospholipids in Human Bile by Using ^{1}H MRS**

Omkar B. Ijare[1], Tedros Bezabeh[1], Nils Albiin[2], Annika Bergquist[2], Urban Arnelo[2], Bo Lindberg[2], Ian C.P. Smith[1]
[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]Karolinska University Hospital, Karolinska Institutet, Huddinge, Stockholm, Sweden

Bile acids, phospholipids and cholesterol are major lipid components in bile. We propose a robust method for the simultaneous quantification of glycine-conjugated bile acids (GCBAs), taurine-conjugated bile acids (TCBAs), total bile acids (TBAs) and phospholipids (PLs). GCBAs and TCBAs have been quantified using peak areas of their characteristic methylene signals resonating at 3.73 and 3.07 ppm, whereas TBA and PLs were quantified using their methyl and trimethylammonium signals resonating at 0.65 and 3.22 ppm respectively. The peak areas of these lipid signals were obtained simultaneously by deconvolution, making the method robust. This method could be extended to *in vivo* applications.

Wednesday 13:30-15:30 Computer 13

13:30 ***3364*. NMR Spectroscopy Based Evaluation of Urine for Identification of Changes in Functional Metabolites on Exposure to Thallium-201 in Mice**

Ritu Tyagi[1], Poonam Rana[1], Priyanka Saxsena[2], M Memita Devi[1], Sonia Gandhi[1], Sunil Pal[3], Subash Khushu[1]
[1]NMR Research Centre, INMAS, Delhi, India; [2]Department of Nuclear Medicine, INMAS, Delhi, India; [3]Division and Cyclotron & Radiopharmaceutical Sciences, INMAS, Delhi, India

Thallium-201 (Tl-201) is routinely used in nuclear medicine scans. Physiologically, it acts as a potassium analog and gets accumulated in the cells leading to some alterations at metabolite levels. Present study was proposed to look upon the changes at metabolite levels in urine samples obtained from Tl-201 treated mice. Urine samples were collected from mice at 3 and 24 hrs post injection of Tl-201.The 1H NMR spectral analysis of urine presented many altered metabolites suggesting a change in energy, amino acid metabolism and gut flora. However, changes observed after Tl-201 injection are functional reversible physiological changes.

14:00 ***3365*. Identifying Constituent Tumor Tissue Subclasses in HR-MAS Spectra Using Advanced Blind Source Separation Techniques**

Anca Ramona Croitor Sava[1], Diana Maria Sima[1], Bernardo Celda[2,3], Sabine Van Huffel[1]
[1]ESAT-SCD-Biomed, Katholieke Universiteit Leuven, Heeverle, Leuven, Belgium; [2]Departamento de Química-Física, Facultad de Química, Universitat de Valencia, Valencia, Spain; [3]CIBER-BBN, ISC-III, Universitat de Valencia, Valencia, Spain

Glial tumors have proved to be very heterogeneous, both in the malignancy grade and in the tumor tissue type. We analyze the mixture of different tumor tissue types (necrotic, high cellular and border tumor tissue) within HR-MAS spectra by separating between the different sources that contribute to the profile of each spectrum. Non-negative matrix factorization and independent component analysis are used to extract the constituent source profiles and their abundance distributions within all samples. Thus each feature vector is represented as a linear combination of profiles corresponding to constituent tissue types.

14:30 ***3366*. NMR Based Metabonomic Approach to Understanding Metabolic Regulatory Variation Due to Acute Cold Stress**

Sonia Gandhi[1], Memita Devi[1], Shubhra Chaturvedi[2], Subash Khushu[1]
[1]NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences, Delhi, India; [2]Division and Cyclotron & Radiopharmaceutical Sciences, Institute of Nuclear Medicine and Allied Sciences, Delhi, India

Cold stress is responsible for affecting multiple biochemical regulatory systems & triggering cardiovascular & respiratory disorders, cognitive impairment, anxiety. Present study investigates the changes in metabolic profiles of urine in rats due to acute cold stress using NMR & multivariate statistical analysis (PCA). Results indicate up regulation of TCA cycle decreasing pyruvate, citrate, 2-oxoglutrate, succinate & fumarate concentration. Creatinine & Hippurate levels were reduced altering gut microbiota. Decreased aromatic amino acids & TMAO also supports kidney dysfunction. Noninvasive monitoring of various biochemical pathways can be done & these results can be used to develop strategies to sustain cold stress.

15:00 *3367*. **NMR Spectroscopy of Urine for the Detection of Urinary Tract Infection (UTI) in Children**

Tedros Bezabeh[1], Omkar B. Ijare[1], Martin Reed[2], Tom Blydt-Hansen[2], Ian C.P. Smith[1]
[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]University of Manitoba Children's Hospital, Canada

Urinary tract infection (UTI) is the most common non-epidemic bacterial infection in adults and children. Due to the longer diagnostic wait time required for the gold standard – the culture method, dipstick methods are commonly used for the quick diagnosis of UTI. However, dipstick methods are commonly associated with false negative and/or false positive results. Therefore, other more rapid methods are desirable. ^{1}H NMR based metabolic profiling of urine samples could be valuable in this regard. Elevated levels of trimethylamine-N-oxide, creatine, and an unassigned signal at 3.71 ppm have been observed in the urine samples with UTI compared to the control group.

Thursday 13:30-15:30 Computer 13

13:30 *3368*. **Toxicological Effect of Thallium in Mice by NMR-Based Metabolic Profiling of Urine**

Ritu Tyagi[1], Poonam Rana[1], Ahmad Raza Khan[1], M Memita Devi[1], Shubhra Chaturvedi[2], Subash Khushu[1]
[1]NMR Research Centre, INMAS, Delhi, India; [2]Division and Cyclotron & Radiopharmaceutical Sciences, INMAS, Delhi, India

Thallium is a heavy metal that gets accumulated in liver and kidney after absorption and causes renal and hepatotoxicity. NMR spectroscopy based study has been conducted for identification of metabolite markers for thallium toxicity. Urine samples were collected from mice at 3, 24 and 96 hrs post injection of low and high dose of Tl2SO4. Spectral analysis showed dose dependent alterations in various metabolites involved in renal and hepatic toxicity and could be seen as early as 3 hrs post injection and may be further helpful in devising the protocol for decorporation of such harmful elements.

14:00 *3369*. **Urinary Metabolic Profiling in Rats Using 1H High Resolution NMR Spectroscopy to Study Metabolic Alterations Due to Heat Stress Exposure**

Sonia Gandhi[1], Poonam Rana[1], Memita Devi[1], Sunil Pal[2], Subash Khushu[1]
[1]NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences, Delhi, India; [2]Division and Cyclotron & Radiopharmaceutical Sciences, Institute of Nuclear Medicine and Allied Sciences, Delhi, India

Heat stress exposure can affect physiological & cognitive performance in humans, alter neurotransmitters & hormone level, causes hypohydration affecting cognitive performance. Present study reveals the changes in metabolite pattern & identifies potential biomarkers in rat urine due to heat stress exposure by NMR & multivariate statistical analysis. Phenylalanine, creatinine, hippurate, pyruvate & citrate concentration was reduced indicating onset of thermoregulatory response, altered renal function & enhanced energy consumption. Increased formate indicates disturbed gut flora. These studies reveal the subtle interplay of functional metabolites & pathways leading to an understanding of the systemic response to external stimuli such as heat stress.

14:30 *3370*. **NMR Spectroscopy Based Study of Physiological Perturbations During Recurrence of Symptoms in Radiation Sickness**

Poonam Rana[1], Ahmad Raza Khan[1], M Memita Devi[1], Sunil Pal[2], Subash Khushu[1]
[1]NMR Research Centre, INMAS, Delhi, India; [2]Division and Cyclotron & Radiopharmaceutical Sciences, INMAS, Delhi, India

Regular monitoring of irradiated patient is essential for clinical management during illness phase of radiation sickness. The present study has been designed to explore metabolic perturbation in mice urine after three weeks of irradiation. The results based on urine NMR spectra analysis exhibited an altered energy, amino acid and gut microflora metabolism which could indicate renal and liver dysfunction. These changes could be the consequence of radiation induced damage to physiological systems during recurrence of clinical symptoms after recovery period. The information attained from the study along with biochemical assays could be very useful in assessing the organ dysfunction during radiation sickness.

15:00 *3371*. **Compressed Sensing for Sparse Magnetic Resonance Spectroscopy**

Xiaobo Qu[1], Xue Cao[2], Di Guo[3], Zhong Chen[4]
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Multidimensional magnetic resonance spectroscopy (MRS) can provide additional information at the expense of longer acquisition time than 1D MRS. Assuming 2D MRS is sparse in wavelet domain, Iddo[1] first introduced compressed sensing (CS) [2][3] to reconstruct multidimensional MRS from partial and random free induction decay (FID) data. However, the darkness in 1D NMR spectra derives from the discrete nature of chemical groups [4]. Significant peaks in these MRS takes up partial location of the full MRS while the rest locations own very small or even no peaks. This type of MRS can be considered to be sparse itself, named sparse MRS. In the concept of sparsity and coherence for CS[5], we will demonstrate that wavelet is not necessary to sparsify sparse MRS and even makes the reconstructed MRS worse than without wavelet. Furthermore, a lp quasi-norm compressed sensing reconstruction is employed to improve the quality of reconstruction.

Spectroscopic Localization & Imaging Methodology

Hall B Monday 14:00-16:00 Computer 14

14:00 *3372*. **In Vivo 31P-MRS at 7T by Single Voxel E-ISIS with GOIA Selection Pulses**

Wolfgang Bogner[1], Marek Chmelik[1], Ovidiu Cristian Andronesi[2], Stephan Gruber[1], Siegfried Trattnig[1]
[1]MR Center of Excellence, Radiology, Medical University, Vienna, Austria; [2]Martinos Center for Biomedical Imaging, Radiology, Massachusetts General Hospital, Havard Medical School, Charlestown, MA, United States

An image-selected in vivo spectroscopy (ISIS) sequence was developed for acquisition of localized 31P-MRS at 7T in vivo. For accurate localization (negligible contamination and chemical shift error) even with B1 inhomogeneous surface coils gradient offset independent adiabatic (GOIA) inversion pulses with high bandwidth were used. To allow short TR without increases in contamination due to “T1 smearing” an E-ISIS acquisition scheme was combined with adiabatic BIR-4 excitation. This allows localized 31P-MRS in clinically feasible measurement time (~3-4 min) and good spatial resolution (~2-2.5 cm isotropic) with high reproducibility.

14:30 *3373*. **Faster T_1 Relaxation Times Allow Additional SNR-Per-Unit-Time Optimization in ^{31}P MRSI at 7T**

Marek Chmelík[1,2], Wolfgang Bogner, [2,3], Stephan Gruber, [2,3], Siegfried Trattnig, [2,3], Martin Krššák, [2,3]
[1]Department of Radiology, Medical University of Vienna, Vienna, Austria; [2]MR Centre of Excellence, Medical University of Vienna, Vienna, Austria; [3]Department of Radiology, Medical University of Vienna, Vienna, Austria

It has been shown that in vivo muscle ^{31}P T_1 relaxation times decrease at higher magnetic field (7T) due to higher contribution of chemical shift anisotropy. The purpose of this study was to compare and optimize SNR-per-unit-time of ^{31}P 3D MRSI in the human calf at 3T and 7T. Phantom experiments with comparable T_1 times showed 94% increase of SNR-per-unit-time whereas in vivo muscle SNR-per-unit time was increased by 140%, partly due to shorter T_1 relaxation. Both higher magnetic field and shorter T_1 relaxation time contribute to improvement of ^{31}P MRSI SNR-per-unit-time at 7T.

15:00 *3374*. **Outer Volume Suppression (OVS) for Single Voxel Spectroscopy (SVS) at 7 Tesla Using Interleaved B1 Shim Settings**

Irina Brote[1,2], Stephan Orzada[1,2], Andreas K. Bitz[1,2], Tom Scheenen[1,3], Oliver Kraff[1,2], Stefan Maderwald[1,2], Mark E. Ladd[1,2]
[1]Erwin L. Hahn Institute for MRI, Essen, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Germany; [3]Department of Radiology, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands

High-field magnetic resonance spectroscopy (MRS) should provide enhanced neurochemical information based on increased sensitivity and higher spectral resolution. Problems arising in high-field MRI, such as B0 and B1 inhomogeneities, may however decrease spectral resolution and SNR. Multi-channel transmit systems have been introduced to overcome problems concerning B1 inhomogeneity. One multi-channel transmit method is RF shimming. In this study, this method is used for outer volume supression (OVS) at 7T in single voxel spectroscopy (SVS) using two interleaved RF shim settings. A suppression of the outer volume signals of more than 90% is achieved.

15:30 *3375*. **31P Magnetic Resonance Spectroscopy and Imaging at 7T and Signal Dependence on Brain Tissue Types**

Manoj K. Sammi[1], Yosef Berlow[1,2], Thomas Barbara[1], John Grinstead[1,3], Dennis Bourdette[4], William D. Rooney[1,2]
[1]Advanced Imaging Research Center, Oregon Health & Science University, Portland, OR, United States; [2]Department of Behavioral Neuroscience, Oregon Health & Science University; [3]Siemens Medical Solutions; [4]Department of Neurology, Oregon Health & Science University

Methodology development for quantitative phosphorous MRSI in human brain at 7T

Tuesday 13:30-15:30 Computer 14

13:30 *3376*. **Tract-Based Spectroscopy of the Cingulum at 7 Tesla**

René Mandl[1], Martijn van den Heuvel[1], Dennis Klomp[2], Vincent Boer[2], Jeroen Siero[3], Peter Luijten[2], Hilleke Hulshoff Pol[1]
[1]Psychiatry, Rudolf Magnus Institute of neuroscience, UMC Utrecht, Utrecht, Netherlands; [2]Radiology, UMC Utrecht, Utrecht, Netherlands; [3]Neurosurgery, Rudolf Magnus Institute of neuroscience, UMC Utrecht, Utrecht, Netherlands

Usage of fiber tracking for positioning and analyzing high spatial resolution 2D Chemical Shift Images of the cingulum at 7 Tesla.

14:00 *3377*. **Optimized Spectroscopic RARE at 7 Tesla Applied to Rat Brain in Vivo**

Wolfgang Dreher[1], *Dieter Leibfritz*[1]
[1]Dept. Chemistry, University of Bremen, Bremen, Germany

The fast spectroscopic imaging method spectroscopic RARE was implemented on a 7-Tesla animal scanner and applied to rat brain in vivo. It is shown that various experimental problems occurring at higher B_0 can be eliminated and, compared to earlier results at 4.7 T, the potential of a higher signal-to-noise ratio and increased spectral resolution can be exploited. As increased spectral resolution requires a larger number of k_Ω -encoding steps and thus a longer minimum total measurement time, the use of phase corrected spectra calculated from asymmetric k_Ω -sampling is considered as an alternative to magnitude spectra calculated from symmetrically sampled k_Ω -data.

14:30 *3378*. **Short-Echo, Single-Shot, Full-Intensity ^{1}H MRS of the Human Brain at 4T**

Gulin Oz[1], *Ivan Tkac*[1]
[1]University of Minnesota, Minneapolis, MN, United States

Short echo times are advantageous for ^{1}H MR spectroscopy because they facilitate quantification of metabolites with coupled spin systems and minimize signal loss due to T_2 relaxation. A semi-adiabatic LASER sequence with short TE was developed and optimized for full intensity ^{1}H MRS at 4T. Neurochemical profiles of the cerebellum and brainstem were measured in 23 healthy subjects using semi-LASER and STEAM pulse sequences. Neurochemical profiles acquired by these two techniques were nearly identical. A high correlation between metabolite concentrations quantified by these two techniques indicated the sensitivity to detect inter-subject variation in metabolite levels.

15:00 *3379*. **Towards a Localized Low Power Adiabatic 2D TOCSY for In-Vivo Use on Clinical Platforms**

Ovidiu Cristian Andronesi[1], *Saadallah Ramadan*[2], *Carolyn E. Mountford*[2], *A Gregory Sorensen*[1]
[1]Martinos Center for Biomedical Imaging, Radiology Department, Masschusetts General Hospital, Harvard Medical School, Boston, MA, United States; [2]Center for clinical spectroscopy, Department of Radiology, Brigham and Women's Hospital, Harvard Medical Schoo, Boston, MA, United States

Two-dimensional spectroscopy is important for unambiguous assignment of overlapping metabolites and could be more efficient than 1D spectral-editing. 2D TOCSY (TOtal-Correlation-SpectroscopY) is one of the most powerful experiments that reveals the full spin connectivity, but demands for a sustained spin-lock can prevent in-vivo applications. 1D spectral-edited TOCSY was demonstrated recently, although an in-vivo 2D TOCSY has not been realized yet. We propose a modified 2D version of the localized TOCSY, including a z filter and the use of gradient offset independent adiabaticity (GOIA) pulses to reduce SAR. Simulations and phantom measurements on a 3T Siemens MR clinical scanner are presented.

Wednesday 13:30-15:30 Computer 14

13:30 *3380*. **Reproducibility of ME-COSI in Human Brain and Phantom**

Gaurav Verma[1], *Scott Logan Lipnick*[2], *Nagarajan Rajakumar*[3], *Saad Ramadan*[4], *Michael Albert Thomas*[3]
[1]Biomedical Engineering, UCLA, Los Angeles, CA, United States; [2]Biomedical Physics, UCLA, Los Angeles, CA, United States; [3]Radiological Sciences, UCLA, Los Angeles, CA, United States; [4]Radiology, Brigham & Women's Hospital, Cambridge, MA, United States

The previously-introduced ME-COSI sequence acquires 2D spectra over a 2D spatial array. ME-COSI reproducibility was investigated in human brain with four volunteers and eight total scans, and in a physiological gray matter phantom with thirty-two scans. Data were post-processed and peak integral/volumes compared to creatine were quantified. Measured coefficients of variation across all scans ranged from 4-17% for single subject in vivo, 7-26% for multiple subjects and 6-25% for in vitro studies, at half the voxel volume. This is comparable to the performance reported from existing single-voxel 2D MRS methods.

14:00 *3381*. **Analysis of Slice Based Versus Volume Based Localization Techniques for Echo-Planar Correlated Spectroscopic Imaging (EP-COSI).**

Scott Lipnick[1], *Gaurav Verma*[1], *M. Albert Thomas*[1]
[1]UCLA, Los Angeles, CA, United States

The presented research details the differences between slice localized and volume localized EP-COSI data sets. Slice localization enables shorter echo times and thus signal acquisition with less T2 losses. The result is increased SNR in the resulting EP-COSI data set. The drawback is more leakage from outer volume signal. When outer volume suppression is achievable more SNR is achievable using slice localization, when it is not the ideal localization scheme is volume based. Both sequences are capable of differentiating J-coupled off diagonal resonances.

14:30 *3382*. **Whole Brain Proton MRSI Using a Multiple 2D Sequence**

Zhengchao Dong[1,2], *Feng Liu*[1,2], *Alayar Kangarlu*[1,2], *Bradley Peterson*[1,2]
[1]Columbia University, NEW YORK, United States; [2]NEW YORK STATE PSYCHIATRIC INSTITUTE, NEW YORK, United States

In this work, we present an extension of a widely used multi-planar MRSI sequence, which has limited brain coverage and spacing between slices. We show that by adjusting sequence parameters we can increase the number of slices without significant increase of total scan time and remove the spacing between slices without significant lose of signal-to-noise ratio. With these approaches, whole brain proton MRSI can be realized. We demonstrated the results with experimental data both on phantom and on human volunteers.

15:00 ***3383*. Compensation of Offresonance Magnetization Transfer Artifact in SPECIAL at 7T**

Alexander Fuchs[1], Anke Henning[1], David Brunner[1], Peter Boesiger[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

The SPECIAL sequence is a 2 step ISIS like localization scheme that allows to measure 3D SV spectra at very short echo times. This is especially interesting for spectroscopy at ultra-high fields were metabolite relaxation complicates the detection of certain metabolites. It is demonstrated in this work that in SPECIAL without outer volume suppression the ISIS inversion pulse induces magnetization transfer effects between bound protons and skull lipids. This can lead to strong outer volume fat contamination of the actual spectrum. Furthermore a modification to the SPECIAL sequence is proposed to overcome these types of artifacts.

Thursday 13:30-15:30 Computer 14

13:30 ***3384*. Double-Shot Center-Out Echo Planar Spectroscopic Imaging at 3 Tesla**

Christian Labadie[1,2], Stefan Hetzer[1], Toralf Mildner[1], Diana R. Amariei[3], Monique Frécon[4], Harald E. Möller[1,2]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; [2]Faculty of Physics and Earth Science, University of Leipzig, Germany; [3]Servei de Ressonància Magnética Nuclear, Universitat Autònoma de Barcelona, Spain; [4]Laboratoire de Spectrométrie Ionique et Moléculaire, Université Claude Bernard Lyon 1, France

A novel MRSI sequence, based on a double-shot echo planar spectroscopic readout, offers a full k-space sampling despite the limitation imposed by the spectral dwell-time of proton spectroscopy at 3 Tesla. In 61 sec, a spectroscopic image was acquired with a 12 x 12 matrix, TE of 33 ms, voxels of 4.91 mL and 16 steps EXOR phase cycling. The quantitation of the voxel spectra significantly determined NAA, creatine, choline and myo-inositol. A longer acquisition of 3 min 44 sec further permits to detect glutamine and glutamate.

14:00 ***3385*. Improved Water and Lipid Suppression in Volumetric Brain 3D-EPSI**

Juan Wei[1], He Zhu[1], Ronald Ouwerkerk[1], Peter B. Barker[1]
[1]Russell H Morgan Department of Radiology, The Johns Hopkins University, Baltimore, MD, United States

3D echo planar spectroscopic imaging (EPSI) was implemented with a new dualband water and lipid suppression with integrated outer volume suppression. Compared to conventional CHESS and inversion recovery lipid suppression, water suppression with the dualband sequence was a factor of 2.65 better, while lipid suppression was 8.61 better. Metabolic images recreated with the dualband acqusition showed markedly reduced lipid contamination artifacts compared to conventional methods.

14:30 ***3386*. Scan Time Reduction in 3D-EPSI Using Reduced Phase-Encoding**

Juan Wei[1], Peter B. Barker[1]
[1]Russell H Morgan Department of Radiology, The Johns Hopkins University, Baltimore, MD, United States

A simple technique is described for scan time reduction in proton echo planar spectroscopic imaging (EPSI) of the human brain. Scan time is reduced by 25% while preserving spatial resolution and the field of view using a circular k-space phase-encoding pattern. Metabolic images created using square or circular-encoding are nearly indistinguishable.

15:00 ***3387*. Analysis of Slice Based Versus Volume Based Localization Techniques for Echo-Planar Spectroscopic Imaging (EPSI)**

Scott Lipnick[1], Gaurav Verma, M. Albert Thomas
[1]UCLA, Los Angeles, CA, United States

The presented research details the differences between slice localized and volume localized EPSI data sets. Slice localization enables shorter echo times and thus signal acquisition with less T2 losses. The results show increased SNR in the acquired EPSI data set. The drawback is more leakage or contamination from outer volume signal, namely skull marrow lipids in brain. When outer volume suppression is achievable more SNR can be obtained using slice localization compared to volume localization.

Non-Proton MRI

Hall B Monday 14:00-16:00 Computer 15

14:00 ***3388*. Fluid-Suppressed ^{23}Na MRI of Knee Joint at 7T**

Jae-Seung Lee[1], Souheil Inati[2], Ravinder Regatte[3], Alexej Jerschow[1]
[1]Chemistry Department, New York University, New York, United States; [2]Center for Brain Imaging, New York University, New York, United States; [3]Center for Biomedical Imaging, New York University, New York, United States

We demonstrate excellent fluid suppression in ^{23}Na MRI at 7T by using inversion-recovery and quadrupolar contrast techniques. These methods will greatly improve quantification of tissue sodium concentrations, which in turn will help in providing diagnostic techniques for cartilage tissues.

14:30 ***3389***. **Lung Imaging in Humans at 3T Using Perfluorinated Gases as MR Contrast Agents**

Brian J. Soher[1], Maureen Ainslie, James MacFall, Ralph Hashoian[2], H. Cecil Charles[1]
[1]Radiology, Duke University Medical Center, Durham, NC, United States; [2]Clinical MR Solutions

We demonstrate the first images showing human lung ventilation using conventional 'thermally' polarized perfluorinated gases (PFx) mixed with oxygen as an inhaled inert MRI contrast agents. Lung airway disease clinical trials often require large numbers of subjects due to the limitations of global assessments or the presence of ionizing radiation in clinical imaging methodologies. Our results demonstrate the feasibility of using PFx to image regional ventilation characteristics throughout the lungs at a resolution and SNR (0.78 cm3 and 15:1 non-optimized) comparable to other imaging methodologies at less cost and with a straightforward path for repeat and cine-style dynamic data acquisitions.

15:00 ***3390***. **Evaluation of Artificial Blood Substitutes by Quantitatively Measuring Multi-Organ Oxygen Using ^{19}F MRI in a Rat Model**

Siyuan Liu[1,2], Sameer J. Shah[2], Lisa J. Wilmes[1], Vikram D. Kodibagkar[3], Michael F. Wendland[1], Christian C. Apfel[2], Nola M. Hylton[1], Harriet W. Hopf[4], Ralph P. Mason[3], Mark D. Rollins[2]
[1]Radiology, University of California, San Francisco, San Francisco, CA, United States; [2]Anesthesia, University of California, San Francisco, San Francisco, CA, United States; [3]Radiology, University of Texas at Southwestern, Dallas, TX, United States; [4]Anesthesiology, University of Utah, Salt Lake City, UT, United States

Hemoglobin based oxygen carriers (HBOCs) are being developed to reduce blood transfusion, yet HBOCs' efficacy on organ oxygenation remain unknown. We used ^{19}F MRI to quantify tissue oxygen (ptO_2) changes during isovolemic anemic hemodilution using high and low affinity HBOCs or colloid control at 30% and 100% inspired oxygen in a rat model. Although ptO_2 significantly increased with 100% vs 30% oxygen under all conditions, differences in ptO_2 between HBOCs or colloid were insignificant. Our results highlight the impact of supplemental oxygen, emphasize need for further HBOC research, and demonstrate the value of ^{19}F MRI in quantifying resuscitation interventions.

15:30 ***3391***. **Optimal Contrast for ^{23}Na MRI**

Jae-Seung Lee[1,2], Ravinder Regatte[2], Alexej Jerschow[3]
[1]New York University, New York, NY, United States; [2]Department of Radiology, New York University School of Medicine, New York, United States; [3]Chemistry Department, New York University, New York, United States

The sodium ions bound to tissues and organs can provide us with an invaluable information on the onset of disorder, such as osteoarthristis and degenerative disc diseases, through their concentration and quadrupolar interaction/relaxation. Slow motion of sodium ions may occur in cells, and its altered relaxation properties further provide important insights into cell viability, such as in the case of tumor tissue, or in the monitoring of muscle activity. In this paper, we are presenting two ^{23}Na MRI contrast schemes, one selecting sodium ions with quadrupolar interation and the other with quadrupolar relaxation.

Perfusion & Permeability Methodology

Hall B Monday 14:00-16:00 Computer 16

14:00 ***3392***. **Parameter Influence in Dynamic-Contrast-Enhanced MRI Analyses**

Xin Li[1], William D. Rooney[1], Charles S. Springer, Jr. [1]
[1]Advanced Imaging Research Center, Oregon Health & Science University, Portland, OR, United States

Simulations based on Gradient Recalled Echo (GRE) data acquisition and a three site water exchange model for pharmacokinetic interpretation are used to investigate parameter influence in DCE-MRI analyses. It is shown that the speed of contrast reagent (CR) extravasation plays the most important role in determining the nature and degree of parameter influence, while the MRI pulse sequence parameter values also have an effect.

14:30 ***3393***. **Quantitative Estimates of Tissue Perfusion Using Simple Initial Upslope Measures in DCE-CT and DCE-MRI**

Iosif Alexandru Mendichovszky[1], Habib Ashoor[2], David L. Buckley[3], Alan Jackson[1]
[1]Wolfson Molecular Imaging Centre, The University of Manchester, Manchester, United Kingdom; [2]Physics Department, University of Bahrain, Bahrain; [3]University of Leeds, Leeds, United Kingdom

The aims of the study were (1) to investigate the validity of perfusion measurements for normal and pathological tissues using the upslope method (USM) in dynamic CT and MR from computer simulations in non-leaky and leaky capillaries and (2) to explore the effects of SNR and injection rate on the accuracy of perfusion estimates. The USM can be used to calculate perfusion in normal and pathological tissues and is most accurate in tissues with relatively long transit times. Its accuracy can be improved with the use of a rapid injection (sharp AIF) and is decreased by image noise.

15:00 ***3394***. **Phase-Based Contrast Agent Concentration Measurement for Determination of Mouse Arterial Input Function**

Ruobing Yang[1], Andrew C. Yung[1], Piotr Kozlowski[1]
[1]UBC MRI Research Centre, Vancouver, British Columbia, Canada

Dynamic Contrast Enhanced MRI and pharmacokinetic modeling have shown promise for imaging tumours based on tissue vascularity. The current standard for measuring contrast agent concentration (T1 mapping) is prone to errors such as flip angle uncertainty and inter/intracellular water flow effects. We propose an alternative method for obtaining the AIF in the mouse by performing phase measurements in the artery of the mouse tail. We present experimental results, from a tail phantom, that demonstrate the feasibility of this technique.

15:30 ***3395***. **Impact of B1-Inhomogeneities on the Quantification of Ktrans and Ve**

Robert Merwa[1], Thorsten Feiweier[2], Franz Ebner[3], Gernot Reishofer[3], Karin Kapp[4], Rudolf Stollberger[5]
[1]Medical Engineering, FH OÖ - Upper Austria University of Applied Sciences, Linz, Austria; [2]Healthcare, Siemens AG, Germany; [3]Department of Radiology, Medical University of Graz, Graz, Austria; [4]Department of Radiation Therapy, Medical University of Graz, Graz, Austria; [5]Institute of Medical Engineering, Graz University of Technology, Graz, Austria

The determination of kinetic parameters depends strongly on the inhomogenities of the RF-field. Due to the local magnitude of these inhomogenities the values for the AIF and tissue concentrations are widespread which lead to an overestimation or underestimation of K^{trans} and V_e. An essential improvement can be achieved if the dynamic data are corrected accordingly. The absolute difference of K^{trans} and V_e obtained with the AIF in two comparable arteries can be improved by a factor up to 33 when using the correction procedure. Also the statistical evaluation of the data shows an improvement if B_1 inhomogeneities are corrected.

Microscopy

Hall B Monday 14:00-16:00 Computer 17

14:00 ***3396***. **Volume Microstrip RF Coil for MRI Microscopy**

Krzysztof Jasinski[1], Peter Latta[2], Vyacheslav Volotovskyy[2], Anna Mlynarczyk[1], Wladyslaw P. Weglarz[1], Boguslaw Tomanek, [12]
[1]Institute of Nuclear Physics PAN, Kraków, Poland; [2]Institute for Biodiagnostics, National Research Council of Canada, Winnipeg, Canada

A microstrip is made of a metallic strip on PCB surface creating a planar RF transmission line. The RF coils based on microstrip design, have been already applied to MRI and MRS. These coils produce homogenous RF field only within a very restricted field of view (FOV). The coil presented in this paper is based on a double microstip concept resembling a volume coil and generating homogenous RF field within a large FOV. Computer simulations of RF field and SNR are presented. An example of the application of the double microstrip volume microcoil to MR microscopy is also shown

14:30 ***3397***. **High-Resolution DTI of Human Articular Cartilage with Long Diffusion Time: Preliminary Findings**

Xu Feng[1], Carol Muehleman[2], Richard Magin[1]
[1]Bioengineering, University of Illinois at Chicago, Chicago, IL, United States; [2]Biochemistry, Rush Medical College, Chicago, IL, United States

Recent publications have shown FA can reflect the orientation of the collagen fibers using DTI in MRI. However, the FA contrasts were low especially between the superficial and middle zone in those literatures. This was possibly because they selected the short diffusion time ($\delta < 10$ ms). In our study, we increase the diffusion time from 10 ms to 30 ms so that the FA contrast increased by 4 times. We also suggest using the maximum diffusivity as a marker of hydration or PG loss of cartilage due to the less effect of the restricted diffusion.

15:00 ***3398***. **Influence of Flow-Induced Mechanical Forces on Thrombolysis Studied by MR and Optical Microscopy**

Jernej Vidmar[1], Franci Bajd[2], Aleš Blinc[3], Dušan Šuput[4], Andrej Vovk[4], Igor Serša[2]
[1]Institute of Physiology, Ljubljana, Slovenia; [2]Jožef Stefan Institute, Ljubljana, Slovenia; [3]University Medical Centere Ljubljana, Slovenia; [4]Institute of Pathophysiology, Ljubljana, Slovenia

Thrombolysis of model blood clots in an artificial perfusion system was studied by MR and optical microscopy. Results of the study showed that thrombolysis is strongly flow dependent process in which biochemical clot dissolution is complemented by flow induced mechanical clot degradation manifested by dislodgement of cell agglomerates from the recanalization channel.

15:30 ***3399***. **Fiber Diameter Mapping of a White Matter Phantom Using D-PFG Filtered MRI**

Michal E. Komlosh[1], Evren Ozarslan[1], Martin J. Lizak[2], Ferenc Horkay[1], Peter J. Basser[1]
[1]NICHD, NIH, Bethesda, MD, United States; [2]NINDS, NIH, Bethesda, MD, United States

Double pulsed field gradient spin echo (d-PFG) MRI was used to measure pore diameters in glass microcapillary arrays. Simulations, taking into account all experimental and sample parameters were used to estimate the pore diameter, which agrees very well with optical microscopy measurements. Pore distribution images suggests a potential for using this new contrast mechanism and our modeling framework to map a useful feature of local material microstructure.

Methodology for MR Elastography

Hall B Monday 14:00-16:00 Computer 18

14:00 ***3400*. Non-Invasive Measurement of Vitreous Humor Stiffness in the Mouse Using MR Elastography**

Erik Holt Clayton[1], Qing Wang[1], Sheng Kwei Song[2], Philip V. Bayly[1,3]
[1]Mechanical Aerospace & Structural Engineering, Washington University in St. Louis, Saint Louis, MO, United States; [2]Radiology/Radiological Sciences, Washington University in St. Louis, Saint Louis, MO, United States; [3]Biomedical Engineering, Washington University in St. Louis, Saint Louis, MO, United States

MR elastography (MRE) shows great promise for estimating the stiffness of various biological tissues. In this study, the shear modulus of the mouse eye vitreous humor was determined with MRE. A novel corneal actuation system was devised to non-invasively impart propagating shear waves into the vitreous. Spatial-temporal images of the corresponding wave field were acquired at 4.7T using a custom spin echo pulse sequence. Viscoelastic material parameters were extracted from the displacement field by a least-squares inversion method. Results show that MRE of the mouse vitreous is feasible, and suggest that MRE may be applicable to diagnosis of ocular disease.

14:30 ***3401*. Development of a Method for Imaging Tissue Elasticity Using Tagged Magnetic Resonance Imaging**

Ryosuke Nasada[1], Tomoki Takeuchi[1], Junfeng Zhang[1], Takashi Tokuno[2], Mitsunori Tada[3], Youichi Yamazaki[1], Kenya Murase[1]
[1]Department of Medical Physics and Engineering, Graduate School of Medicine, Osaka University , Suita, Osaka, Japan; [2]Course of Precision Engineering, School of Science and Engineering, Chuo University, Tokyo, Japan; [3]Digital Human Research Center, National Institute of Advanced Industrial Science and Technology, Tokyo, Japan

This study was undertaken to develop a method for generating the maps of Young fs elastic modulus using tagged MRI. The maps were generated using the strain obtained by harmonic phase analysis and stress distribution. The accuracy of our method was investigated using silicone phantoms of different hardness. There was a good correlation between the strain obtained by our method and that measured using a material testing machine (r=0.99). The difference in hardness in phantoms was clearly demonstrated. Our method will be useful for evaluating the tissue elasticity, because it allows us to automatically generate the maps of elastic modulus.

15:00 ***3402*. Is a Velocity Encoding of 5 Cm/sec Sufficient to Quantify Brain Motion?**

Guillaume Calmon[1,2], Marc Labrousse, [1,3], Gabriela Hossu[4], Jacques Felblinger[1,4], Marc Braun[1,5]
[1]IADI, Nancy, France; [2]GE Healthcare, Buc, France; [3]CHU Reims, France; [4]INSERM CIT801, CIC-IT, Nancy, France; [5]Nancy Université, Nancy, France

Brain motion during cardiac cycle, linked to the one of cerebro-spinal fluid (CSF), presents interesting challenges and can have an interest to analyze brain “elastography”. In this study, we measured brain speed and motion in volunteers at the level of thalamus and brain stem. A velocity encoding of 5 cm/sec was sufficient to obtain brain values consistent with literature. Absolute brain tissue speeds were measured between 0.0002 and 0.17 cm/sec in thalami ROIs and between 0.0014 and 0.48 cm/sec in brain stem ROIs. There was a decreased of motion with cardiac frequency and with age in certain territories.

15:30 ***3403*. Gas Content Dependence in Magnetic Resonance Elastography of the Lungs**

Marlies Friese[1,2], Roberta Santarelli[2], Lionel Martin[2], Luc Darrasse[2], Ralph Sinkus[3], Xavier Maître[2]
[1]Center for Magnetic Resonance, The University of Queensland, Brisbane, Queensland, Australia; [2]Imagerie par Résonance Magnétique et MultiModalités (UMR8081), Univ Paris-Sud, CNRS, Orsay, France; [3]Institut Langevin (UMR 7587), ESPCI, Univ Denis Diderot, CNRS, Paris, France

Magnetic resonance elastography is performed in a pig lung inflated with three different gases, helium-4 (4He), air and sulphur hexafluoride (SF6), in a phantom designed for voxel-by-voxel comparison. Proton MRI morphology and computed l, Gd and Gl maps were compared on a voxel-by-voxel basis by computing mean differences between corresponding voxels. Voxel-by-voxel comparison of Morphology data and l values shows good agreement between air/4He, Air/Air and Air/SF6 measurements while Gd and Gl values agree less well. Global values of Gl, Gd and l are in excellent agreement for the different gases, showing gas density does not affect MRE measurement.

Tuesday 13:30-15:30 Computer 18

13:30 ***3404*****.** **Poroelastic MRE Reconstructions of Brain Acquired with Intrinsic Activation**

Adam J. Pattison[1], Irina M. Perreard[2], John B. Weaver, [12], Keith D. Paulsen[1,2]
[1]Thayer School of Engineering, Dartmouth College, Hanover, NH, United States; [2]Radiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH, United States

Magnetic resonance elastography has recently shown great promise in measuring the mechanical properties of brain tissue. However, the skull and cerebral meninges dampen much of the intracranial motion that occurs. Utilizing the natural arterial pulsation (called "intrinsic activation) that occurs in the brain could allow for a more comfortable and reliable way of measuring mechanical properties of brain tissue. Here, a study consisting of three brains was performed using a phase-contrast gradient echo sequence to measure velocity and, thus, calculate the displacements. Two algorithms, one with linear elastic assumptions and the other with poroelastic assumptions, were used to estimate the shear modulus distribution. Results show that intrinsic activation does provide feasible results and that the poroelastic estimation is more symmetric and uniform than the linear elastic estimation. Also, the poroelastic estimates were consistent amongst the three cases.

14:00 ***3405*****.** **The Effect of Frequency on the Uniformity of Hepatic Shear Wave Illumination**

Kevin John Glaser[1], David Stanley[2], Jun Chen[1], Meng Yin[1], Richard Ehman[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States; [2]GE Healthcare, Waukesha, WI, United States

MR elastography (MRE) has emerged as a promising noninvasive tool for diagnosing hepatic fibrosis. However, making the distinction between healthy and mildly fibrotic livers can be difficult, partly due to the soft, highly attenuating nature of the liver tissue. In this work, the improvement in hepatic illumination achieved by decreasing the frequency of mechanical vibration was studied. The results show that a significant increase in the volume of hepatic tissue with high phase difference to noise ratio can be achieved by decreasing the frequency of vibration.

14:30 ***3406*****.** **Feasibility Study to Measure Changes in Intracranial Pressure Using Magnetic Resonance Poroelastography**

Adam J. Pattison[1], Phillip R. Perrinez[1], Matthew DJ McGarry[1], John B. Weaver, [12], Keith D. Paulsen[1,3]
[1]Thayer School of Engineering, Dartmouth College, Hanover, NH, United States; [2]Radiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH; [3]Radiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH, United States

Small changes in intracranial pressure (ICP) have large effects on neurological function. Having the ability to measure ICP noninvasively could lead to a much more reliable and efficient method to diagnosing diseases like hydrocephalus, where an increase in ICP and ventricle size can be misconstrued with other ex vacuo changes like periventricular leukomalacia or cerebral atrophy. Magnetic resonance poroelastography (MRPE) is a recent idea in which both a shear modulus and pore-pressure estimate are attainable. A feasibility study was done on tofu, which has been widely used to model brain tissue, in which different external pressures were applied in an enclosed container. Reconstructed values show an increase in average pressure as well as a lack of difference in shear modulus. This is an important indicator for future studies of hydrocephalus and other neurological diseases.

15:00 ***3407*****.** **Magnetic Resonance Elastography (MRE) of the Kidney in Healthy Volunteers**

Remi Souchon[1], Mustapha Bouhrara[1], Gaële Pagnoux[2], Jean-Michel Ménager[3], Richard L. Ehman[4], Olivier Rouvière[2]
[1]INSERM, Lyon, France; [2]Hospices Civils de Lyon; [3]SCM IRM du Tonkin, Villeurbanne, France; [4]Mayo Clinic, Rochester, MN, United States

The feasibility of renal MR elastography (MRE) was investigated in 10 healthy volunteers. The study demonstrated that kidney MRE at low vibration frequencies (45-76 Hz) is feasible. It also provided evidence of a viscoelastic behavior.

fMRI Signals: Detection & Characteristics

Hall B Monday 14:00-16:00 Computer 19

14:00 ***3408*****.** **The Spatiotemporal Characteristics of Visual Stimulus-Induced BOLD Responses in Cat Visual Areas**

Cecil Chern-Chyi Yen[1], Hiro Fukuda[2], Seong-Gi Kim[2,3]
[1]Bioengineering, University of Pittsburgh, Pittsburgh, PA, United States; [2]Radiology, University of Pittsburgh, Pittsburgh, PA, United States; [3]Neurobiology, University of Pittsburgh, Pittsburgh, PA, United States

BOLD fMRI has been widely used to map the neuronal activity of the cortical visual areas in mammals. In addition, the subcortical visual regions such as lateral geniculate nucleus (LGN) have also been successfully mapped in humans. However, unlike visual cortex, our understanding about the spatiotemporal BOLD response induced by visual stimulus in LGN is relatively poor. In this study, we investigated the BOLD response in the cat primary visual cortex (A17) and LGN. We found the onset time different in these two areas and the contamination of draining vein in LGN.

14:30 ***3409*.** **Spatiotemporal Exploratory Analysis of FMRI Data**

Radu Mutihac[1]
[1]Electricity & Biophysics, University of Bucharest, Bucharest, Romania

Spatiotemporal characteristics of brain activity are frequently unknown and variable, which preclude their evaluation by confirmatory methods only. Revealing unanticipated or missed patterns of activation, exploratory data analysis (EDA) allows to improve or even to change the original hypotheses. Artifactual behavior that EDA may easily discover could raise questions on data appropriateness, if additional preprocessing steps are required, or if the preprocessing employed has introduced spurious effects. Spatial independent component analysis (sICA) and temporal fuzzy cluster analysis (tFCA) were comparatively investigated as typifying EDA of neuroimaging data.

15:00 ***3410*.** **Spatial Variation of BOLD Contrast in the Activated ROI Is Correlated with Voxel-Wise Gray Matter Volume Fraction**

Wanyong Shin[1]*, Hong Gu*[1]*, Qihong Zou*[1]*, Pradeep Kurup*[1]*, Yihong Yang*[1]
[1]Neuroimaging Research Branch, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States

In this study, we investigate spatial variations of BOLD contrast (β) within individual subjects and correlate it with voxel-wise T1 and fractional volume (fv) of each tissue component using a new brain segmentation technique, FRASIER. Our data show that spatial ¥â variation within individual subjects in a ROI activated by a visual task is highly correlated with T1 and fractional volume of GM, as well as resting-state fluctuation amplitude (RSFA). The dependency (slop of the linear regression), however, varies over subjects. These findings may be used to calibrate BOLD signals for improving sensitivity and specificity in detecting brain activity.

15:30 ***3411*.** **Comparison of the Location and Extent of BOLD Activation in High Spatial Resolution SE and GE FMRI of the Motor Cortex at 7T**

Jack Harmer[1]*, Rosa Maria Sanchez-Panchuelo*[1]*, Richard W. Bowtell*[1]*, Susan T. Francis*[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, The University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Gradient-echo (GE) and spin-echo (SE) EPI based fMRI is used to compare SE and GE BOLD responses at high field strength (7T) and resolution (1.5mm isotropic) using a motor paradigm. We investigate CNR, fractional signal change as a function of echo time, spatial specificity of SE BOLD and the localisation of GE and SE activation in relation to underlying venous blood vessels. Robust activation was detected using both SE and GE EPI. A higher proportion of GE activation was found to occur in voxels classified as having a high venous contribution than in SE data.

Tuesday 13:30-15:30 Computer 19

13:30 ***3412*.** **A Theoretical Direct Neuronal Detection Study to Estimate Percentage Local Field Perturbations**

Syed Muhammad Anwar[1]*, Greg Cook*[1]*, Martyn Paley*[2]
[1]Electronic and Electrical Engineering, University of Sheffield, Sheffield, United Kingdom; [2]Academic Radiology, University of Sheffield, Sheffield, United Kingdom

Direct neuronal detection (DND) of nerve impulses using MR techniques to image brain activity is currently under study as an alternative to BOLD based functional MRI. This work theoretically estimates the percentage local signal perturbations caused by the weak transient neuronal fields, and the effect of various axonal firing delays on these perturbations is also studied. The modelling suggests that detection of neuronal fields should be within the capability of current MR technology, and that better post processing may be required for more reliable and reproducible results.

14:00 ***3413*.** **Investigating the Earthworm (Lubricus Terrestris) as a Model for NcMRI at 9.4T**

Martyn Paley[1]*, Steven Reynolds*[1]*, LiSze Chow*[1]*, Syed Anwar*[2]*, Greg Cook*[2]
[1]Academic Radiology, University of Sheffield, Sheffield, Yorkshire, United Kingdom; [2]Electronics and Electrical Engineering, University of Sheffield, Sheffield, Yorkshire, United Kingdom

The feasibility of performing ncMRI in the intact resting earthworm has been investigated using a high resolution probe at 9.4T.

14:30 ***3414*.** **Optimization of Echo Time in Direct Detection of Neuronal Currents with MRI**

Qingfei Luo[1]*, Jia-Hong Gao*[1]
[1]The University of Chicago, Chicago, IL, United States

To detect the weak neuronal current MRI (ncMRI) signal, the imaging parameters (e.g., echo time) need to be optimized to achieve the maximum detection sensitivity. In this study, by theoretical modeling, we estimated the optimal echo time (TE) in a typical in-vivo ncMRI experiment using gradient-echo EPI pulse sequence. The results show that the optimal TE for detecting ncMRI magnitude/phase signal is 92/56ms in human brain at 3T. Also, the difference of optimal TE between magnitude and phase signals suggests that a dual-echo pulse sequence should be used to achieve the highest sensitivity to both signals in a MRI scan.

15:00 **3415**. **Modeling Neuronal Current MRI Signal with Human Neuron**

Qingfei Luo[1], Jia-Hong Gao[1]
[1]The University of Chicago, Chicago, IL, United States

Previously, neuronal current MRI (ncMRI) signal has been modeled with the real neuronal morphology and physiology in animals, such as monkey and rat. This study is an extension of the ncMRI modeling work to human subjects using human pyramidal neurons. The difference of neuron density in different human cortical layers is considered in calculation of ncMRI signal to achieve higher simulation accuracy. Our results show that ncMRI magnitude/phase signal changes are up to 1.8×10-5/0.02° when using the typical gradient echo EPI pulse sequence. In practice, such a small signal change is difficult to be detected using present MRI technology.

Wednesday 13:30-15:30 Computer 19

13:30 **3416**. **Combined Analysis of Breath Hold and Post-Stimulus Undershoot Signals**

Todd B. Harshbarger[1], Allen W. Song[1]
[1]BIAC, Duke University, Durham, NC, United States

A previous study indicated that diffusion weighting can be used to separate regions based on the characteristics of the post-stimulus undershoot. These regions were hypothesized to contain separate vascular contributions, and indicated an undershoot metabolic origin. Here, we use a breath hold task (BHT) to further investigate the vasculature within these regions. The BHT produces a vascular response without a metabolic response, and is used in calibrated BOLD methods to even out activity based on varying vasculature. We found regions which, based on undershoot characteristics, are hypothesized to contain larger vessels do show larger breath hold responses, corroborating previous results.

14:00 **3417**. **fMRI of the Human Retina Associated with Oxygen Inhalation**

Yi Zhang[1,2], Qi Peng[2], Timothy Q Duong[1,2]
[1]Research Imaging Institute, University of Texas Health science center at San Antonio, San Antonio, TX, United States; [2]Radiology, University of Texas Health science center at San Antonio, San Antonio, TX, United States

Synopsis: fMRI of the human retina is challenging because the thin retina is located in a region of high magnetic susceptibility, is susceptible to eye motion and high spatial resolution is needed. This study successfully demonstrated a novel fMRI application to image normal human retinas associated with oxygen challenge. fMRI utilized an inversion-recovery balanced steady state precession (IR-bSSFP) acquisition to suppress vitreous signal and to achieve high spatiotemporal resolution free of image distortion and signal dropout. This approach has the potential open up new avenues for retinal research and may have important research and clinical applications.

14:30 **3418**. **Normalisation of BOLD FMRI Data Between Different Baseline Conditions Using Hyperoxia**

Daniel Bulte[1], Molly Bright[1,2], Peter Jezzard[1]
[1]FMRIB Centre, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]National Institutes of Health (NIH), Bethesda, MD, United States

The fact that BOLD FMRI is highly sensitive to resting blood flow levels is a significant limitation in the clinical application of the technique. As many commonly ingested substances can cause significant changes in CBF, correcting for this confound would be a distinct advantage in comparing between subjects, sessions or pharmacological conditions. In this study subjects were imaged during visual stimulation pre and post- caffeine consumption. Short epochs of hyperoxia were used to normalise between these 2 conditions. Despite changes in BOLD response on the order of 10-40%, the normalisation effectively reduced the baseline vascular confounds.

15:00 **3419**. **The Effect of Graded Hypercapnia on Arterial Cerebral Blood Volume (ACBV)-Weighted Inflow Vascular-Space Occupancy (IVASO) Contrast**

Molly Gallogly Bright[1,2], Manus J. Donahue[2], Daniel P. Bulte[2], Jeff H. Duyn[1], Peter Jezzard[2]
[1]Advanced MRI Section, LFMI, NINDS, NIH, Bethesda, MD, United States; [2]FMRIB Centre, Department of Clinical Neurology, University of Oxford, Oxford, United Kingdom

Inflow vascular space occupancy (iVASO) MRI uses arterial spin nulling and dynamic subtraction to create cerebral blood volume (CBV)-weighted images that can be sensitized to pre-capillary vessels. We aim to validate this technique by examining the relationship between the iVASO contrast and graded levels of CO2 inhalation, a common vasodilatory stimulus, in the human visual cortex. Robust correlation between the iVASO measurements and end-tidal CO2 was observed, indicating potential for iVASO techniques to improve our understanding of the role of arterial CBV in regulatory vasoreactivity and cerebrovascular disease.

Thursday 13:30-15:30 Computer 19

13:30 **3420**. **A Simple Approach for Mapping CSF Volume Fraction**

Qin Qin[1], Peter C.M. van Zijl[1]
[1]Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States

CSF's redistribution in response to local blood volume change during activation renders CSF volume fraction in baseline an important factor in fMRI models. Here a simple method of measuring CSF volume maps is proposed, which is based on the fitting of exponential decay of only CSF signal using a non-selective T2 preparation scheme. CSF volume fractions in ventricles were found to be about 1.0, while cortical volumes ranged from 0.05-0.5. The T2 of CSF was found to be 1654ms±389ms.

14:00 ***3421*. Simultaneous BOLD and ASL for Characterizing Cerebrovascular Responses to Hyperoxia in Normal Brain and in Glioblastoma**

Heisoog Kim[1,2], Ciprian Catana[1], Grace Kim[1], Ovidiu C. Andronesi[1], Dominique L. Jennings[1], Divya S. Bolar[1,3], Elizabeth R. Gerstner[4], Tracy T. Batchelor[4], Rakesh K. Jain[5], A Gregory Sorensen[1]

[1]A.A.Martinos center, Massachusetts General Hospotal, Charlestown, MA, United States; [2]NSE/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; [3]EECS/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; [4]Neurology, Massachusetts General Hospotal, Boston, MA, United States; [5]Radiology, Massachusetts General Hospotal, Boston, MA, United States

In this study, simultaneous BOLD-ASL method was used to assess quantitatively the characteristic cerebral responses to 100% oxygen exposure in normal brain and in glioblastoma (GB). BOLD and Flow effects in normal brain were detected primarily in the cortex (increased BOLD and decreased CBF responses), which agreed with previously published data. Heterogeneous BOLD signal was observed in GB. The enhancing tumor showed a larger increase in BOLD and a smaller decrease responses in CBF than contralateral normal tissue did, which implies the characteristic properties of the tumor vasculature (i.e. tortuous, large vessels, inefficient blood circulation).

14:30 ***3422*. Detecting Focal Changes in CBF Independently from Tissue Content Using Arterial Spin Labeling (ASL) FMRI**

Ajna Borogovac[1], Christian Habeck[2], Joy Hirsch[3], Iris Asllani[4]

[1]Biomedical Engineering, Columbia University, New York, NY, United States; [2]Neurology, Columbia University; [3]Neuroscience & Psychiatry, Columbia University; [4]Radiology, Columbia University

Quantification of inter-subject differences in cerebral blood flow (CBF) separately from respective differences in tissue content presents a known challenge in analysis of group data. Recently, our group has developed an algorithm which corrects for partial volume effects (PVE) in arterial spin labeling (ASL) imaging and also yields tissue specific flow ‘density’ maps (CBFd) which are, theoretically, independent of tissue content. The goals of the present work are to (1) optimize the PVEc algorithm for applications where focal differences in CBFd occur (e.g. in functional imaging) and (2) demonstrate how segmentation can affect accuracy of CBF and CBFd estimation.

15:00 ***3423*. Left/right Asymmetry Measures in Somatosensory Cortex Using MEG, ASL and BOLD FMRI.**

Claire M. Stevenson[1], Karen J. Mullinger[1], Joanne R. Hale[1], Peter G. Morris[1], Susan T. Francis[1]

[1]SPMMRC School of Physics and Astronomy, The University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Functional asymmetry in the human brain, as measured by fMRI, has been well documented in motor regions but to a lesser extent in the somatosensory cortex. Here we combine ultra-high field BOLD fMRI, CBF and modulations in electrical oscillatory activity as measured by MEG to gain insight into mechanisms of cerebral lateralisation in the somatosensory cortex. fMRI results show an increased response contra-laterally and suggest an increase in lateralisation with dominant hand stimulation. Beta power activity appears to follow this trend reinforcing the importance of considering both phase locked and non-phase-locked neural activity when describing the BOLD response.

Fluctuations & Noise

Hall B Monday 14:00-16:00 Computer 20

14:00 ***3424*. Identification of Resting State Networks Using Whole-Brain CASL**

Jingyi Xie[1], Peter Jezzard[1], Linqing Li[1], Yazhuo Kong[1], Christian F. Beckmann[1,2], Karla L. Miller[1], Stephen M. Smith[1]

[1]Oxford Centre for Functional MRI of the Brain, Oxford, United Kingdom; [2]Department of Clinical Neuroscience, Imperial College, London, United Kingdom

There is increasing interest in resting brain activity. However, to our knowledge, ASL has not yet been used to study RSNs across the whole brain with single timeseries acquisitions. In this study, we implemented a novel true whole-brain CASL technique with EPI readout to study dynamic characteristics of cerebral blood flow during the resting state. We extracted the major covarying networks in the resting brain, as imaged in 8 subjects at rest. The major brain networks are highly similar to recent published results obtained using BOLD fMRI. We also characterised very low-frequency RSN temporal behaviour for the first time.

14:30 ***3425*. A Randomized Global Signal Regression Method for Resting State Functional Connectivity Studies**

Hongjian He[1,2], Anna Leigh Rack-Gomer[2], Thomas T. Liu[2]
[1]Department of Physics, Zhejiang University, Hangzhou, Zhejiang, China; [2]Center for Functional MRI, University of California, San Diego, La Jolla, CA, United States

Global signal removal is a widely used and controversial method for resting state functional connectivity analysis. When all voxels are used for the computation of the global signal, removal of the global signal can produce artifactual negative correlations. In this study, we consider the use of an alternative estimate of the global signal that utilizes a random sample of voxels chosen to be outside the regions of interest that are used to compute the correlation. Because this estimate does not include voxels within the regions of interest, its use does not force negative correlations to exist.

15:00 ***3426*. Caffeine Alters Connectivity Measured by BOLD: A Resting-State FMRI Study**

Xue Wang[1], Todd Parrish[1]
[1]Radiology, Northwestern University, Chicago, IL, United States

Resting state BOLD data were collected before and after the injection of a 2.5mg/kg dose of caffeine. Caffeine is a known vasoconstrictor and neural stimulant. Correlation analysis was completed that demonstrated global decreases in connectivity. The default mode network had the largest decrease due to changes in physiology and alertness induced by caffeine. The result demonstrates that the resting state BOLD signal is a mixture of neural and physiologic signals and needs to be interpreted with caution.

15:30 ***3427*. Temporal Resolution in Resting State Time-Series Acquisitions for Functional Connectivity Mapping**

Christina Triantafyllou[1,2], Randy L. Buckner, [2,3], Steven Shannon[1], Sheeba Arnold[1], Lawrence L. Wald[2,4]
[1]A.A. Martinos Imaging Center, Mc Govern Institute for Brain Research, MIT, Cambridge, MA, United States; [2]A.A. Martinos Center for Biomedical Imaging, Department of Radiology, MGH, Harvard Medical School, Charlestown, MA, United States; [3]Center for Brain Science, Harvard University, Cambridge, MA, United States; [4]Harvard-MIT Division of Health Sciences and Technology, MIT, Cambridge, MA, United States

Many studies have utilized functional connectivity as a tool to uncover brain networks, however limited effort devoted to characterizing the effect of image acquisition parameters such as temporal and spatial resolution on the quality of the connectivity maps. In this work we examine the effect of temporal resolution in the motor network, by modulating TR, number of measurements and acquisition time. Our findings show increased z-scores when TR was shortened for constant acquisition time, and were independent of TR for the acquisitions with a constant number of measurements. Furthermore, z-scores were improved when a 32ch array was used.

Tuesday 13:30-15:30 Computer 20

13:30 ***3428*. Correlations Between Cerebral Blood Flow and Amplitude of BOLD Fluctuation in the Resting State**

Qihong Zou[1,2], JiongJiong Wang[3], Hong Gu[1], Yufeng Zang[2], Yihong Yang[1]
[1]Neuroimaging Research Branch, National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States; [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China; [3]Center for Functional Neuroimaging and Department of Radiology and Neurology, School of Medicine, University of Pennsylvania, Philadelphia, PA, United States

Amplitude of low-frequency fluctuations (ALFF) has been used to quantify the strength of spontaneous fluctuations of fMRI signal in the resting state. However, its underlying physiological/biophysical mechanisms are unknown. In this study, the relationship between BOLD fluctuation amplitude and resting-state cerebral blood flow (CBF) were investigated. Our results showed that ALFF of BOLD and CBF were positively correlated within multiple cortical and subcortical networks. These findings provided first evidences that ALFF is related to baseline CBF and likely reflects the level of spontaneous neuronal activity.

14:00 ***3429*. Effect of Voxel Size and Spatial Smoothing in Functional Connectivity**

Christina Triantafyllou[1,2], Randy L. Buckner, [2,3], Susan Whitfield-Gabrieli[1], Lawrence L. Wald[2]
[1]A.A. Martinos Imaging Center, Mc Govern Institute for Brain Research, MIT, Cambridge, MA, United States; [2]A.A. Martinos Center for Biomedical Imaging, Department of Radiology, MGH, Harvard Medical School, Charlestown, MA, United States; [3]Center for Brain Science, Harvard University, Cambridge, MA, United States

In this study we investigate the effect of voxel size, across a range of isotropic resolutions and we determine whether acquisition at high spatial resolution and smoothing in post-processing is a favorable strategy compared to direct acquisition at larger voxel size. The comparisons indicate that at least 3x3x3mm3 voxels are needed to see robust correlations in the unsmoothed maps, but smoothing to 6mm reveals the correlations with approximately equal z-scores regardless of the original acquisition resolution. Acquiring at high spatial resolution and smoothing to low resolution was found to be a favorable strategy compared to direct acquisition at lower resolution.

14:30 **3430. Caffeine Reduces Resting-State BOLD Functional Connectivity**

Wen-Chau Wu[1]
[1]Graduate Institute of Oncology, National Taiwan University, Taipei, Taiwan

We investigated the effect of caffeine upon resting-state BOLD connectivity by performing measurements at different anatomic areas (primary motor cortex, primary visual cortex, and thalamus) in combination with multiple TE's. Results showed that the obtained connectivity was more significant when data was collected with a longer TE, and noticeably dropped after caffeine injestion. When correlated to resting-state perfusion as measured by the pseudo-continuous arterial spin-labeling technique, the decrease of connectivity was larger in the region where caffeine caused more flow reduction, which suggested the role of vascular regulation in the functional connectivity measured by BOLD.

15:00 **3431. Spontaneous Low-Frequency Fluctuations in the Thalamus: Evidence from 3T and 7T Resting-State FMRI**

Lin Tang[1], *Yulin Ge*[1], *Daniel Sodickson*[1], *Kellyanne Mcgorty*[1], *Joseph Reaume*[1], *Robert Grossman*[1]
[1]Department of Radiology, The Center for Biomedical Imaging of New York University, New York City, NY, United States

The thalamus, as the centrally located relay station for transmitting information throughout the brain, participates in communication with many associative brain regions and involves global multi-functional pathways. The purpose of this study was to investigate whether the 7T resting-state functional scans can give us more information on this low frequency resting state network (RSN) associated with thalamic function. This study demonstrates for the first time, the thalamic functional network during resting state obtained from both 3T and 7T scans in healthy volunteers. Thalamus was implicated to be primarily involved with motor control based on results from 3T scans. Meanwhile thalamus was showed to be functionally related to a number of more brain areas from 7T scans. The 7T scan verified the larger functional network of thalamus in brain neural activity and demonstrated that the thalamus is involved in regulating the transmission of information regarding visual, motor control, perception, some cognitive functioning and so forth.

Wednesday 13:30-15:30 Computer 20

13:30 **3432. Respiratory Noise Correction Using Linear Phase Regression (RCP)**

Hu Cheng[1], *Yu Li*[2]
[1]Indiana University, Bloomington, IN, United States; [2]Invivo Diagnostic Imaging, Gainesville, FL, United States

Respiratory noise is a confounding factor in functional MRI data analysis. A novel method is proposed to retrospectively correct for the respiratory noise in fMRI data using linear regression of the phases from different slices. This method can effectively remove noise that correlates with the respiration. This new method is compared with RETROICOR, which requires recording respiration signal simultaneously in an fMRI experiment. The two techniques show comparable performance with respect to the respiratory noise correction for fMRI time series.

14:00 **3433. Temporal Noise Change of EPI with GRAPPA in Multiple Runs**

Hu Cheng[1], *John Kirsch*[2], *Rebecca Ward*[1], *Thea Atwood*[1], *Arian Ashourvan*[1], *Yang Wang*[3]
[1]Indiana University, Bloomington, IN, United States; [2]Siemens Medical Solutions, United States; [3]Indiana University, Indianapolis, IN, United States

Temporal characteristics of the noise in multi-run fMRI scans using GRAPPA are examined with a gel phantom for acceleration factors 2-4 and various number of ACS lines. It is demonstrated that the noise distribution can change significantly from run to run. However, little change is observed from the offline reconstruction if the same reference scans are used. The results indicate that the variation is mainly caused by the noise fluctuation in the reference scans.

14:30 **3434. The Effect of Repetition Time on Model Selection in Dynamic Causal Modeling**

Christian H. Kasess[1,2], *Ewald Moser*[1,2], *Christian Windischberger*[1,2]
[1]MR Center of Excellence, Medical University Vienna, Vienna, Austria; [2]Center for Biomedical Engineering and Physics, Medical University Vienna, Vienna, Austria

Most studies applying DCM have thus far used relatively long repetition times. However, higher sampling rates should provide for a better comparison of different model structures due to better sampling of the hemodynamic response and an increased number of samples. Here we tested the influence of the repetition time on model selection at different noise levels based on simulated data. Results show improved model selection on a group level at short repetition times, in particular at lower signal-to-noise ratios illustrating the benefits of using short repetition times.

15:00 *3435*. **Investigating the Feasibility of Correlating Evoked Responses and BOLD Signals Using Simultaneous EEG/fMRI at 7T.**

Karen Julia Mullinger[1], Claire M. Stevenson[1], Susan T. Francis[1], Richard W. Bowtell[1]
[1]Sir Peter Mansfield Magnetic Resonance Center, School of Physics and Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Haemodynamic and electrical responses may show unpredictable variations over repeated trials due to habituation or modulation of attention. Here we investigate if these effects can be measured in the somatosensory cortex using simultaneous EEG/fMRI. An average of 10 trials was required to ensure detection of the evoked response. With this averaging, attenuation of the BOLD response was observed suggesting habituation, but the evoked response did not reflect this. Variance of the evoked response was assessed and found to be similar to that of the baseline prohibiting the determination of whether the evoked response attenuates as observed for BOLD.

Thursday 13:30-15:30 Computer 20

13:30 *3436*. **Adaptive Noise Removal IRF-RETROICOR**

Erik B. Beall[1], Mark J. Lowe[1]
[1]Radiology, Cleveland Clinic, Cleveland, OH, United States

RETROICOR is a good general model for physiologic noise, however it is inefficient and provides no information about actual temporal signatures of noise. We show modifications that provide these signatures and that a small subset of these account for all the RETROICOR modeled noise variance without removing as much non-noise (signal of interest) variance. We show remarkable concurrence of these 4 cardiac and 2 respiratory signatures across 34 subjects, in both fMRI and resting connectivity data. Based on the stability of these, we propose that they may be used to study abnormal physiology of cardiac and respiratory coupling.

14:00 *3437*. **The Impact of Physiological Noise Correction on FMRI at 7T**

Chloe Hutton[1], Oliver Josephs[1], Jörg Stadler[2], Eric Featherstone[1], Alphonso Reid[1], Oliver Speck[3], Johannes Bernarding[4], Nikolaus Weiskopf[1]
[1]Wellcome Trust Centre for Neuroimaging, Institute of Neurology, University College London, London, United Kingdom; [2]Special Lab Non-Invasive Brain Imaging, Leibniz Institute for Neurobiology, Magdeburg, Germany; [3]Department of Biomedical Magnetic Resonance, Institute for Experimental Physics, Otto-von-Guericke University, Magdeburg, Germany; [4]Institute for Biometry and Medical Informatics, Faculty of Medicine, Otto-von-Guericke University, Magdeburg, Germany

This study aims to demonstrate the impact of physiological noise correction on the detection of brain activations for BOLD fMRI studies acquired at 7T. We use fMRI studies of subjects at rest and performing a visual task to estimate temporal SNR (tSNR) as a function of image SNR and the t-scores associated with detected activations after performing physiological noise corrections based on peripheral measurements of subject physiology. The results demonstrate that the corrections lead to an increase in mean tSNR and voxel-wise improvements in t-scores in the visual cortex.

14:30 *3438*. **Periventricular Areas Anti-Correlate with Visual Cortex in High Resolution Resting-State FMRI at 7T**

Marta Bianciardi[1], Masaki Fukunaga[1], Peter van Gelderen[1], Jacco A. de Zwart[1], Jeff H. Duyn[1]
[1]Advanced MRI Section, LFMI/NINDS/NIH, Bethesda, MD, United States

Anti-correlation between the default mode network and an extended dorsal attention system has been previously observed in resting-state fMRI. Here we report on the presence of regions that anti-correlate with the visual cortex in resting-state fMRI at 7T. This activity occurs in proximity of the ependymal vascularization of the ventricular system, is modulated by behavioral state and is not an artifact due to head motion, heartbeat or respiration. The findings are consistent with a blood volume increase of veins downstream from visual areas.

15:00 *3439*. **Principal Component Projections Achieve Frequency Decomposition on Resting-State FMRI Data**

Yi-Ou Li[1], Pratik Mukherjee[1]
[1]University of California San Francisco, San Francisco, CA, United States

In this work, we observe that principal component analysis (PCA) on fMRI data not only decomposes the signal fluctuations into principal components ranked by the variance contribution, but also decomposes their temporal dynamics into ordered frequency bands, even within the 0.01 to 0.1 Hz BOLD frequency range. This observation suggests that dimension reduction of fMRI data using PCA should be determined not only based on the variance distribution of the spatial domain principal components, but also based on the frequency distribution of their corresponding projection vectors in the temporal domain.

fMRI Acquisition Techniques

Hall B Monday 14:00-16:00 Computer 21

14:00 ***3440*. Direct Comparison of BOLD Measurements Acquired Using Functional Spectroscopy Versus EPI**

Oliver Hinds[1], Aaron Hess[2], M. Dylan Tisdall[3], Hans Breiter[3], André van der Kouwe[3]
[1]A. A. Martinos Imaging Center at the McGovern Institute, Massachusetts Institute of Technology, Cambridge, MA, United States; [2]Human Biology, University of Cape Town, Cape Town, South Africa; [3]A. A. Martinos Center for Biomedical Imaging, Department of Radiology, MGH, Harvard Medical School, Charlestown, MA, United States

We performed a direct comparison between BOLD signal measured using single-voxel functional spectroscopy (FS) and EPI. A pulse sequence that performed both acquisition methods at each TR was developed and implemented. The FS portion of the sequence was modeled after a PRESS sequence without water suppression. An FS VOI and an EPI slice were positioned to sample the same brain region under visual stimulation. We found that FS gave statistically significantly higher BOLD estimates than EPI, although by a modest amount.

14:30 ***3441*. Towards Whole Brain T2-Weighted FMRI at Ultra-High Fields Using an Integrated Approach**

Johannes Ritter[1], Pierre-Francois Van de Moortele[1], Gregor Adriany[1], Kamil Ugurbil[1]
[1]CMRR/University of Minnesota, Minneapolis, MN, United States

Ultra-High Magnetic Fields offer large advantages, including higher image SNR, higher functional contrast and increased spatial specificity (i.e. accuracy) for T2-weighted fMRI. Short transverse relaxation times, increased magnetic susceptibility effects, specific absorption rate and B1 inhomogeneities, however, can all undermine these advantages. Here we present an integrated approach consisting of a T2 weighted sequence that reduces SAR significantly (SPIF-T2), a large volume B1 shim to improve T2 contrast and a 16 channel or a 30 channel transceiver array coil that enable and improve RF shimming for large volumes of the human brain. Robust activation is demonstrated in both the visual and motor areas of the human brain.

15:00 ***3442*. Combining Balanced Steady State Free Precession with Parallel Functional Imaging**

Michael H. Chappell[1], Anders Kristoffersen[2], Pål E. Goa[2], Asta Håberg[1]
[1]ISB, NTNU, Trondheim, Sør Trondelag, Norway; [2]Department of Medical Imaging, St Olavs University Hospital, Trondheim, Norway

Balanced steady state free precession (bSSFP)is a new method of acquiring functional data. Its advantages over conventional BOLD imaging are its high SNR, and its freedom from the signal dropout and distortion artifacts which can affect BOLD in regions of high susceptibility gradient. Previous research has shown bSSFP to be effective for visual imaging. This study takes that a step further to investigate its performance when combined with parallel imaging. We found evidence of increased sensitivity when SENSE was used. This suggests it could be worthwhile to combine the advantages of bSSFP with the advantages of parallel imaging.

15:30 ***3443*. FMRI of the Medial Temporal Lobe Using Balanced Steady State Free Precession**

Michael H. Chappell[1], Hanne Lehn[1], Pål E. Goa[2], Anders Kristoffersen[2], Rob L. Tijssen[3], Asta Håberg[1], Karla L. Miller[3]
[1]ISB, NTNU, Trondheim, Sør Trondelag, Norway; [2]Department of Medical Imaging, St Olavs University Hospital, Trondheim, Sør Trondelag, Norway; [3]Centre for Functional MRI of the Brain (FMRIB), University of Oxford, Oxford, United Kingdom

Balanced SSFP (bSSFP) acquisitions do not suffer from the signal dropout and distortions that susceptibility gradients can cause in conventional BOLD imaging. This makes bSSFP a strong candidate for high resolution functional imaging in regions such as the medial temporal lobe (MTL). Previous studies have shown that it performs well with visual stimuli and with hypercapnia across the whole brain. This study uses a novelty paradigm to stimulate neuronal activity in hippocampal/parahippocampal and visual regions. We present results with 1.5 mm3 isotropic acquisitions in these regions using bSSFP.

Tuesday 13:30-15:30 Computer 21

13:30 ***3444*. Increasing FMRI Specificity Using Asymmetric Spin Echo (ASE) Spiral: an ROC-Based Analysis**

Kimberly Brewer[1,2], Lindsay Cherpak[1,2], Tynan Stevens[1,2], Ryan D'Arcy[1,3], Chris Bowen[1,4], Steven Beyea[1,4]
[1]Institute for Biodiagnostics (Atlantic), National Research Council of Canada, Halifax, Nova Scotia, Canada; [2]Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia, Canada; [3]Psychology and Radiology, Dalhousie University, Halifax, Nova Scotia, Canada; [4]Physics and Atmospheric Science, Radiology and Biomedical Engineering, Dalhousie University, Halifax, Nova Scotia, Canada

When studying brain function, both the *sensitivity* and *specificity* of a technique are essential for improving accuracy. Most fMRI studies use sequences with T_2' weighting to maximize BOLD sensitivity, but T_2-weighted sequences are more specific to “true”

BOLD activation within parenchymal tissue compared to activation in draining veins. Using the ASE Spiral technique three images with matched T_2'-weighting, and varying T_2-weighting can be acquired in a single excitation. In this work, we analyzed ASE Spiral images obtained during visual checkerboard stimulus using a Receiver-Operator-Characteristic (ROC)-based analysis, to study changes in specificity as a function of varying relaxation weighting.

14:00 ***3445*. Somatotopic Mapping at 7T Using a Natural Stimulus.**

Juliane Farthouat[1], Roberto Martuzzi[2], Wietske van der Zwaag, [1,3], Sebastian Dieguez[2], Silvio Ionta[2], Olaf Blanke[2], Rolf Gruetter, [1,3]
[1]CIBM, EPFL, Lausanne, Vaud, Switzerland; [2]Laboratory of Cognitive Neuroscience, EPFL, Lausanne, Vaud, Switzerland; [3]Radiology, Université de Lausanne, Lausanne, Vaud, Switzerland

Identification of digit representation in primary somatosensory cortex is hampered by the small distances between finger representations and the high inter-subject variability. In this study, the high BOLD sensitivity and spatial resolution available at ultra-high field were employed for somatotopic mapping using a natural somatosensory stimulus. Consistent somatotopic maps were acquired in BA 3b for four individual subjects as well as in BA 2 for two subjects. Digits representations were located consecutively in the brain, with the thumb positioned most anterior, inferior and distal. Inter-digit Euclidian distance was XX ± XX mm (mean ± stderr).

14:30 ***3446*. Layer-Specific Differential Activation in Human V1 at 3 T Using 3D-EPI**

Peter Jan Koopmans[1], Eelke Visser[1], David Gordon Norris[1,2], Markus Barth[1,2]
[1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

A fast, high-resolution fMRI study of human V1 at 3 T is presented showing layer-specific effects. While contrasting grating stimuli versus rest shows activation profiles that inside the cortex peak in the granular layer, differential effects can be seen in the supragranular layer when contrasting coloured versus achromatic stimuli. Using 3D-EPI, 32 slices with 0.75 mm isotropic voxels could be measured with a volume repetition time of only 2.5 seconds opening the door to event related stimulus designs at the laminar level.

15:00 ***3447*. Investigating Activation Dependence on Cortical Depth and TE Using 2D FLASH**

Rosa Maria Sanchez Panchuelo[1], Jack Harmer[1], Richard Bowtell[1], Susan Francis[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, United Kingdom

Here we examine the echo time dependence of the cortical depth-related grey matter GE BOLD signal change in visual cortex using high resolution (0.35x0.35x1.5 mm3) 2D FLASH imaging at 7 T. A linear dependence of the average fractional signal change with echo time was found for all bands defined across the cortex. There was a reduction in δR2* on moving from the pial surface (1.5±0.1)s-1 to the border with white matter (0.59±0.05)s-1, and no evidence of increased δR2* in the stria of Gennari. In contrast, the measured R2* showed a clear peak in the stria of Gennari.

Wednesday 13:30-15:30 Computer 21

13:30 ***3448*. Implementation of SE and GE SIR-EPI at 7 T Using Fast Switching Gradients and Parallel Imaging**

David Feinberg[1,2], Sudhir Ramanna[1], Vibhas Deshpande[3], Kamil Ugurbil[4], Essa Yacoub[4]
[1]Advanced MRI Technologies, Sebastopol, CA, United States; [2]University of California, Berkeley, San Francisco, CA, United States; [3]Siemens, San Francisco, CA, United States; [4]University of Minnesota, Minneapolis, MN, United States

FaFaster acquisitions are desirable for both anatomical and functional scans which can be limited by gradient capabilities and/or SAR, depending on the field strength and/or sequence used. The implementation of Simultaneous Image Refocusing (SIR) EPI, which refocuses multiple slices during a single gradient switch, can be limited at high fields due to the necessary increase in the readout time. However, with the use of parallel imaging and fast switching gradients, we demonstrate here the ability to achieve high quality GE and SE SIR EPI images at 7T.

14:00 ***3449*. High Resolution GRE BOLD FMRI Using Multi-Shot Interleaved Spiral In/Out Acquisition**

Youngkyoo Jung[1], Thomas T. Liu[1], Giedrius T. Buracas[1]
[1]Radiology, Univerisity of California, San Diego, La Jolla, CA, United States

Blood oxygenation level dependent (BOLD) fMRI has been widely used for mapping brain function noninvasively. High resolution also affords increased BOLD contrast due to reduced partial volume effects and more accurate localization of BOLD activation. However, current standard acquisition methods for human brain BOLD fMRI typically have relatively low spatial or temporal resolution. We developed the multi-shot interleaved spiral in/out acquisition for high resolution BOLD fMRI. We tested this technique using visual and memory tasks. The proposed high resolution fMRI technique shows excellent activation with large spatial coverage.

14:30 ***3450***. **Functional Magnetic Resonance Imaging Using Super-Resolved Spatially-Encoded MRI**

Noam Ben-Eliezer[1], Ute Goerke[2], Michael Garwood[2], Lucio Frydman[1]
[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel; [2]Center for Magnetic Resonance Research, Radiology, University of Minnesota, Minneapolis, MN, United States

The sensitivity and specificity needed to detect neuronal activation is affected by the type of fMRI sequence and reconstruction algorithm used. Recent development of a new single-scan imaging scheme provides an alternative fMRI tool, based on spatial encoding, which offers higher robustness to B0 field inhomogeneities. A new post-processing procedure was combined onto this scheme based on super-resolution image reconstruction algorithms, which improves the ensuing spatial-resolution while reducing the initially higher hardware requirements and SAR constraints. We analyze the performance afforded by super-resolution using two novel spatially-encoded based sequences for human fMRI studies, as compared to standard EPI.

15:00 ***3451***. **Rapid Full-Brain FMRI with Multi-Shot 3D EPI Accelerated with UNFOLD and GRAPPA**

Onur Afacan[1,2], Dana Brooks[2], Scott Hoge[1], Istvan A. Morocz[1]
[1]Dept. of Radiology, Harvard Medical School & Brigham and Women's Hospital, Boston, MA, United States; [2]ECE Dept., Northeastern University, Boston, MA, United States

Cognitive imaging desires both whole brain coverage, relatively high spatial resolution, and high temporal resolution. In an effort to achieve these goals with multi-shot 3D-EPI, we implemented: i) UNFOLD (in the slice encoding direction) and ii) Parallel imaging (in both the 3D slice and phase encoding directions). We decreased the volume TR from 3s to 0.82s. We demonstrate the results on healthy volunteer subjects using two different fMRI paradigms: a) event related complex cognitive stimuli where the events lasted for a time period of up to twenty TRs and b) a simple visuospatial-motor task in a random-length block design.

Thursday 13:30-15:30 Computer 21

13:30 ***3452***. **Event-Related Whole-Brain FMRI: EPI with Slice Dependent Echo Times Versus Standard EPI**

Sebastian Domsch[1], Julia Linke[2], Michaela Ruttorf[1], Michele Wessa[2], Lothar Rudi Schad[1]
[1]Department of Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany; [2]Department of Cognitive and Clinical Neuroscience, Central Institute of Mental Health, Mannheim, Germany

We present an event-related whole-brain fMRI study at 3T testing an EPI with slice dependent TE (modified EPI) against an EPI with TE of 27ms (standard EPI). Twelve subjects performed a learning task, which predominantly involved limbic and frontal brain regions. The number of supra-threshold voxels found in putamen, thalamus, parahippocampal gyrus, hippocampus and superior frontal cortex is more than twice as great in the modified EPI as compared to the standard EPI. More activation is found in the middle frontal gyrus and the olfactory cortex using the standard EPI. Maximal Z-scores are slightly higher in most regions when using the modified EPI.

14:00 ***3453***. **Accelerated Three-Dimensional *Z*-Shimming for FMRI**

Jung-Jiin Hsu[1], Gary H. Glover[2]
[1]Department of Radiology, University of Miami School of Medicine, Miami, FL, United States; [2]Lucas Center for Imaging, Stanford University, Stanford, CA, United States

Z-shimming is an effective method to mitigate the signal loss caused by through-slice magnetic field inhomogeneity and is conventionally implemented by two-dimensional imaging. When *z*-shimming is implemented with three-dimensional imaging, more *z*-shims are available to reconstruct images of higher quality. In this work, we show that accelerated three-dimensional *z*-shimming by partial *k*-space acquisition can significantly increase the number of available *z*-shims and improve temporal resolution for fMRI without activation detectablility being compromised.

14:30 ***3454***. **Automatic Z-Shimming Based on a Real-Time Feedback Optimization Framework in BOLD-EPI**

Yu-Wei Tang[1], Teng-Yi Huang[1]
[1]Department of Electrical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan

Z-shimming is a useful method for correcting the susceptibility-induced signal losses in BOLD-EPI. For seeking the best z-shim images for compensating the lost signal, an automatic real time z-shimming method was proposed in this study. By implementing a feedback loop between the scanner and a PC through network connection, the best z-shim value could be converged by the optimization algorithm. In conclusion, our method not only can amend the signal losses problem successfully but also provide rapider searching time and higher accuracy of optimal z-shim value.

15:00 ***3455*. Understanding the Limitations of the Effectiveness of Z-Shim for Use with FMRI**

Kimberly Brewer[1,2], James Rioux[1,2], Ryan D'Arcy[1,3], Chris Bowen[1,4], Steven Beyea[1,4]
[1]Institute for Biodiagnostics (Atlantic), National Research Council of Canada, Halifax, Nova Scotia, Canada; [2]Physics and Atmospheric Science, Dalhousie University, Halifax, Nova Scotia, Canada; [3]Psychology and Radiology, Dalhousie University, Halifax, Nova Scotia, Canada; [4]Physics and Atmospheric Science, Radiology and Biomedical Engineering, Dalhousie University, Halifax, Nova Scotia, Canada

Over the past decade, the application of z-shim gradients has been successfully used to reduce susceptibility field gradient (SFG) effects. Recently, work has been done to add z-shim to spiral-in, a technique that was designed to recover signal in susceptibility regions. However, questions remain as to whether the potential benefits of combining multiple signal recovery techniques are worth the effort and time to use both techniques. We demonstrate that although z-shim may be efficient at recovering signal in sequences prone to SFG effects, its use does not offer significant benefits at the group level when combined with spiral-in.

Tools & Techniques for fMRI Applications

Hall B Monday 14:00-16:00 Computer 22

14:00 ***3456*. Standard Space and Individually-Derived Regions of Interest: An Experimental Comparison**

Joanna Lynn Hutchison[1,2], Traci Sandoval[1], G. Andrew J. Hillis[1], Ehsan Shokri Kojori[1], M. Amanda E. Colby[1], Michael A. Motes[1], Mary Jo Maciejewski[1,2], Bart Rypma[1,2]
[1]BrainHealth, University of Texas at Dallas, Dallas, TX, United States; [2]Psychiatry, University of Texas Southwestern Medical Center, Dallas, TX, United States

Using a standard space brain-template is an efficient way of determining anatomical ROIs for functional data analyses. Although individually-derived ROIs would be preferable, such ROIs are time-intensive to acquire. The present analysis examined whether or not Colin-derived and individually-derived anatomically-based ROI methods differed significantly from one another in terms of both the number of voxels and beta values contained within a Brodmann-area (BA) ROI. Results suggest that utilizing standard-space normalization/ROI boundary determination can affect the outcome of statistical analyses in terms of numbers of voxels and beta values. Caution should be exercised when using standard-space BA ROIs for PFC.

14:30 ***3457*. Brainstem Specific Warping Improves Locus Coeruleus Functional Imaging in Humans**

Evelyne Balteau[1], Christina Schmidt[1], Pierre Maquet[1], Christophe Phillips[1]
[1]Cyclotron Research Centre, University of Liege, Liege, Belgium

The locus coeruleus (LC), a specific but small brainstem structure, has recently attracted much interest because the LC is involved in attention processes and attention modulations. The accurate localisation of LC activity with functional imaging in group studies was questioned since the LC is anatomically difficult to localise on standard functional (EPI) or structural (T1-weighted) MR images. We aim to show here that standard EPI-based normalisation leads to approximate alignment of the LC across subjects, and that using a T1-based brainstem specific normalisation improves the match of the group averaged LC localisation, in line with an independent LC template.

15:00 ***3458*. Fluid Delivery System for Gustatory Tasks in FMRI**

Jonathan Worth Howard[1], John D. Beaver[1], Rexford D. Newbould[1]
[1]GlaxoSmithKline, Clinical Imaging Centre, London, United Kingdom

Although the response to taste stimulus may be useful in several areas of neuroscience, fMRI is rarely used in conjunction with gustatory stimulus. A major problem with gustatory stimulus apparatus is the use of long tubing, connecting computer-controlled pumps in the control room to the subject's mouth. This results in a messy and difficult setup, imprecise liquid delivery, and problems with off-cue drips eliciting responses. In this study these problems are overcome using a hydraulic relay system that allows the use of short tubing, for rapid setup, replacement, and precise delivery of reward stimuli.

15:30 ***3459*. EPI Distortion Correction by Constrained Nonlinear Coregistration Improves Group FMRI**

Eelke Visser[1,2], Shaozheng Qin[1,3], Marcel P. Zwiers[1,2]
[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, Netherlands; [2]Department of Psychiatry, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [3]Department of Neurology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Susceptibility gradient induced distortions are a well-known problem of EPI. We show that group fMRI results can be improved using a variation on an existing method for estimating the displacements using the mutual information between the EPI images and a reference T1 image.

Tuesday 13:30-15:30 Computer 22

13:30 ***3460***. **Is Use of a Site-Specific EPI Template Still Beneficial for Group FMRI Studies?**

David F. Abbott[1,2], Sarah J. Wilson[1,3], Graeme D. Jackson[1,4]
[1]Brain Research Institute, Florey Neuroscience Institutes (Austin), Melbourne, Victoria, Australia; [2]Department of Medicine, The University of Melbourne, Melbourne, Victoria, Australia; [3]School of Behavioural Science, The University of Melbourne, Melbourne, Victoria, Australia; [4]Departments of Medicine and Radiology, The University of Melbourne, Melbourne, Victoria, Australia

Voxel-based analysis of group fMRI requires spatial normalisation to a common space. A standard template is most often used to permit comparison between studies. A popular approach is normalisation of EPI images directly to the standard template. Other options have included use of a site-specific template to provide better inter-subject registration, at the expense of systematic differences between its co-ordinates and standard space. However, with advances in registration algorithms, is it still worth using a site-specific template? We used SPM8 to analyse 3T fMRI data of 26 healthy controls and found a site-specific template still provided increased significance of group activation.

14:00 ***3461***. **Visual Attention for Brain-Computer Interface: Towards Using 7T FMRI to Localize Electrode Implant Sites**

Patrik Andersson[1], Jeroen Siero[2], Josien Pluim[1], Max Viergever[1], Nick Ramsey[3]
[1]Radiology, Image Sciences Institute, Utrecht, Netherlands; [2]Radiology, Rudolf Magnus Institute, Utrecht, Netherlands; [3]Neurology and Neurosurgery, Rudolf Magnus Institute, Utrecht, Netherlands

Brain-Computer interface technology is moving towards implantable systems with electrodes placed directly on the cortex. For correct placement, prior knowledge is required about the exact location of a targeted brainfunction. In this study we test whether subjects can control a cursor by directing visual attention to the left or the right. Brain regions activated by attention in a localizer task are identified with a 7T MRI system. 8 subjects then received feedback about their attention-related brain activity and performance was measured. Results suggest that 7T fMRI can be used to identify regions for invasive BCI.

14:30 ***3462***. **Kohs' Block Design Task for FMRI: Implemented for Naturalistic Execution Using Game Control Techniques**

John A. Jesberger[1,2], Matthew Stokes, Sonia Minnes[3], Marc Buchner[4], Jean A. Tkach, [5]
[1]Radiology, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Cleveland, OH, United States; [3]Psychology, Case Western Reserve University; [4]Electrical Engineering, Case Western Reserve University; [5]Biomedical Engineering, Case Western Reserve University

The Kohs Block Design Task is one of the most well understood and well described neuropsychological tests of visual spatial reasoning, used widely for intelligence testing, with early sensitivity to brain injury. Comprehensive models of cognitive subprocesses entailed in its execution have been developed. Task variables critical to various aspects of execution have also been identified. As one of the most well understood and characterized neuropsychological tests it is an excellent candidate for application in functional neuroimaging. We report a realistic 3D virtual version of the task for fMRI based on computer game interface design methods.

15:00 ***3463***. **An LCD Monitor for Visual Stimulation FMRI at 7 Tesla**

Jens Groebner[1], Moritz Berger[2], Reiner Umathum[2], Michael Bock[2], Wolfhard Semmler[2], Jaane Rauschenberg[2]
[1]Medical Physics in Radiology , German Cancer Research Center, Heidelberg, Germany; [2]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

Visual stimulation at high fields is challenging due to the long magnet bores. In this work an LCD system for fMRI at 7T is presented which can be placed close to magnet iso-center. MR-compatible LCD illumination is achieved with 100 white LEDs. RF Noise measurements did not show RF-induced artifacts. Visual stimulation fMRI studies could be performed with the new presentation tool.

Wednesday 13:30-15:30 Computer 22

13:30 ***3464***. **Reducing the Gradient Artefact in Simultaneous EEG-FMRI by Adjusting the Subject's Axial Position.**

Karen Julia Mullinger[1], Winston X. Yan[1], Takayuki Ohma[1], Richard W. Bowtell[1]
[1]Sir Peter Mansfield Magnetic Resonance Center, School of Physics and Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

EEG data recorded simultaneously with fMRI acquisition are contaminated by large voltages generated by the time-varying magnetic field gradients. Here, we show that this gradient artefact (GA) can be reduced in magnitude by adjusting the subject's axial position in the scanner. Experiments carried out on four subjects show that the average GA produced by a multi-slice EPI acquisition can be reduced by 36% by moving the subject 4 cm towards the feet, starting with the nasion at iso-centre. A significant reduction in the residual gradient artefact after average artefact subtraction was also found with the subject at the optimal position.

14:00 ***3465*. Effect of EEG Electrodes Density (32 and 64 EEG Channels) on the FMRI Signal**

Abdelmalek Benattayallah[1], Nino Bregadze[2], Aureliu Lavric[3]
[1]Physics, Peninsular MR Research Centre, Exeter University, Exeter, Devon, United Kingdom; [2]School of Psychology, Exeter University, Exeter, Devon, United Kingdom; [3]School of Psychology , Exeter University, Exeter, Devon, United Kingdom

We examined the effect of the number of EEG electrodes on the fMRI image quality, by employing a simple validation procedure. Each participant performed the same cognitive task in two runs during the same scanning sessions, wearing in one run a 32-electrode EEG cap and in the other run a 64-electrode EEG cap. fMRI activations in response to the experimental conditions in the task were contrasted within each run and across runs. Statistical analysis of the fMRI data revealed that overall there was adequate correspondence between the activations in the 32-electrode run and the 64-electrode run. Of the 13 regions that contained clusters of statistically significant differences in activation ('nogo' > 'go' or 'go' > 'nogo'), 10 contained such clusters in both runs, 6 in the 'nogo' > 'go' contrast and 4 in the 'go' > 'nogo' contrast.

14:30 *3466.* Withdrawn by Author

15:00 ***3467*. Concurrent *f*MRI and Optical Imaging Spectroscopy at High Field (7T): Investigation of the Haemodynamic Response Underlying the BOLD Signal**

Aneurin James Kennerley[1], David Keith Johnston[1], Michael Port[1], Luke William Boorman[1], Ying Zheng[1], John Edward Mayhew[1], Jason Berwick[1]
[1]Psychology, University of Sheffield, Sheffield, South Yorks, United Kingdom

We have developed a methodology for concurrent high field (7T) functional magnetic resonance imaging and 2D optical imaging spectroscopy for the investigation of the haemodynamics underlying BOLD signal changes to neuronal activation. The technique has been used to investigate the negative BOLD phenomenon and haemodynamic interactions between two adjacent cortical regions. Data were used to test and refine biophysical models of the BOLD signal important in interpreting measurements of the BOLD signal as reflecting changes in metabolic activity.

Thursday 13:30-15:30 Computer 22

13:30 ***3468*. Visualization of Stripe of Gennari-Like Structure in the Primary Visual Cortex by High-Resolution MRI: Correlation of Structure Vs. Function**

Tae Kim[1], Seong-Gi Kim[1]
[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States

Stripes of T1-dependent contrast were detected in the cat primary visual cortex by high-resolution imaging at 9.4 T. These stripes were well-matched with the regions of highest stimulus-induced CBV fMRI percentage changes. The persistent presence of in stripes paraformaldehyde fixed brains shows that they arise from structural features.

14:00 ***3469*. High-Resolution FMRI of Visual Stimulation and Attention in Human Superior Colliculus**

David Ress[1,2], Sucharit Katyal[2], Clint Greene[1]
[1]Imaging Research Center, University of Texas at Austin, Austin, TX, United States; [2]Neurobiology, University of Texas at Austin, Austin, TX, United States

We measured the retinotopic organization of superior colliculus to direct visual stimulation using a 90°-wedge of moving dots that rotated around fixation. The retinotopy of covert attention was measured using a full-field array of moving dots. Subjects were cued to perform a task within a 90° portion of the stimulus, and only the cue rotated around fixation. FMRI (1.2 mm voxels) data shows retinotopic maps of both visual stimulation and covert attention that are in registration with each other. Visual attention and stimulation produced activity primarily in the superficial and intermediate laminae, but attention activity was more superficial than stimulation.

14:30 ***3470*. The Ability of FMRI at 7T to Detect Functional Differences Between Areas 1 and 3b of Primary Somatosensory Cortex**

Elizabeth Ann Stringer[1], Li Min Chen[1], Robert M. Friedman[2], J Christopher Gatenby[1], John C. Gore[1]
[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Psychology, Vanderbilt University, Nashville, TN, United States

Previously we have demonstrated the ability of ultra-high field fMRI to detect topographical organization of digits within areas 1 and 3b of human primary somatosensory cortex. Here we test the feasibility of 7T fMRI to detect functional differences between these neighboring areas. Functional images were acquired using a 7T Philips Achieva scanner while air puffs were delivered to individual distal fingerpads. Magnitude and temporal differences in the BOLD signal were detected between areas 1 and 3b. The data support previous finding that using fMRI at high fields allows the detection of more stimulus selective responses.

15:00 ***3471*. Laminar-Specific Output- To Input-Layer Connections Between Cortical Areas V1 and MT Observed with High-Resolution Resting-State FMRI**

Jonathan Rizzo Polimeni[1], Bruce Fischl[1,2], Douglas N. Greve[1], Lawrence L. Wald[1,3]
[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Charlestown, MA, United States; [2]Computer Science and AI Lab (CSAIL), Massachusetts Institute of Technology, Cambridge, MA, United States; [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

In this study, we demonstrate a laminar-specific BOLD response using resting state measurements of functional connectivity within visual cortex by exploiting the known anatomical connectivity pattern between output Layer II/III in cortical area V1 and input Layer IV in area MT observed by invasive studies. This laminar correlation signature was absent from cross-hemispheric laminar correlations measured between left and right V1. These V1-to-MT laminar-specific resting state correlations demonstrate the ability of high-resolution rs-fMRI to probe laminar-specific connections and to infer the directionality of the connectivity, and provide evidence that the BOLD signal is controlled, to some degree, on the laminar level.

fMRI Quantitation/Calibration

Hall B Monday 14:00-16:00 Computer 23

14:00 ***3472*. Combined Interactions of Respiratory and Cardiac Signals Measured by High-Temporal Resolution FMRI**

Pierre LeVan[1], Thimo Grotz[1], Benjamin Zahneisen[1], Maxim Zaitsev[1], Juergen Hennig[1]
[1]Medical Physics, University Hospital Freiburg, Freiburg, Germany

This study investigates the effect of respiratory and cardiac artifacts in the fMRI signal using very high-temporal resolution acquisitions (TR=80ms). It is shown that high-order harmonics of the respiratory (up to order 5) and cardiac (up to order 10) signals account for widespread, statistically significant effects in the fMRI signal ($p<0.05$). Moreover, the amplitude of the cardiac artifact is shown to be significantly modulated by the respiratory signal. This effect was seen in 81% of the studied brain volume in 7 healthy subjects. The proper modeling of these artifacts could increase the sensitivity of fMRI studies.

14:30 ***3473*. Hypercapnic Scaling of Task Induced FMRI BOLD Signals and Its Dependence on Task Design**

Sridhar S. Kannurpatti[1], Michael Motes[2], Bart Rypma[2], Bharat B. Biswal[1]
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Blocked and event related stimulus designs are typically used in fMRI studies depending on the importance of detection power or estimation efficiency. The extent of vascular contribution to variability in blocked and event related fMRI-BOLD response is not known. Using hypercapnic scaling, the extent of vascular weighting in the fMRI-BOLD response during blocked and event related design paradigm was investigated. BOLD data from healthy volunteers performing a block design motor paradigm and an event related memory paradigm that needed the performance of a motor task were analyzed from the region of interest (ROI) surrounding the primary and supplementary motor cortices.

15:00 ***3474*. Susceptibility-Induced BOLD Sensitivity Variation in Breath Hold Task**

Yue Zhuo[1], Bradley P. Sutton[1]
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Magnetic field inhomogeneity exists near the interface of air/tissue, leading to susceptibility artifacts including echo time shift. BOLD sensitivity has strong dependence on echo time, and thus is changed by the susceptibility gradients. We examined BOLD sensitivity change in a breath hold task among different subjects. The breath hold fMRI experiment analyzed to determine if susceptibility gradient induced BOLD sensitivity changes are observable within susceptibility regions in subjects. Results show a significant relationship between susceptibility gradients and BOLD signal in 81% of the subjects, which means the effect of susceptibility gradients on BOLD signal robustly exist among subjects.

15:30 ***3475*. Modeling the Effect of Changes in Hematocrit, O_2 Extraction Fraction, and Blood Volume Distribution on the BOLD Signal and Estimates of $CMRO_2$ Change with a Calibrated BOLD Method**

Valerie Griffeth[1,2], Richard Buxton[3]
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We applied a calibrated-BOLD methodology to assess effects of caffeine consumption on coupling of CBF and cerebral metabolic rate of O2 (CMRO2) responses to a visual stimulus. Although the BOLD responses were similar, we found an increase in *** CMRO2 change after administration of caffeine, both as a fraction of the current baseline state and in a more absolute sense referred to the pre-caffeine baseline. More modest changes were found in the CBF response, leading to a decrease of the CBF/CMRO2 coupling ratio.

Tuesday 13:30-15:30 Computer 23

13:30 ***3476*. A New Method for Measuring Changes in Venous Cerebral Blood Volume Using Hyperoxia**

Nicholas P. Blockley[1], Ian D. Driver[1], Susan T. Francis[1], Penny A. Gowland[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, School of Physics & Astronomy, University of Nottingham, Nottingham, United Kingdom

Venous cerebral blood volume (CBVv) is key to the BOLD response, but could not be measured directly until the advent of the VERVE technique. We present a new method for measuring changes in CBVv using hyperoxia. This new method has a high signal-to-noise ratio enabling high spatial (2×2×3mm) and temporal (TR=2.4s) resolution. In this work we show measurements of relative changes in CBVv. However with refinements to the acquisition and analysis it will be possible to measure the percentage change in CBVv.

14:00 ***3477*. Spatial and Temporal Responses of Arterial and Venous Blood Volume Changes**

Tae Kim[1], Seong-Gi Kim[1]
[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States

Spatial and temporal responses in arterial (CBVa) and total blood volume (CBVt) were measured in the same animals. Cortical depth profile analysis of ΔCBVa and ΔCBVt was performed to examine spatial specificity. The highest signal changes were detected at the middle of cortex in both ΔCBVa and ΔCBVa, and spatial specificity to the middle of the cortex appears to improve with time for both parameters. The venous blood volume response (ΔCBVv) was calculated by subtracting ΔCBVa from ΔCBVt. Rapid initial increases were obtained for CBVa, while slow prolonged increases were observed for CBVv.

14:30 ***3478*. Investigating the Temporal Characteristics of the BOLD Response with Field Strength**

Ian Driver[1], Kay Head[1], Penny Gowland[1], Susan Francis[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, United Kingdom

There has been much interest in how spatial extent of activation and the shape of the haemodynamic response alters with field strength, due to differing extravascular and intravascular signal contributions. We apply an event-related visual stimulus with long inter-stimulus-interval to assess the temporal features of the BOLD response. Findings show high similarity between hrf shapes across field strength, despite a decrease in relative IV/EV fraction of BOLD contrast with increased field. Time-to-peak maps show tissue areas are highly homogenous, with large deviances occurring only in the large vessels.

15:00 ***3479*. Adding Transients to Model BOLD FMRI Time Courses for Somatosensory-Motor Activations**

Michael Marxen[1,2], Ryan J. Cassidy[1], Tara L. Dawson[1], Bernhard Ross[1,2], Simon J. Graham[1,2]
[1]Rotman Research Institute, Baycrest, Toronto, Ontario, Canada; [2]Heart and Stroke Foundation Centre for Stroke Recovery, Toronto, Ontario, Canada

BOLD fMRI time courses for somatosensory stimuli of variable lengths are modeled using the general linear model with a latency optimized hemodynamic impulse response function and three different neuronal input functions: boxcar (model A), boxcar + offset transient (model B), onset transient + boxcar + offset transient (model C). Only model C is capable of fitting the bimodal nature of the response to the 7s stimulus and the relative peak amplitudes for all stimulus lengths in key areas of the somatosensory-motor system. Therefore, including onset and offset transients provides a more comprehensive picture of the underlying brain activity.

Wednesday 13:30-15:30 Computer 23

13:30 ***3480*. The Effects of Basal Vascular Tone on Hypercapnic and Hypocapnic Cerebrovascular Reactivity: Implications for Clinical Autoregulation Studies.**

Molly Gallogly Bright[1], Daniel P. Bulte[2], Manus J. Donahue[2], Jeff H. Duyn[1], Peter Jezzard[2]
[1]Advanced MRI Section, LFMI, NINDS, NIH, Bethesda, MD, United States; [2]FMRIB Centre, Department of Clinical Neurology, University of Oxford, Oxford

The cerebrovascular reactivity response to arterial gas tensions offers insight into vascular compliance and may be useful for experimentally simulating conditions of hemodynamic compromise. We utilize BOLD fMRI and CO_2 inhalation in healthy volunteers to understand how an increase in basal vasodilation influences the response to both vasoconstrictive (Cued Deep Breathing) and vasodilatory (Breath Hold) challenges. Three repetitions of each challenge were performed at 0% and 4%CO_2 inhalation, and voxelwise %BOLD/δetCO_2 mmHg maps were averaged across gray matter. BH-reactivity responses were significantly greater during 4% CO_2 inhalation while CDB-reactivity responses were not significantly affected, indicating these challenges may offer complementary diagnostic information.

14:00 ***3481*. High Resolution Cerebral Blood Volume Mapping in Humans at 7T with Hyperoxic Contrast**

David Thomas Pilkinton[1], Santosh Gaddam[1], Mark A. Elliott[1], Ravinder Reddy[1]
[1]Center for Magnetic Resonance and Optical Imaging, University of Pennsylvania, Philadelphia, PA, United States

It has recently been shown that hyperoxic contrast allows for an accurate measurement of cerebral blood volume using low resolution (4x4x6mm) standard T2*-weighted EPI at 3T. The increase in BOLD contrast at 7T can potentially allow for significantly increased spatial resolution with this technique. However, the standard EPI approach used at 3T is unsuitable for 7T due to shorter venous blood T2* and increased B0 inhomogeneity. We have shown here that these problems can be addressed with steady-state acquisition segmented 3D EPI with partial-Fourier encoding in the phase direction, which produced robust high resolution (1x1x2mm) CBV maps at 7T.

14:30 ***3482*. Negative Contrast Enhancement in T2*-Weighted Images of the Human Brain During Hyperoxia**

David Thomas Pilkinton[1], Santosh Gaddam[1], Mark A. Elliott[1], Ravinder Reddy[1]
[1]Center for Magnetic Resonance and Optical Imaging, University of Pennsylvania, Philadelphia, PA, United States

Hyperoxia is known to provide positive contrast enhancement (CE) on T2*-weighted images based on the BOLD effect. We have shown here that hyperoxic contrast, despite producing positive CE across most of the brain, generates significant negative CE in T2*-weighted images in inferior regions of the brain located near large arteries, even at lower FiO2 levels (<0.6). We believe this effect is due to the shortening of T2* in arterial blood from excess paramagnetic molecular oxygen dissolved in the plasma. Hyperoxic contrast on T2*-weighted images may therefore produce negative or positive CE depending on the characteristics of the local blood volume.

15:00 ***3483*. Determination of Maximum BOLD Calibration Constant Using Hyperoxia.**

Daniel Bulte[1], Molly Bright[1,2], Peter Jezzard[1]
[1]FMRIB Centre, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]National Institutes of Health (NIH), Bethesda, MD, United States

Calculation of the maximum theoretical BOLD signal change (M) has been achieved using short epochs of mild hyperoxia. This value can be used to produce estimates of the change in CMRO2 during functional tasks. This study seeks to minimise the number and duration of hyperoxic blocks needed to determine this value. 2x2 minute blocks of mild hyperoxia are shown to be sufficient to produce reliable results, reducing the total time needed to be added to a scan to 8 minutes.

Thursday 13:30-15:30 Computer 23

13:30 ***3484*. Comparison of Active Voxel Composition Using BOLD Vs. VASO and VAST/GMN FMRI**

Ronald A. Meyer[1,2], Jill M. Slade[2], Robert W. Wiseman[1,2]
[1]Physiology, Michigan State University, East Lansing, MI, United States; [2]Radiology, Michigan State University, East Lansing, MI, United States

Vascular Space Occupancy (VASO) and VASO with Tissue suppression (VAST, or Gray Matter Nulling, GMN) are fMRI methods which detect blood volume changes, and hence are thought be more localized to gray matter than conventional BOLD fMRI. However this study shows that at the typical spatial resolution of fMRI studies, these methods are no better localized to gray matter voxels than BOLD.

14:00 ***3485*. Arterial Cerebral Blood Volume (ACBV)-Weighted Inflow Vascular-Space-Occupancy (IVASO) Provides Complementary Hemodynamic Information to Dynamic Susceptibility Contrast in Patients with Stenotic Artery Disease.**

Manus Joseph Donahue[1,2], Bradley J. Macintosh[2,3], Ediri Sideso[4], James Kennedy[4], Peter Jezzard[1,2]
[1]Clinical Neurology, Oxford University, Oxford, United Kingdom; [2]Physics Division, FMRIB Centre, Oxford, United Kingdom; [3]Imaging & Brain Sciences, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [4]Nuffield Department of Clinical Medicine, Oxford University, Oxford, United Kingdom

Inflow vascular-space-occupancy with dynamic subtraction (iVASO-DS) has been proposed as a non-invasive approach for measuring arterial cerebral blood volume (aCBV). Here, we compare iVASO-DS contrast with DSC-measured CBF, CBV and MTT in patients with stenotic artery disease. We find consistency between iVASO and DSC-CBV, especially when MTT discrepancies are accounted for. Finally, in patients with moderate-to-severe stenoses, CBF is generally symmetric between unaffected and affected hemispheres (R=0.85), yet iVASO contrast is more asymmetric (R=0.69). This finding is consistent with autoregulatory vasodilation and indicates that aCBV adjustments may precede CBF reductions in patients with stenotic artery disease.

14:30 ***3486*. Magnetization Transfer Enhanced Vascular-Space-Occupancy (MT-VASO) MRI with Whole Brain Coverage**

Jun Hua[1], Domenico Zaca[1], Samson Jarso[1], Jay J. Pillai[1], Peter C.M. van Zijl[1]
[1]Department of Radiology, The Johns Hopkins University, Baltimore, MD, United States

Vascular-space-occupancy (VASO) MRI is an inversion-recovery based method that employs tissue signal changes during blood nulling to image blood volume changes. By adding an MT pulse before the VASO inversion pulse, the recovery process of tissue can be accelerated, which leads to increased tissue SNR. Recent work showed that gradient-spin-echo (GraSE) imaging may be a better choice for VASO-MRI than the conventional EPI. We combined the MT-VASO technique with 3D-GraSE sequence to extend it from single-slice to whole-brain coverage. Compared to the commonly used 2D multi-slice EPI-VASO approach, this new whole-brain VASO sequence drastically improved SNR/CNR by 60-150%.

15:00 ***3487*. First Application of Whole Brain CBV Weighted FMRI to a Cognitive Stimulation Paradigm: Robust Activation Detection in a Stroop Task Experiment Using 3D GRASE VASO**

Benedikt A. Poser[1,2], David G. Norris[1,2]
[1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, Netherlands; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Duisburg-Essen, Essen, Germany

Using a recently developed multi-slice variant of VASO that enables single-shot whole-brain coverage by virtue of a 3D GRASE readout, we here present the first application of VASO to an fMRI study with a ‘real cognitive’ stimulation paradigm on twelve subjects. Within acceptable measurement times of ~12 min, the numerous clusters brain activation during a Stroop color-word matching task could be detected reliably both on the group (N=12) and single subject level, as evident from a qualitative comparison with separately acquired BOLD data and literature reports.

fMRI Analysis, Connectivity & Clustering

Hall B Monday 14:00-16:00 Computer 24

14:00 ***3488*. Resting State BOLD Fluctuations in Large Draining Veins Are Highly Correlated with the Global Mean Signal**

Hongjian He[1,2], David D. Shin[2], Thomas T. Liu[2]
[1]Physics Department, Zhejiang University, Hangzhou, Zhejiang, China; [2]Center for functional MRI, UC San Diego, La Jolla, CA, United States

Removal of the global mean signal is a common step in the processing of resting-state fMRI data. However, its usage can produce spurious negative correlations. . Here we propose the use of BOLD signal fluctuations in the large draining veins as an alternative to the global mean signal that does not force the existence of negative correlations. We show that signals from two vein regions (sagittal sinus and great vein of Galen) are significantly correlated with the global mean signal and may therefore represent a useful alternative for the analysis of resting-state fMRI studies.

14:30 ***3489*. Network-Level Comparisons of Functional Connectivity Differences Between Cognitive Tasks**

Johanna M. Zumer[1], Svetlana V. Shinkareva[2], Vladimir Gudkov[3], Matthew J. Brookes[1], Paul S. Morgan[4], Peter G. Morris[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Psychology, University of South Carolina, Columbia, SC, United States; [3]Physics and Astronomy, University of South Carolina, Columbia, SC, United States; [4]Radiology and Radiological Science, Medical University of South Carolina, Charleston, SC, United States

A network-level information approach is applied to functional connectivity data from 7T fMRI to discern differences in processing of a semantic task comprising words with either abstract or concrete meaning. Structurally, network nodes are similar between tasks, however functional processing differences between the nodes are distinguisable in each subject.

15:00 ***3490*. Functional Connectivity Between Structures in Auditory Pathway Using FMRI Technique**

Michalina Justyna Ryn[1], Michael Erb[2], Uwe Klose[3]
[1]Diagnostic and Interventional Neuroradiology, University Hospital Tuebingen , Tuebingen, Baden-Wunterberg, Germany; [2]Sektion Experimentelle Kernspinresonanz des ZNS, University Hospital Tuebingen, Tuebingen, Baden-Wunterberg; [3]Diagnostic and Interventional Neuroradiology, University Hospital Tuebingen, Tuebingen, Baden-Wunterberg, Germany

Analysis of functional connectivity can be useful tool which can describe the correlation between functionally related regions. This study was performed with seven volunteers on a 3T scanner. Time courses from auditory cortex were used as references in correlation analysis in individual subject. Similarity of the time courses demonstrated the connection between structures in auditory pathway and gives the reason to applied correlation analysis. Results demonstrate a tight functional relation between auditory cortex and brainstem in the human brain and provide an improvement in the t-test analysis about location of activated areas within the brainstem by correlation analysis

15:30 ***3491***. **Thalamic Functional Connectivity in Healthy Volunteers with and Without Task Engaged**

Lin Tang[1], Yulin Ge[1], Daniel Sodickson[1], Kellyanne Mcgorty[1], Joseph Reaume[1], Robert Grossman[1]
[1]Department of Radiology, The Center for Biomedical Imaging of New York University, New York City, NY, United States

The thalamus is important to communication among many associative brain regions including sensory, motor, cognitive, and behavior and it is one of the key elements of neuronal organization in the global function of the brain related to the rich thalamocortical interconnectivity[2]. This study demonstrates for the first time the thalamic functional network during both resting state and task related sessions in healthy volunteer.

Tuesday 13:30-15:30 Computer 24

13:30 ***3492***. **Hierarchical Clustering for Network Analysis in Functional Connectivity MRI**

Garth John Thompson[1,2], Matthew Magnuson[1,2], Shella Dawn Keilholz[1,2]
[1]Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, United States; [2]Biomedical Engineering, Emory University, Atlanta, GA, United States

Functional connectivity MRI promises to elucidate networks in the healthy and diseased brain, but the large amounts of data collected prove difficult to analyze. To solve this problem a hierarchical clustering algorithm is proposed which requires neither manual definition of anatomical regions nor manual determination of correlation threshold. When this algorithm was run on data from anaesthetized rats, it was able to create groups that corresponded to bilateral primary somatosensory cortex, motor cortex and secondary somatosensory cortex in a majority of the rats. It was also able to flag merges between these groups without having prior knowledge of anatomical regions.

14:00 ***3493***. **Adaptive Seeding for Resting-State Network Correlation Analysis with Empirical Mode Decomposition**

Hsu-Lei Lee[1], JÃ¼rgen Hennig[1]
[1]Department of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

The widely-used seed voxel correlation analysis for resting-state fMRI data requires priori seed ROI assumptions, and the result is strongly susceptible to the choice of this ROI. In this study we used empirical mode decomposition to separate low-frequency BOLD signals into different intrinsic mode functions before analyzing for underlying coherent networks. We also propose an adaptive weighted seeding scheme for generating the correlation map that's less susceptible to cut-off threshold and seed ROI selection, and can potentially provide a more reliable correlation map for further functional analyses.

14:30 ***3494***. **Instantaneous and Causal Connectivity in Resting State Brain Networks Derived from FMRI Data**

Gopikrishna Deshpande[1], Priya Santhanam[1], Xiaoping Hu[1]
[1]Department of Biomedical Engineering, Georgia Institute of Technology and Emory University, Atlanta, GA, United States

Granger causality, though not requiring a priori assumptions, is influenced by the zero-lag correlation in resting state networks (RSNs) such as default mode (DMN), hippocampal cortical memory (HCMN), dorsal attention (DAN) and fronto-parietal control (FPCN) networks. We simultaneously derived functional and effective connectivities in these RSNs using correlation-purged Granger causality, a measure capable of reliably inferring causality without interference from correlation. Our results show extensive causal interactions between RSNs with the posterior cingulate and inferior parietal areas acting as major transit hubs. In addition, our results also support the role of FPCN in the control of DMN and DAN.

15:00 ***3495***. **Stimulus-Independent Functional Connectivity in the Rat Brain**

Adam J. Schwarz[1,2], Alessandro Gozzi[1], Angelo Bifone[1]
[1]Neuroscience CEDD, GlaxoSmithKline, Verona, Verona, Italy, Italy; [2]Translational Imaging , Eli Lilly, Indianapolis, IN, United States

To what extent functional connectivity is determined by neuronal wiring constraints, or by the dynamical features of the brain functional processes is an open question. To this end, we have investigated functional connectivity in the rat brain under various pharmacological challenges to identify stimulus-independent patterns of connectivity that may mirror general features of the brain organization. Complex network analysis revealed two networks of tightly connected voxels that were independent of the particular neurotransmitter system engaged, and likely to reflect the organization of the underlying neuronal substrate

Wednesday 13:30-15:30 Computer 24

13:30 ***3496*. A Fixed-Point Iteration Based Constrained Independent Component Analysis and Its Application in FMRI**

Ze Wang[1]
[1]Department of Psychiatry, University of Pennsylvania, Philadelphia, PA, United States

We presented a new constrained independent component analysis (cICA) in this work. Evaluated with synthetic data, it demonstrated better performance than the original cICA in terms of higher SNR and faster convergence time. Using synthetic fMRI data, the proposed cICA also demonstrated a superior activation detection sensitivity/specificity performance. Applied to sensorimotor fMRI data, it yielded spatially more extended activation patterns in the target functional regions than standard univariate general linear model approach.

14:00 ***3497*. On the Relationship Between Seed-Voxel and ICA Measures of Functional Connectivity**

Suresh Emmanuel Joel[1,2], *Brian S. Caffo*[3], *Peter CM van Zijl*[1,2], *James J. Pekar*[1,2]
[1]Radiology, Johns Hopkins University, Baltimore, MD, United States; [2]FM Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States; [3]Biostatistics, Johns Hopkins University, Baltimore, MD, United States

Two methodologies are widely used for evaluating brain functional connectivity from BOLD fMRI data: Correlation with the time series of a specified “seed voxel” (or small region of interest); and spatial independent component analysis (ICA). While results from seed-voxel and ICA methodologies are generally similar, they can also differ, and we are unaware of a discussion of the relationship between them. The present study is intended to elucidate and illustrate the relationship between seed-voxel and ICA derived measures of FC and to show that FC measures from the two methods are complementary.

14:30 ***3498*. Effect of HRF Spatial Variability on the Accuracy of Multivariate Granger Causal Networks Obtained from FMRI Data**

Gopikrishna Deshpande[1], *Xiaoping Hu*[1]
[1]Department of Biomedical Engineering, Georgia Institute of Technology and Emory University, Atlanta, GA, United States

The hemodynamic response of fMRI is known to vary across brain regions. This has the potential to confound inferences about neuronal causality obtained from Granger causality analysis of fMRI. We investigated this aspect in a multivariate model using a simulated neuronal system. The results suggest that Granger causality inferred from fMRI data had accuracies well above chance and up to 90%, provided the data had low measurement noise, was sampled at a TR less 2 s, the causal influences were strong and the hemodynamic delay variation is within its normal physiological range.

15:00 ***3499*. Unsupervised Clustering of FMRI Time Series with the Granger Causality Metric**

Santosh B. Katwal[1,2], *John C. Gore*[2,3], *Baxter P. Rogers*[2,3]
[1]Electrical Engineering and Computer Science, Vanderbilt University, Nashville, TN, United States; [2]VUIIS, Nashville, TN, United States; [3]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States

Unsupervised clustering methods such as Self-Organizing Map (SOM) or Hierarchical Clustering (HC) use the conventional Euclidean distance or correlation as the similarity metric to cluster data. The Euclidean distance cannot fully represent the noise points and correlation metric cannot efficiently detect small timing variability in fMRI time-series data. High field fMRI provides high signal-to-noise ratio (SNR) measurements. With high TR during acquisition, small temporal differences, down to 100 ms, can be resolved using the directed influence measure from the Granger causality approach. We use the Granger causality as a similarity metric in SOM or HC to cluster fMRI data with small timing variability.

Thursday 13:30-15:30 Computer 24

13:30 ***3500*. A Novel Variational Bayesian Method for Spatiotemporal Decomposition of Resting-State FMRI**

Yi-Ou Li[1], *Pratik Mukherjee, Srikantan Nagarajan, Hagai Attias*[2]
[1]University of California San Francisco, San Francisco, CA, United States; [2]Golden Metallic Inc

We apply a new variational Bayesian factor partition (VBFP) method to the sparse spatiotemporal decomposition of resting state fMRI data. The VBFP method estimates sources with sparse distributions in both spatial and temporal domain and incorporates automatic relevance determination in a fully Bayesian inference framework. Hence it achieves dimension reduction as an integrated part of the inference. We apply VBFP to the resting state fMRI data and compare it with a maximum likelihood independent component analysis (ICA) algorithm [Bell and Sejnowski, 1998] and show that VBFP indentifies similar functional coherent brain networks and their temporal fluctuations. The potential advantages of VBFP on the integrated inference of noise model and robustness on small sample size motivate further investigation.

14:00 ***3501*.** **A Data-Driven FMRI Analysis Using K-SVD Sparse Dictionary Learning**

Kangjoo Lee[1], Jong Chul Ye[1]
[1]Dept. Bio & Brain Engineering, KAIST, Daejon, Korea, Republic of

Statistical parametric mapping (SPM) is widely used for the statistical analysis of brain activity with fMRI. However, if the general linear model employs a fixed form of a canonical HRF, the ignorance of experimental and individual variance can lead to inaccurate detection of the real activation area. A variety of data-driven methods, which combine independent component analysis (ICA) with statistical analysis of fMRI dataset, were suggested to overcome the problem, such as the `HYBICA¡¯approach and the unified `SPM-ICA¡¯method. However, recent study demonstrates that representation of the brain fMRI using sparse components is more promising rather than independent components. Also, the real brain fMRI signal may be regarded as a combination of small set of dynamic components, where each of them has different signal patterns and sparsely distributed in each voxel. Hence, we employ the K-SVD, a powerful sparse dictionary learning algorithm, to decompose the neural signal into dictionary atoms with specific local responses. Using the trained sparse dictionary as a design matrix in SPM, we extract which signal components contribute to the neural activation. We show the proposed method adapts the individual variation and extract the activation better than conventional methods.

14:30 ***3502*.** **Functional Coherence Index for FMRI Network Analysis Using K-Means Cluster**

David Matthew Carpenter[1], Emily Eaves[1], Johnny Ng[1], David H. Schroeder[2], Chris A. Condon[2], Daniel David Samber[1], Richard Haier[3], Cheuk Ying Tang[4]
[1]Radiology, Mt. Sinai School of Medicine, New York, NY, United States; [2]Johnson O'Connor Research Foundation, Chicago, Il, United States; [3]School of Medicine (Emeritus), UC Irvine, Irvine, Ca, United States; [4]Radiology & Psychiatry, Mt. Sinai School of Medicine, New York, NY, United States

There is no standard metric for the integrity of a functional network but such a measure is necessary for quantitatively comparing networks between subjects and groups. The k-means clustering algorithm can be used to segment fMRI data into functional networks or clusters in a very fast and efficient way. In this abstract we present an index for quantifying the overall functional coherence of a network.

15:00 ***3503*.** **A Novel Method in Functional Magnetic Resonance Imaging Analysis Based on Spatial Clustering**

Sharon Chia-Ju Chen[1], Chun-Chao Chuang[2], Mei_Ling Su[2], Yu-Ting Kuo[1], Keh-Shih Chuang[2]
[1]Department of Medical Imaging and Radiological Sciences, Kaohsiung Medical University, Kaohsiung, Taiwan, Taiwan; [2]Department of Biomedical Engineering and Environmental Sciences, National Tsing-Hua University, Hsin-Chu, Taiwan, Taiwan

In this study, we present a novel analytical method to detect brain activation using spatial clustering. Spatial clustering is determined by the correlation of each pixel with its nearest neighbors. Preliminary results show that the proposed method has larger area under the ROC curve compared to the SPM (statistical parametric mapping) and MTCA (modified temporal clustering analysis) methods in the detection of activated regions using simulated data. This method can detect activation area without prior information and regardless of the shape of the response function. Keywords: fMRI, spatial clustering analysis, spatial correlation

Resting State Connectivity

Hall B Monday 14:00-16:00 Computer 25

14:00 ***3504*.** **Connectivity Patterns Produced Without Neuronal Activity**

Todd B. Harshbarger[1], Allen W. Song[1]
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Functional connectivity in the human brain has been an area of increasing study. Although neural activity provides a portion of the fluctuations seen within the brain, it is unclear if functional connectivity can be observed based on vascular changes alone. In this study, we perform resting state connectivity analysis on human legs. This model provides vascular changes without neuronal input. We find that significant functional connectivity, both within and between legs, is observed. This result indicates that vascular contributions alone can produce functional connectivity, and future studies of connectivity in brain should consider methods to reduce possible confounding vascular contributions.

14:30 ***3505*.** **The Effects of Task Context and Brain Injury on Default Mode Network Brain Functional Connectivity**

Suzanne T. Witt[1], Vince D. Calhoun[2,3], Godfrey D. Pearlson[1,4], Michael C. Stevens[1,4]
[1]Olin Neuropsychiatry Research Center, Institute of Living, Hartford, CT, United States; [2]The MIND Institute, Albuquerque, NM, United States; [3]Department of ECE, University of New Mexico, Albuquerque, NM, United States; [4]Department of Psychiatry, Yale University School of Medicine, New Haven, CT, United States

Activity in the default mode network has been demonstrated to be correlated with rest and anti-correlated with task performance. Questions arising from this include whether task performance or brain abnormality, injury, or disease state modulate the default mode network. We show that both performance of an auditory oddball task as well as traumatic brain injury modulate the function of the default mode network. Performance of the task results in recruitment of additional frontal regions, while the presence of TBI alters the functional connectivity.

15:00 *3506*. **DMN Is Affected Incongruently by Either Internal or External Environments**

Tun Jao[1,2], Ya-Chih Yu[1], I-Ning Tang[1], Chang-Wei Wu[1], Jiann-Shing Jeng[3], Jyh-Horng Chen[1]

[1]MRI/MRS Lab, NTU, Taiwan, Taipei, Taiwan; [2]Department of Neurology, National Taiwan University Hospital, Taipei, Taiwan; [3]National Taiwan University Hospital, Stroke Center and Department of Neurology, Taipei, Taiwan

In this study, we deprive subjects from light and aim to investigate possible fluctuations of DMN under visual deprivation. 10 healthy subjects underwent 4 resting-state scans: 1) eyes-closed in dark, 2) eyes-open in dark, 3) eyes-closed in light, and 4) eyes-open in light. PCC was chose as the seed to generate PCC-FC map. FC between PCC and PCu, thalamus, and prefrontal cortex fluctuated significantly but incongruently. Besides the effect of physiological conditions, DMN also showed changes upon light. To sum up, DMN fluctuates incongruently across different situations. Both intrinsic physiological activities and external environments contribute to these changes.

15:30 *3507*. **Resting State Network and Human Intelligence, and FMRI Study**

Cheuk Ying Tang[1], David C.M. Carpenter[2], Emily Eaves[2], Johnny Ng[2], Chris A. Condon[3], David H. Schroeder[3], Roberto Colom[4], Richard Haier[5]

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fMRI using a N-Back paradigm as well as resting state were obtained on 40 normal control subjects. Cognitive performance scores were also recorded on these subjects. Significant correlations were found between measures of the coherence of the resting state network and cognitive scores. General intelligence scores were also correlated with functional connectivity measures between the parietal cortex and the DLPFC.

Tuesday 13:30-15:30 Computer 25

13:30 *3508*. **Spontaneous Low-Frequency BOLD Signal Fluctuations: Changes in Default Mode Network in Brain Diseased with Glioblastoma**

Heisoog Kim[1,2], Alexander E. Drzezga[1], Ciprian Catana[1], Grace Kim[1], Ovidiu C. Andronesi[1], Dominique L. Jennings[1], Elizabeth R. Gerstner[3], Tracy T. Batchelor[3], Rakesh K. Jain[4], Alma Gregory Sorensen[1]

[1]A.A.Martinos center, Massachusetts General Hospotal, Charlestown, MA, United States; [2]NSE/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; [3]Neurology, Massachusetts General Hospotal, Boston, MA, United States; [4]Radiology, Massachusetts Institute of Technology, Boston, MA, United States

This pilot study investigated quantitative changes in the "default mode network (DMN)" in patients with glioblastoma (GB) to understand how brain tumors and their associated treatment affect the integrity of the DMN. In general, it was possible to identify coherent BOLD DMN-activity in brain tumor patients in a similar pattern as demonstrated previously in healthy subjects. However, distinct asymmetry of the DMN was observed with a decreased connectivity of the inferior parietal cortex in tumor-affected hemisphere. The z-score values were reduced in a hemisphere diseased with GB compared to those in a contralateral hemisphere.

14:00 *3509*. **Acute Social Stress Increases Amygdala Functional Connectivity with Posterior Cingulate Cortex and Medial Orbitofrontal Cortex**

Ilya Milos Veer[1,2], Nicole Y. Oei[1,3], Mark A. van Buchem[1,2], Bernet M. Elzinga[1,3], Serge A. Rombouts[1,2]

[1]Leiden Institute for Brain and Cognition (LIBC), Leiden, Netherlands; [2]Department of Radiology, Leiden University Medical Center (LUMC), Leiden, Netherlands; [3]Leiden University - Institute of Psychology, Leiden, Netherlands

The amygdalae are crucial in mediating stress effects and have extensive interplay with brain regions involved in emotion and memory. The present study investigated whether acute stress alters amygdala functional connectivity with these areas. Healthy males underwent acute social stress (n=18) or a control procedure (n=20). Hereafter, resting-state fMRI data were acquired. Group differences were analyzed in a priori regions of interest ($p \leq 0.001$, uncorrected). After stress, increased amygdala connectivity with the posterior cingulate cortex and medial orbitofrontal cortex was found. Acute social stress thus has prolonged effects on amygdala functional connectivity with areas involved in emotion processing and regulation.

14:30 *3510*. **Investigating the Deactivation of Default Mode Network Across Multiple Cognitive Task**

Pan Lin[1], Simon Robinson[1], Jorge Jovicich[1,2]

[1]Center for Mind/Brain Sciences, University of Trento, Trento, TN, Italy; [2]Department of Cognitive and Education Sciences, University of Trento, TN, Italy

Recently the task independent deactivation (TID) properties of the default mode network (DMN) have attracted increased attention in the neuroscience community because of their potential functional interpretations. TID refers to a decrease in brain activity during an active task relative to a baseline. However, most deactivation studies have used one or only a few cognitive tasks in the same subjects,

which makes difficult the study TID features. In this study a series of different cognitive systems (language, memory, emotion, mathematics and mental rotation) were tested in a group of subjects to investigate the TID characteristics in DMN, specifically in terms of spatial differences across the various tasks.

15:00 ***3511*. A Comprehensive Study of Whole-Brain Functional Connectivity and Grey Matter Volume in Children and Young Adults**

Dietsje D. Jolles[1,2], Mark A. Van Buchem[2,3], Eveline A. Crone, [3,4], Serge A. Rombouts, [23]
[1]Leiden Institute for Brain and Cognition (LIBC), Leiden , Netherlands; [2]Department of Radiology, Leiden University Medical Centre, Leiden, Netherlands; [3]Leiden Institute for Brain and Cognition (LIBC), Leiden, Netherlands; [4]Developmental and Educational Psychology, Leiden University, Leiden, Netherlands

In the present study we investigated voxel-wise whole-brain functional connectivity in children (11-13 years) and adults (19-25 years), without a priori restriction to specific seed regions or networks. In addition we examined to what extent observed changes in functional brain connectivity could be explained by changes in local grey matter. We show that networks in children were more widespread than adult networks. Moreover, several networks showed altered connectivity in children compared to adults. The majority of the observed changes in functional connectivity could not be explained by changes in grey matter volume.

Wednesday 13:30-15:30 Computer 25

13:30 ***3512*. Default Mode Network: Granger Causality Characterization of Cognitive State Changes**

Pan Lin[1], Simon Robinson[1], Nicola De Pisapia[1], Jorge Jovicich[1,2]
[1]Center for Mind/Brain Sciences, University of Trento, Trento, TN, Italy; [2]Department of Cognitive and Education Sciences, University of Trento, Italy

Characterization of the default mode network (DMN) as a complex network of functionally interacting dynamic systems has received great interest. However, it is still unclear how DMN sub-regions interact during resting state and how these interactions change when task performance. In this study, we used Granger causality method to explore how intrinsic causal temporal interactions within DMN sub regions during resting state may change when subjects perform a task. We find that although the spatial scale of DMN maps during rest and task are similar, the causal relationships in sub-regions show significant changes, suggesting potential markers for potential clinical applications.

14:00 ***3513*. The Effect of Ethanol on Resting State Brain BOLD Signal**

Alex M. Weber[1], Peter Sheffield[1], Michael D. Noseworthy[2]
[1]School of Biomedical Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada; [2]Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

Herein we present the effects of ethanol on resting state blood oxygen level dependent fMRI signal using a novel fractal dimension (FD) analysis technique,correlated with proton MRS detection of ethanol. The FD structure of the resting state BOLD signal in normal healthy males decreased post ethanol ingestion. This correlated with significant ethanol concentration presence in the anterior cingulate cortex and basal ganglia. These findings, although only suggestive, shed further light on alcohol's effect on the brain, specifically the brain's functional connectivity.

14:30 ***3514*. A Multivariate Approach Reveals Interactions of Brain Functional Networks During Resting and Goal-Directed Conditions**

Wei Gao[1], Hongtu Zhu[2], Kelly Giovanello[3], Weili Lin[4]
[1]Biomedical Engineering, UNC-Chapel Hill, Chapel Hill, NC, United States; [2]Biostatistics and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill; [3]Psychology and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill; [4]Radiology and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill

The brain is intrinsically organized by functional networks. However, most of the brain functional imaging studies thus far have largely focused on the interaction of different brain regions instead of among different brain networks. In this study, a multivariate approach was developed to discern the interaction of five predefined brain functional networks, including the default (D), fronto-parietal control (FPC), motor-sensory (MS), visual (V), and language (L) networks during resting, movie watching and finger tapping, respectively. The ability to elucidate the interaction of different brain networks and assess the dynamic perturbations of their interactions under different cognitive statuses should complement our understanding of brain functional interaction on a regional level and offer a more comprehensive insight into how the brain works at a different scale.

15:00 ***3515*. Localization and Detrending of Physiological Noise in Resting State FMRI Using Machine Learning**

Thomas WJ Ash[1], John Suckling[2], Martin Walter[3], Cinly Ooi[2], T Adrian Carpenter[1], Guy B. Williams[1]
[1]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Brain Mapping Unit, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [3]Department of Psychiatry, University of Magdeburg

Using machine learning tools on fMRI imaging data, we can predict the output of a physiological monitoring device with accuracy far better than chance. The model thus derived shows physiological noise to be localized mainly to the cerebrovascular system, CSF and

the brain edge. Upon detrending this noise to the extent that it is no longer predictable, voxel autocorrelation as measured by the Hurst exponent is significantly decreased in the brain parenchyma, in contrast to results when using common physiological noise correction tool RETROICOR, which does not affect autocorrelation in our dataset.

Thursday 13:30-15:30 Computer 25

13:30 ***3516*. Neural Oscillatory Basis of Functional Connectivity MRI Differences Between Semantic Word Tasks**

Johanna M. Zumer[1], Svetlana V. Shinkareva[2], Matthew J. Brookes[1], Paul S. Morgan[3], Peter G. Morris[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Psychology, University of South Carolina, Columbia, SC, United States; [3]Radiology and Radiological Science, Medical University of South Carolina, Charleston, SC, United States

The neural basis of functional connectivity in a semantic word processing task is examined, by comparing whole-brain connectivity matrices obtained from both MEG and fMRI data acquired in the same task and subjects. Novel methods are used for computing the connectivity in both modalities. Changes were observed between task vs rest as well as between task types in relevant brain areas and in multiple neural oscillatory frequency bands.

14:00 ***3517*. Resting State ICA Enhanced with Multi-Echo FMRI**

Prantik Kundu[1], Peter Bandettini
[1]Laboratory of Brain and Cognition, NIMH, Bethesda, MD, United States

It is proposed that the multiple voxel timecourses obtained from multi-echo (ME) fMRI can be input to Independent Components Analysis (ICA) to enhance decomposition quality. Robust hemodynamic activity should be expressed across all contrasts within the TE range for BOLD, and providing fMRI data of multiple TEs should enhance ICA by increasing the representation of true hemodynamic sources, decreasing relative ratios of TE-specific RF noise, and weighting contribution of non-hemodynamic physiological signal towards one TE. The hypothesis is verified, and it is shown that ME fMRI greatly enhances ICA decomposition without prolonging resting fMRI acquisitions otherwise required for larger datasets.

14:30 ***3518*. Discrepancy of Functional Connectivity in Sensorimotor Network Between Pre- And Post-Sleep Conditions**

Po-Yu Liu[1], Yu-Chin Wu[2], Changwei Wesley Wu[3], Chia-Ju Chen[4], Ching-Po Lin[1]
[1]Department of Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan; [2]Institute of Nuclear Engineering and Science, National Tsing-Hua University, Hsinchu, Taiwan; [3]Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan; [4]Department of Medical Imaging and Radiological Sciences, Kaohsiung Medical University, Kaohsiung, Taiwan

Sleep usually refreshes our daily fatigue and rejuvenates our body, which is achieved due to physiological alterations in the sensorimotor network. However, the detailed mechanism of sleep under the brain circuit level remains unclear. To disclose the sleep effects on the sensorimotor system, the functional connectivity in bilateral primary motor cortex (M1) and supplementary motor area (SMA) were compared between Pre- and Post-sleep conditions using the resting-state fMRI. Results showed that connectivity strengths between motor areas were significantly decreased after sleep, implying a relaxing effect after an effective sleep.

15:00 ***3519*. fMRI BOLD Correlates of Individual EEG Alpha Frequency Reveal Working Memory and Attention Related Resting State Networks**

Kay Jann[1], Thomas Koenig[1], Thomas Dierks[2], Chris Boesch[3], Andrea Federspiel[1]
[1]Department of Psychiatric Neurophysiology, University Hospital of Psychiatry, University of Bern, Bern, Switzerland; [2]Department of Psychiatric Neurophysiolog, University Hospital of Psychiatry, University of Bern, Bern, Switzerland; [3]Deptartment of Clinical Research (AMSM), University and Inselspital Bern, Bern, Switzerland

The individual EEG alpha frequency (IAF) is a potential marker for a person’s cognitive abilities. It has been demonstrated that subjects with a higher IAF perform better in working memory tasks. Additionally, there exist resting state networks (RSNs) that are involved in task execution. However, little is known about the functional networks that underlie the IAF. We performed simultaneous EEG-fMRI recordings in 20 subjects and correlated the intra-iondividual IAF fluctuations to fluctuations in the fMRI BOLD signal. The results were spatially compared to RSNs. Our results highlighted a positive association of IAF with RSNs important for attention and working memory.

fMRI: Neuroscience Applications

Hall B Monday 14:00-16:00 Computer 26

14:00 ***3520*.** **Methylphenidate Causes Changes in the Amplitude and Latency of the Breath-Hold Response Function**

Thalia Van der Doef[1,2], Fernando Osmin Zelaya[2], Sarah Lee[2], Astrid Pauls[2,3], Mitul Mehta[2]
[1]VU University Medical Centre, VU University, Amsterdam, Netherlands; [2]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, United Kingdom; [3]VU University, Netherlands

A modified breath-hold (BH) paradigm was used to assess the effect of methylphenidate administration on the BH response function. An oral dose of 40mg of methylphenidate or a placebo were randomly administered to a group of 16 male subjects who took part in two separate scans one week apart. Whilst no statistically significant effect was found on the averaged temporal signal of grey matter, a significant increase in the amplitude of the BH response in the frontal-superior medial cortex (FSMC) was observed; as well as a significant reduction in latency in the putamen, the caudate nucleus and the FSMC

14:30 ***3521*.** **Cerebellar Abnormalities in Adolescents with Marijuana Dependence**

Melissa Lopez-Larson[1,2], Jadwiga Rogowska[3], Deborah Yurgelun-Todd[1,2]
[1]Brain Institute, University of Utah, Salt Lake City, UT, United States; [2]VISN 19 MIRECC, Salt Lake City, UT, United States; [3]Brain Imaging Center, McLean Hospital/Harvard Medical School, Belmont, MA, United States

This is one of the first studies to evaluate cortico-cerebellar circuits in a group of adolescents with heavy marijuana (MJ) use utilizing a bilateral finger tapping fMRI task. Nineteen MJ using adolescents and 19 aged-matched healthy controls (HC) had functional (f)MRI scans on a 3T Siemens Trio scanner, including a standard bilateral fMRI finger tapping sequence. HC were found to have greater activation than MJ for Broadmann's areas 4 and 6 and in the cerebellum. Furthermore, our findings suggest that age of first use and amount of MJ used may have an impact on functioning in the developing brain.

15:00 ***3522*.** **Methamphetamine Abuse Impacts Glial Metabolism**

Napapon Sailasuta[1], Osama Abulseoud[2], Kent Harris[1], Martha Hernandez[2,3]
[1]Clinical MR Spectroscopy, Huntington Medical Research Institutes, Pasadena, CA, United States; [2]University of Southern California, Keck School of Medicine, Los Angeles, CA, United States; [3]Rudi Schulte Research Institute, Santa Barbara , CA, United States

Molecular Imaging in CNS depends upon selective probes which penetrate the blood brain barrier and document receptors, transporters enzymes or metabolic flux rates. 1-13C enriched acetate, a normal cerebral fuel has the unique property of cellular transport into glia and exclusion from neurons. Advances in 13C MR have brought this assay to routine use whereby glial metabolic rate can be assayed in frontal brain without unsafe heat deposition conventionally associated with the 13C method. 50% reduction frontal metabolism of glia was detected in severely methamphetamine dependent patients during the initial phase of abstinence.

15:30 ***3523*.** **Correlation of Changes in Brain Activation and Cognitive Impairment During 30 Hours of Continuous Sleep Deprivation Using Latent Growth Curve Analysis**

Jason Glenn Parker[1], Eric Zalusky[1], J. Lynn Caldwell[2], Regina M. Schmidt[2], Laurie Quill[3], Cemil Kirbas[1], Ke Cheng Liu[4]
[1]Innovation Center, Kettering Health Network, Kettering, OH, United States; [2]Human Effectiveness Directorate, Wright-Patterson AFB, Dayton, OH, United States; [3]Research Institute, University of Dayton, Dayton, OH, United States; [4]Siemens Medical Solutions, United States

Previous studies correlating changes in fMRI activation with sleep deprivation-induced cognitive impairment have assumed a linear increase in cognitive impairment over a period of sleep deprivation, but this method fails to model the nonlinear effects of circadian rhythm on cognition. In this work, we seek to use a latent growth curve analysis which models each individual subject's fatigue vulnerability profile using a 3rd order polynomial to correlate changes in brain activation and deactivation between rested wakefulness and 30 hours of sleep deprivation with cognitive impairment.

Tuesday 13:30-15:30 Computer 26

13:30 ***3524*.** **Functional Imaging of Fibromyalgia Using Empathy for Pain**

Hui-jin Song[1], Joo-hyun Kim[1], Jeehye Seo[1], Moon-jung Hwang[2], Young-ju Lee[2], Kyung Jin Suh[3], Sung Woo Kim[3], Young Hwan Lee[4], Dong Soo Yoo[5], Yongmin Chang[1,6]
[1]Medical & Biological Engineering, Kyungpook National University, Daegu, Korea, Republic of; [2]GE healthcare, Seoul; [3]Dongguk University, Gyungju; [4]Radiology, College of Medicine, Catholic University, Daegu; [5]Radiology, College of Medicine, Dankook University, Chunan; [6]Diagnostic Radiology, Kyungpook National University, Daegu, Korea, Republic of

Fibromyalgia(FM) is disorder of unknown etiology1, characterized by chronic widespread pain and are often accompanied by symptoms of sleep disturbance, anxiety, memory problems, fatigue, and exhaustion. Previous functional imaging studies of FM mainly focused on pain by applying pressure to specific FM tender point. However, there is no emotional and cognitive functional imaging study with FM. Therefore, the aim of this study investigates difference of pain perception between fibromyalgia patient and

healthy controls using empathy for pain task. Based on our finding that the FM group did not show activation in the several pain empathy related areas during the empathy for pain task, the current study suggest that DLPFC and ACC hypoactivity in FM group is associated with a deficit in cognitive function in empathizing and evaluating other's pain.

14:00 ***3525*. Interpersonal Relationships and Intimacy Affect Top-Down Processing of Empathy**

I-Yun Chen[1], Kun-Hsien Chou[2], Chun-Wei Lan[3], Ya-Wei Cheng[1], Ching-Po Lin[1,3]
[1]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan; [2]Institute of Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan; [3]Institute of Biomedical imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan

Being in a close relationship is essential to human life. Such closeness can be described as including other in the self. To what extent does imagining a loved one differ from imagining an unfamiliar individual being in painful situations? In this functional MRI study, participants were exposed to animated stimuli depicting hands or feet in painful and non-painful situations, and instructed to imagine the scenarios perceived from three different perspectives: self, loved one and stranger. The results demonstrate that interpersonal relationships and intimacy affect top-down processing of empathy, as indicated by greater overlap between neural representations of self and other.

14:30 ***3526*. Improved Methods and Analysis in FMRI Studies to Assess Taste and Aroma Integration**

Sally Eldeghaidy[1,2], Luca Marciani[3], Johann C. Pfeiffer[4], Joanne Hort[4], Kay Head[2], Andy J. Taylor[4], Robin C. Spiller[3], Penny A. Gowland[2], Sue Francis[2]
[1]Physics Departement, Suez Canal University , Ismailia, Egypt; [2]Sir Peter Mansfield Magnetic Resonance Centre, Nottingham, United Kingdom; [3]Nottingham Digestive Diseases Centre NIHR Biomedical Research Unit,, Nottingham University Hospitals, Nottingham, United Kingdom; [4]Flavour Research Group, Division of Food Sciences, University of Nottingham, Nottingham, United Kingdom

Improved paradigms (including dual-echo EPI, spray delivered samples and an immediate swallow) and subtraction and conjunction analysis methods have been used to study the crossmodal, supra-additive response to a congruent flavour. We show the control stimulus may cancel out some cortical responses of interest, and that a conjugate analysis is advantageous to subtraction analysis, showing additional supra-additive activity in oral somatosensory areas (SII and inferior parietal areas). This supports the suggested model for flavour perception that the oral somatomotor areas play a principal role in binding taste, aroma and oral somatosensory modalities into the flavour percept.

15:00 ***3527*. Representation of Sweet and Salty Taste Intensity in the Brain**

Maartje Sara Spetter[1], Paul A.M. Smeets[1], Cornelis de Graaf[2], Max A. Viergever[1]
[1]Radiology, Image Sciences Institute, Utrecht, Netherlands; [2]Human Nutrition, Wageningen University, Wageningen , Netherlands

Sucrose and salt are commonly used to season foods. We investigated the brain representation of sweet and salty taste intensity using fMRI. 14 subjects visited twice and tasted a range of four solutions of either sucrose or salt (0 – 1 M). Insula activation increased with increasing concentration for both salt and sucrose. Moreover, despite similar subjective intensity ratings, insula activation by salt increased more with concentration than that by sucrose. Amygdala activation increased with increasing salt concentration only. In conclusion, sweet and salty taste intensity is represented in the insula.The greater responsiveness of the brain to saline provides supports for the idea that sensory-specific satiety may be stronger for savoury than for sweet tastes.

Wednesday 13:30-15:30 Computer 26

13:30 ***3528*. The Neural Correlates of Everyday Recognition Memory.**

Abdelmalek Benattayallah[1], Fraser Milton[2], Nils Muhlert[3], Chris Butler[4], Adam Zeman
[1]Peninsula Medical School, Exeter, Devon, United Kingdom; [2]Psychology, University of Exeter, Exeter, Devon, United Kingdom; [3]Peninsula Medical School, University of Exeter, Exeter, Devon, United Kingdom; [4]University of Oxford

We used an automatic camera, SenseCam, to create a recognition memory test for real-life events. Using fMRI, participants classified images as strongly or weakly remembered, strongly or weakly familiar or novel, 36 hours and 5-6 months after image acquisition. At 36 hours, diverse neocortical regions were activated by recollected and familiar stimuli. There was increasing activation in right hippocampus/ posterior parahippocampal gyrus (pPHG) with increasing memory strength. Strong recollection elicited greater activity in left posterior hippocampus/pPHG than weak recollection. At 5-6 months, MTL activated for familiarity but not recollection memory. Neocortical regions were recruited for both recollection and familiarity processes.

14:00 ***3529*. Altered Working Memory Process in Welders Using N-Back FMRI**

Jeehye Seo[1], Jae-jun Lee[1], Hui-jin Song[1], Joo-hyun Kim[1], Kyung Jin Suh[2], Sung Woo Kim[2], Young Hwan Lee[3], Dong Soo Yoo[4], Yongmin Chang[1,5]
[1]Medical & Biological Engineering, Kyungpook National University, Daegu, Korea, Republic of; [2]Radiology, College of Medicine, Dongguk University, Gyungju; [3]Radiology, College of Medicine, Catholic University, Daegu; [4]Radiology, College of Medicine, Dankook University, Chunan; [5]Diagnostic Radiology, Kyungpook National University, Daegu, Korea, Republic of

Excessive accumulation of Mn in the globus pallidus(GP) is known to cause cognitive and motor deficits in human. Until now pallidal index(PI) in terms of T1 bright signal intensity at GP is only imaging diagnostic measure to manganism. Currently no functional

measure is available for motor behavior of manganese exposure in vivo. The aim of this study investigates motor behavior of manganese exposure compared to normal group using simple motor task. Compared to normal controls, the welder groups showed widespread activations in the supplementary motor area, cingulate motor areas and bilaterally increased activation in the parietal lobe and frontal lobe. This observation suggests the change of motor network in response to Mn accumulation. Therefore, motor fMRI is quite sensitive measure to change of motor network of Mn exposed brain even without T1 high signal at GP and has a great potential as functional diagnostic tool of damaged motor system in occupational exposure to Mn.

14:30 ***3530*. Hippocampal Functional Networking in Wakefulness and Sleep**

Kátia Cristine Andrade[1], Victor I. Spoormaker[1], Martin Dresler[1], Roberto Goya-Maldonado[1], Renate Wehrle[2], Florian Holsboer[1], Philipp G. Sämann[1], Michael Czisch[1]

[1]Max Planck Institute of Psychiatry, Munich, Bavaria, Germany; [2]Institute of Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland

Simultaneous EEG/fMRI resting state data reveal varying hippocampal functional connectivity during wakefulness and NREM sleep. Our data suggest a transition from DMN bound hippocampal connectivity during the waking state to neocortical networking during sleep stage 2. These findings may signify memory consolidation processes hypothesized to occur during sleep.

15:00 ***3531*. Improved BOLD Detection in the Working Memory Network Using a 32 Channel Phased Array Head Coil**

Sheeba Arnold[1], Susan Whitfield-Gabrieli[2], Steven Shannon[1], John Gabrieli[2], Christina Triantafyllou[1,3]

[1]A.A. Martinos Imaging Center, McGovern Institute for Brain Research, MIT, Cambridge, MA, United States; [2]Department of Brain and Cognitive Sciences, MIT, Cambridge, MA, United States; [3]A.A. Martinos Center for Biomedical Imaging, Department of Radiology, MGH, Charlestown, MA, United States

BOLD activations cannot be located precisely with fMRI at low-resolutions. Improved sensitivity of 32-channel coil with high-resolution has been reported, but is yet to be demonstrated using fMRI at 3T. We used the n-back task to evaluate if this combination would identify the working memory (WM) network. 12- and 32-channel data at low- and high-resolutions were acquired in 18 subjects. Paired t-test revealed WM activation for high-resolution to be significantly more with 32-channel compared to 12-channel. When both coils are used at 3T, the increased SNR offered by 32-channel coil produces the greatest benefit for experiments in the high-resolution regime.

Thursday 13:30-15:30 Computer 26

13:30 ***3532*. Cross-Modal Plasticity for Auditory Processing Is Present in Normal-Hearing Children for Non-Speech Stimuli**

Vincent Jerome Schmithorst[1], Scott Kerry Holland[1], Elena Plante[2]

[1]Radiology, Children's Hospital Medical Center, Cincinnati, OH, United States; [2]Speech, Language, & Hearing Sciences, University of Arizona, Tucson, AZ, United States

An fMRI investigation of cross-modal plasticity (the recruitment of visual areas for auditory processing tasks) was conducted in normal-hearing children ages 7-11. Activation patterns from a narrow-band noise task were correlated with two audiological measures of performance on comprehension of degraded speech: speech-in-noise, and time-compressed sentences at 40% comprehension. For both audiologic tests, the visual cortex displayed a negative correlation with test performance, with positive activation present in the worst-performing children. Results indicate that cross-modal plasticity is present even in normal-hearing children and even for non-speech stimuli and that it negatively correlates with comprehension of degraded speech.

14:00 ***3533*. The Rostral Supplementary Motor Area Supports the Repetition of Visually and Auditorily Presented Pseudowords**

Gesa Hartwigsen[1], Stephan Ulmer[2], Annette Baumgaertner[1], Hartwig Roman Siebner[1,3]

[1]Department of Neurology, Christian-Albrechts-University Kiel, Kiel, Germany; [2]Institute of Neuroradiology, University Hospital of Schleswig-Holstein, Kiel, Germany; [3]Danish Research Centre for Magnetic Resonance, Hvidovre University Hospital, Copenhagen, Denmark

We used functional magnetic resonance imaging to delineate areas involved in modality-independent pseudoword repetition in healthy right-handed subjects. A conjunction analysis revealed that the rostral supplementary motor area (rSMA) was activated during pseudoword repetition. Activity in the right rSMA showed increased task-related coupling with activity in the ipsilateral primary motor cortex (M1) and contralateral ventral premotor cortex (PMv) as revealed by a psychophysiological interaction. We show that rSMA is involved in modality-independent pseudoword repetition. The increased task-related influence of rSMA on M1 and PMv during pseudoword repetition suggests a supervisory role of the rSMA on executive motor areas in language production.

14:30 *3534*. **Single Word Reading in Reading Disability Depends on Word Frequency**

Aanandhi Venkatadri[1], Sheryl L. Rimrodt[2,3], Amy Clements[4], Kenneth R. Pugh[5], Laurie E. Cutting[6]

[1]F.M.Kirby Center, Kennedy Krieger Institute, Baltimore, MD, United States; [2]Division of Developmental Medicine, Children's Hospital of Vanderbilt, Nashville, TN, United States; [3]Department of Cognitive Neurology, Kennedy Krieger Institute, Baltimore, MD, United States; [4]Brain Sciences Institute , Johns Hopkins University, Baltimore, MD, United States; [5]Haskins Laboratories, New Haven, CT, United States; [6]Education and Brain Research Laboratory, Vanderbilt University, Nashville, TN, United States

Reading Disabled (RD) and Typically Developing Readers (TDR) were tested on a word discrimination task using high and low frequency words and pseudowords. ANOVAs were used to analyze differences in activation patterns between words versus pseudowords and between high versus low frequency words. For low frequency words, RDs showed greater activation than TDRs in right angular gyrus. For pseudowords, RDs also showed greater activation than TDRs in left superior temporal gyrus and several right hemisphere regions. Our findings suggest modulation of neurobiological response depending on the type of words presented; however, our findings also suggest that this modulation was present regardless of the word imageability level.

15:00 *3535*. **Speech Perception in Noise, SNR Dependent Activity**

Mattias Ragnehed[1], Stefan Stenfelt[1], Ingrid Johnsrude, [1,2], Jerker Rönnberg[1]

[1]Linköping University, Linköping, Sweden; [2]Queens University, Canada

Brain activity induced by auditory speech perception at different noise levels was captured by fMRI. The analysis revealed noise modulated activity in a number of relevant areas. In response to increased noise level reduced activity was found in auditory cortex and lingual gyrus whereas increased activity was observed in dorsolateral prefrontal cortex. This is in line with the idea that higher cognitive functions are engaged in order to extract the available lingual information in an degraded auditory signal.

Animal fMRI

Hall B Monday 14:00-16:00 Computer 27

14:00 *3536*. **Anesthesia Modulated Correlation Between Spontaneous FMRI BOLD and Local Field Potentials in Rat Somatosensory Cortex**

Wen-Ju Pan[1], Garth Thompson[1], Matthew Magnuson[1], Waqas Majeed[1], Dieter Jaeger[2], Shella Keilholz[1]

[1]BME, Georgia Institute of Technology / Emory University, Atlanta, GA, United States; [2]Biology, Emory University, Atlanta, GA, United States

To investigate the relationship between spontaneous fMRI BOLD and neural electrophysiological signal, we developed a combined imaging and recording techniques for the rodent model. By comparing BOLD and local field potential (LFP) in rat somatosensory cortex under different anesthesia states, the studies showed close relationship between the measurements from different modalities and demonstrated that the time lag of the correlation may be modulated by anesthesia types of probe, which provided insights on the neural base of spontaneous BOLD fluctuations.

14:30 *3537*. **Stimulus-Evoked CMRO2 Changes in Non-Human Primate (Baboon): Isoflurane Versus Ketamine**

Hsiao-Ying Wey[1,2], Timothy Q. Duong[1,2]

[1]Research Imaging Institute, UT Health Science Center at San Antonio, San Antonio, TX, United States; [2]Radiology, UT Health Science Center at San Antonio, San Antonio, TX, United States

Brains of large non-human primates are highly evolved with extensive gyrations that are most similar to humans compared to other species, resulting in better recapitulation of many human diseases compared to the more commonly used rodent models. This study compared the stimulus-evoked $CMRO_2$ changes in baboons under isoflurane versus ketamine. Visual and somatosenory stimulations were employed. BOLD and CBF were measured simultaneously using the arterial-spin-labeling technique on a Siemens 3T TIM-Trio. Davis¡¦ biophysical BOLD model was used to calculate $CMRO_2$ changes via hypercapnic calibration. The comparisons of various physiological parameters were made between isoflurane and ketmaine anesthetics.

15:00 *3538*. **Spontaneous Fluctuations of BOLD Signal: Effect of Anesthesia and Functional Significance**

Robert N.S Sachdev[1], Basavaraju G. Sanganahalli[2], Peter Herman[2,3], Fahmeed Hyder[2,4]

[1]Neurobiology, Yale University, New Haven, CT, United States; [2]Diagnostic Radiology, Yale University, New Haven, CT, United States; [3]Human Physiology, Semmelweis University, Budapest, Hungary; [4]Biomedical Engineering, Yale University

We measured spontaneous fluctuations of BOLD signal together with whisker functional stimulation in rat cortex with two slightly different baseline states: lightly anesthetized with domitor and awakened animals (from domitor) to explore the connection between power of spontaneous fluctuations and magnitude of functional response. The same experimental paradigm was applied during the anesthesia and the waking the rats. Both anesthetized and awakened rodents showed similar power in the frequency spectrum of spontaneous fluctuations, but the awakened animals showed higher variability in their functional responses. Therefore difference in functional response cannot be explained by the effect of baseline.

15:30 **_3539_. Functional Networks of the Anesthetized Rat Brain at Rest**

R. Matthew Hutchison[1,2], Seyed M. Mirsattari[3], Craig K. Jones[4], Joseph S. Gati[1], L. Stan Leung[5]

[1]Robarts Research Institute, University of Western Ontario, London, Ontario, Canada; [2]Graduate Program in Neuroscience, University of Western Ontario, London, Ontario, Canada; [3]Clinical Neurological Sciences, University of Western Ontario; [4]F.M. Kirby Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States; [5]Physiology and Pharmacology, University of Western Ontario

This work is an examination of the spatio-temporal dynamics of low-frequency hemodynamic fluctuations of the anesthetized rat brain. Applying independent component analysis to baseline BOLD fMRI timecourses, synchronous bilateral cortical and subcortical networks were observed including: primary and secondary somatosensory cortices; motor cortices; striate cortices; posterior and anterior cingulate; hippocampi; caudate putamen; and thalamic nuclei. Networks were preserved under two different anesthetic regimes: isoflurane and ketamine/xylazine. This technique has allowed a complete exploration of the resting networks in the rat brain that was not afforded by previously used correlational techniques that have been used for rat imaging.

Tuesday 13:30-15:30 Computer 27

13:30 **_3540_. Somatosensory Stimulus Frequency-Dependent Neural, CBF, and BOLD FMRI Responses in Isoflurane-Anesthetized Rat**

Tae Kim[1], Kazuto Masamoto[2], Alberto Vazquez[1], Mitsuhiro Fukuda[1], Seong-Gi Kim[1]

[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States; [2]The University of Electro-communications, Chofugaoka, Japan

Frequency-dependence of neural, CBF, and BOLD fMRI responses on stimulation duration were measured in the isoflurane-anesthetized rats. Higher frequency stimulation produced a larger neural activity per unit time during the early stimulation period, but dramatically decreased for later periods, while lower frequency stimulation induced smaller, but similar field potential amplitude responses maintained over the entire stimulation period. Similar frequency-dependent trends were observed in CBF and BOLD responses. Our findings suggest that the optimal stimulation frequency is dependent on stimulus duration, and it should be aware on the experiment design under isoflurane anesthesia.

14:00 **_3541_. BOLD Temporal Dynamics of Superior Colliculus and Lateral Geniculate Nucleus During Monocular Visual Stimulation**

Condon Lau[1,2], Kyle Xing[1,2], Kevin C. Chan[1,2], 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

The superior colliculus (SC) and lateral geniculate nucleus (LGN) are the main destinations for fibers from the optic nerves. Their functions are important for processing and responding to visual stimuli. BOLD fMRI with TR = 200ms is used to measure the temporal dynamics of the SC and LGN (of Sprague-Dawley rats) in response to monocular visual stimuli to better understand their functions. The results show that the LGN response has smaller amplitude and is delayed relative to the SC response by approximately 0.8s. This shows that the neuronal and/or hemodynamic responses in the SC and LGN are temporally different.

14:30 **_3542_. Functional MRI of Substantia Nigra Upon Visual Flash Illumination**

Kevin C. Chan[1,2], Matthew M. Cheung[1,2], 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

In the mammalian midbrain, increasing evidence suggested a direct projection from the superior colliculus (SC) to the substantia nigra (SN), yet their functional characteristics remain largely unknown. This study explores the capability of blood oxygenation level–dependent (BOLD) fMRI to detect simultaneous activations in SC and SN upon visual flash illumination in order to understand the basic visual properties and hemodynamic responses in this functional connection. Upon monocular stimulation, activations were found predominantly in the contralateral SC and SN, whereas upon binocular stimulation activations were observed in SC and SN of both hemispheres. Significantly lower BOLD percent changes were also observed in the SN of both groups than SC before reaching similar peak heights after stimulation. The current results of having the same visual event initiating afferent inputs to both SC and SN could have important implications for interpreting the responses to biologically salient sensory events in relation to novelty, intensity or reward within the SC-SN connection.

15:00 **_3543_. Cortical and Subcortical Activations by High Field FMRI for Different Sensory Stimuli**

Basavaraju G. Sanganahalli[1], Peter Herman[1,2], Christopher J. Bailey[1,3], Douglas L. Rothman[1,4], Hal Blumenfeld[5,6], Fahmeed Hyder[1,4]

[1]Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Human Physiology, Semmelweis University, Budapest, Hungary; [3]Center of Functionally Integrative Neuroscience, Aarhus University, Denmark; [4]Biomedical Engineering, Yale University; [5]Neurology, Yale University, New Haven, CT, United States; [6]Neuroscience, Yale University

We used 11.7T fMRI to study subcortical activations during tactile and non-tactile stimuli. Forepaw stimulation activates medial portions of the lateral thalamic nucleus. Whisker stimulation activates broader regions within the thalamus. Visual stimulation

activates superior colliculus and lateral geniculate nucleus. Comparison with atlas-based anatomy shows that thalamic activations were in different parts of ventroposterior and laterodorsal nuclei, as well as medial and dorsal parts of the geniculate nucleus, anterior and posterior regions of the pretectal nucleus, and the periaqueductal gray region. Mainly top layers of the superior colliculus were activated. These subcortical regions are implicated in integration of sensory stimuli

Wednesday 13:30-15:30 Computer 27

13:30 ***3544*. Thalamo-Cortical Responses to Deep Brain Stimulation of the Posterior Hypothalamic Nucleus in Rats-An FMRI Study of Neuroconnectivity**

Jeff F. Dunn[1,2], Calvin K. Young[1,3], Ursula I. Tuor[1,4], Campbell Teskey[1,5], Brian H. Bland[1,3]
[1]Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta, Canada; [2]Department of Radiology, University of Calgary, Calgary, Alberta, Canada; [3]Department of Psychology, University of Calgary; [4]NRC Institute of Biodiagnostics, University of Calgary; [5]Departments of Cell Biology and Anatomy/ Psychology, University of Calgary

Deep brain stimulation has been successful at treating Parkinson's disease and has potential for treating other disorders. Neuroconnectivity between regions is important in understanding functional outcome. We stimulated within the posterior hypothalamic nuclei in a rat model (which has been shown to reduce haloperidol and 6-OHDA lesion induced akinesia). We used a novel implantable electrode suitable for use at 9.4T. fMRI responses in the cortex and other regions were monitored. Large regions of the cortex (bilateral) and hippocampus show a positive BOLD response. This extensive neuroconnectivity helps explain the positive response to DBS in the posterior hypothalamic nuclei.

14:00 ***3545*. Combining EEG and FMRI Data from a Wistar Rat: A New Tool for Comparative Neuroimaging**

Akira Sumiyoshi[1], Takeshi Ogawa[1], Ryuta Kawashima[1], Jorge Javier Riera[1]
[1]The Institute of Development, Aging and Cancer (IDAC), Tohoku University, Sendai, Japan

Concurrent recordings of EEG and fMRI are nowadays possible in numerous laboratories for humans. However, its extension to rodents has been limited in terms of the number and the characteristics of the utilized electrodes. Here, we introduce a methodology to obtain EEG recordings from a dense array of scalp electrodes concurrently with fMRI-BOLD in a 7T MRI. We evaluate the performance of the proposed methodology using a conventional forepaw stimulation paradigm in a Wistar rat. By means of the proposed methodology one can have brain electrical source reconstruction in addition to their coupled hemodynamic responses at the level of single voxels.

14:30 ***3546*. The Role of GABA and Glutamate Neuromediators in Generating the BOLD Response**

Daniil P. Aksenov[1], Limin Li[1], George Iordanescu[1], Xiaomu Song[1], Alice Wyrwicz[1]
[1]Center for Basic MR Research, NorthShore Univ. RI, Evanston, IL, United States

Many questions remain about the relationship between the local cellular metabolic and hemodynamic changes measured by fMRI and the underlying neuronal electrical activity. In this study we examined the effect of neuromediators on BOLD and neuronal activity. Simultaneous fMRI and electrophysiological measurements of whisker stimulation were performed before and after localized injection of the GABA agonist and antagonist and glutamate antagonists into the somatosensory cortex. The cocktail of the GABA agonist and antagonist removed stimulus-dependent GABA-ergic responses without affecting the neuronal baseline level and magnitude of the BOLD signal. Glutamate antagonists decreased or abolished BOLD response.

15:00 ***3547*. Power of Spontaneous BOLD Signal and Neural Activity Fluctuations Is Baseline-Dependent**

Peter Herman[1,2], Robert N. S. Sachdev[3], Basavaraju G. Sanganahalli[1], Fahmeed Hyder[1,4]
[1]Department of Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Institute of Human Physiology, Semmelweis University, Budapest, Hungary; [3]Department of Neurobiology, Yale University, New Haven, CT, United States; [4]Department of Biomedical Engineering, Yale University, New Haven, CT, United States

Evoked responses in functional studies show baseline dependence, we asked if we can observe baseline differences in power of spontaneous fluctuations of BOLD signal. We compared spontaneous neural and BOLD signal fluctuations in high and low energy baseline states of light (domitor) and deep (α-chloralose) anesthesia. Extracellular electrodes were used to measure local field potential (LFP) and multi-unit activity (MUA) from middle cortical layers of rat brain and compared these neural signals with BOLD signal (11.7T). Results show that the power of spontaneous LFP or MUA activities is correlated with the magnitude of BOLD signal fluctuations in a baseline-dependent manner.

Thursday 13:30-15:30 Computer 27

13:30 ***3548***. **Repeatability of ASL Cerebral Blood Flow and BOLD Cerebrovascular Reactivity Measurements Using a Computer-Controlled Gas Delivery System in a Pediatric Animal Model**

Jeff D. Winter[1], Jorn Fiestra[2,3], Stephanie Dorner[4], Joseph A. Fisher[5,6], Keith St. Lawrence[7,8], Andrea Kassner[1,9]
[1]Physiology and Experimental Medicine, The Hospital for Sick Children, Toronto, Ontario, Canada; [2]Department of Medical Imaging, University Health Network, Toronto, Ontario, Canada; [3]Department of Neurosurgery, University Health Network, Toronto, Ontario, Canada; [4]Respiratory Therapy, University Health Network, Toronto, Ontario, Canada; [5]Anaesthesiology, University Health Network, Toronto, Ontario, Canada; [6]Physiology, University of Toronto, Toronto, Ontario, Canada; [7]Imaging Division, Lawson Health Research Institute, London, Ontario, Canada; [8]Medical Biophysics, University of Western Ontario, London, Ontario, Canada; [9]Medical Imaging, University of Toronto, Toronto, Ontario, Canada

Cerebrovascular reactivity (CVR) caused by a CO_2 stimulus may improve the assessment of childhood cerebrovascular disease. Reliable BOLD-based CVR measures may be obtained using precise model-driven prospective end-tidal CO_2 targeting (MPET). In this study, we adapted the method of MPET of CO_2 to anesthetised and ventilated animals. BOLD CVR repeatability was assessed in nine mechanically ventilated juvenile pigs. We found excellent BOLD-CVR repeatability (intra-class correlation coefficient > 0.84), which was similar to baseline ASL cerebral blood flow repeatability. Translation of this method to pediatric imaging will enable CVR imaging in small children who require anesthetic for imaging procedures.

14:00 ***3549***. **Impact of Tube Hematocrit on Calibrated FMRI**

Peter Herman[1,2], Basavaraju G. Sanganahalli[1], Daniel Coman[1], Fahmeed Hyder[1,3]
[1]Department of Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Institute of Human Physiology, Semmelweis University, Budapest, Hungary; [3]Department of Biomedical Engineering, Yale University, New Haven, CT, United States

Oxygen consumption has become an important measure of brain function and can be measured by multi-modal measurement of BOLD, blood flow and volume. While discharge hematocrit is unchanged, the tube hematocrit in microvessels (Hct_{micro}) can decrease during activation because it depends on velocities of RBC and plasma. We combined laser-Doppler and fMRI measurements of RBC and plasma velocities to estimate Hct_{micro}. Our results show that Hct_{micro} decrease, corresponding to reduced blood viscosity, needs to be included in functional hyperemic response of the BOLD signal, as without it δCMR_{O2} can be underestimated by as much as 30%.

14:30 ***3550***. **Nonlinear Model for Preprocessing of Cerebral Blood Volume Weighted Functional MRI Data and for Evaluating Pharmacokinetic Properties of USPIO**

Adriana Teodora Perles-Barbacaru[1], Daniel Procissi[1], Andrey Valentinovich Demyanenko[1], Russell E. Jacobs[1]
[1]Caltech Brain Imaging Center, California Institute of Technology, Pasadena, CA, United States

In cerebral blood volume (CBV) weighted pharmacological MRI (phMRI), the R_2*-weighted signal is a nonlinear function of the USPIO concentration in tissue that changes with cerebral activity. The signal recovery caused by USPIO elimination from the blood pool is modeled to assay the USPIO dependent functional sensitivity of the technique and to establish its applicability to study psychoactive drugs in mouse models of disease. The relaxivities and pharmacokinetic properties of three USPIO (MION, MoldayION and P904) are derived and maps of the CBV response to cocaine in mice are computed.

15:00 ***3551***. **Sustained Negative BOLD, CBF, CBV, and CMRO2 FMRI Responses to the Noxious Stimuli in the Rat Striatum at 11.7T**

Yen-Yu Ian Shih[1], Hsiao-Ying Wey[1], Qiang Shen[1], Timothy Q. Duong[1]
[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States

We recently reported that noxious forepaw electrical stimulation increases spike activity but, surprisingly, decreases CBV fMRI signals in the striatum. The present study focused on investigating this apparent discrepancy by performing BOLD, CBF, CBV, and CMRO2 fMRI on the same animals associated with noxious electrical forepaw stimulation at 11.7T. Neurovascular coupling among these hemodynamic and metabolic parameters were analyzed. The animal model and multiparametric fMRI protocol herein may prove useful to study neurovascular uncoupling and dysfunction of the striatum in various neurological disorders.

Myocardial Function Human & Experimental Studies

Hall B Monday 14:00-16:00 Computer 28

14:00 ***3552*. Free Breathing Navigator Gated Cine Cardiac MR at 3T: Feasibility Study in Patients.**

Chika Obele[1], Christopher Sibley[2], Jatin Matta[1], Roderic I. Pettigrew[1], Ahmed M. Gharib[1]

[1]Integrative Cardiovascular Imaging Section, The National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Bethesda, MD, United States; [2]Radiology and Imaging Sciences Department, National Institutes of Health.

We demonstrate the feasibility of obtaining free-breathing cine images utilizing a single respiratory navigator gating technique. This method was made possible by utilizing the high signal-to-noise ratio (SNR) available at 3T to apply parallel imaging methods allowing the acquisition of up to 30 cardiac phases within clinically acceptable imaging time. Compared to traditional breath-holding techniques this methods showed no statistical difference in qualitative and quantitative imaging parameters, thereby, could be used as an alternative for children and patients who are unable to hold their breath.

14:30 ***3553*. Pericardial Fat Overlaying the Left Ventricle: A Better Indicator of Left Ventricular Function**

Ning Hua[1], Zhongjing Chen[1], Sherman Bigornia[1], Alkystis Phinikaridou[1], Ye Qiao[1], Caroline Apovian[1], Hernan Jara[1], Frederick Ruberg[1], James Hamilton[1]

[1]Boston University, Boston, MA, United States

We imaged 40 metabolic syndrome (MetS) subjects as well as 17 healthy controls using MRI to determine if left ventricular (LV) function would be better correlated with LV fat instead of total pericardial fat. We found that in MetS subjects, stroke volume, cardiac output(CO), wall mass, end-diastolic volume and early filling (E) rate were inversely related to LV fat but not RV fat. The total pericardial fat was only correlated with CO and E-rate. This study suggests that LV pericardial fat rather than total pericardial fat might better correlate to LV function, the mechanism of which remains to be defined.

15:00 ***3554*. Real-Time 3D Visualization of the Heart**

Joseph Yitan Cheng[1], Juan M. Santos[1,2], John M. Pauly[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]HeartVista, Inc., Los Altos, CA, United States

The lack of proper visual guidance greatly impairs and lengthens cardiac procedures, such as atrial fibrillation therapy. In this work, we present a practical approach for fast data acquisition and 3D visualization. Acquisition is achieved with a fast multi-slice spiral sequence, and the visualization is achieved with a simple tissue segmentation and surface rendering. With the introduced depth perception, we provide real-time visual feedback for better control in interventional cardiac treatment.

15:30 ***3555*. Assessment of Cardiac Remodelling After Myocardial Infarction in Diabetic Mice Using Self-Gated MRI**

Kristine Skårdal[1], Natale Rolim[1], Ole Christian Eidheim[2], Marius Widerøe[1], Ulrik Wisløff[1], Pål Erik Goa[3], Marte Thuen[1]

[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway; [2]Department of Laboratory Medicine, Children's and Women's Health, Norwegian University of Science and Technology, Trondheim, Norway; [3]Department of Medical Imaging, St. Olavs University Hospital, Trondheim, Norway

Type II diabetic patients suffer from higher susceptibility to develop post myocardial infarction (MI) heart failure. By adapting a self-gated FLASH to a murine model of the diabetic heart, we obtained multiple slices of the left ventricle and assessed changes in cardiac physiology post MI. Diabetic MI mice displayed decreased cardiac contractility and increased end-systolic volume, while non-diabetic MI mice presented increased end-diastolic volume with preserved ejection fraction. These data suggest that imaging of murine hearts is achievable using a self-gated FLASH, and the results are accurate enough to detect differences in functional analysis between genotypes and interventions.

Tuesday 13:30-15:30 Computer 28

13:30 ***3556*. Radial Tagging for Assessment of Circumferential Myocardial Function**

Melanie S. Kotys[1], Xiaopeng Zhou[2], Scott D. Flamm[2], Randy M. Setser[2]

[1]MR Clinical Science, Philips Healthcare, Cleveland, OH, United States; [2]Imaging Institute, Cleveland Clinic, Cleveland, OH, United States

Myocardial tags applied in radial orientation using selective saturation bands may have distinct advantages over SPAMM methods for routine clinical examinations. We compared radial tagged images with 4-16 tag lines and grid tagged images in five volunteers. Analysis revealed that radial tags persisted longer than grid tags and had a comparable first acquired cardiac phase. There was no significant difference in end systolic strain or rotation and 12 radial tag lines had the least variation in both measures. Application of radial tags appears to be as efficient as SPAMM tagging with the potential for clinical analysis of circumferential myocardial function.

14:00 ***3557*. Investigation of High Fat Diet Effects on Myocardial Tryglyceride and Function in Mice**

Marzena Wylezinska[1], Jordi L. Tremoleda[1], Jelena Anastasovska[2], Willy Gsell[1], Jimmy Bell[2]

[1]Biological Imaging Centre, Imaging Sciences Department, MRC Clinical Sciences Centre, Imperial College, London, United Kingdom; [2]Metabolic Imaging Group, MRC Clinical Sciences Centre, Imperial College, London, United Kingdom

The aim was to investigate the effect of high fat diet on myocardial triglyceride and function in preclinical model. Male C57/Bl6 mice were maintained on a high (21%) fat (HF n=6) or a normal (3%) fat diet (C, n=5). Using MRI left ventricular ejection fraction (LVEF) was measured, while localized 1H MRS was used to estimate lipids content in the interventricular septum in animals. Lipid content was significantly increased in HF group, while trend was observed in LVEF decrease in HF group. These preliminary results suggest that high fat diet may have implications on myocardial lipid content and cardiac function.

14:30 ***3558*. In Vivo Cardiac MRI Detects Differential Response to Partial and Complete Akt1 Deficiency**

Katrien Vandoorne[1], Inbal E. Biton[2], Alon Harmelin[2], Michal Neeman[1]

[1]Biological Regulation, Weizmann Institute, Rehovot, Israel; [2]Veterinary Resources, Weizmann Institute, Rehovot, Israel

The PKB/Akt family of intracellular protein kinases regulates cellular growth, proliferation, survival and metabolism. It is known that Akt1/PKBalpha controls heart size and function. Baseline left ventricular structure and function of Akt1/PKBalpha; null, heterozygote and wild type mice, were assessed using retrospectively reconstructed FLASH cine scans with the aid of navigator scans. Here, we showed in vivo, that LV mass and cardiac output are reduced in knockout animals. This reduction is consistent with the reduced body weight. Surprisingly, cardiac hypertrophy observed here by MRI of heterozygote mice, and noted also previously by ultrasound, was resolved in the full Akt1 knockout.

15:00 ***3559*. Measurement of Changes in Left Ventricular Volume and Strain During Isovolumic Relaxation**

June Cheng-Baron[1], Kelvin Chow[1], Ben T. Esch[2], Jessica M. Scott[2], Mark J. Haykowsky[2], John V. Tyberg[3], Richard B. Thompson[1]

[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada; [2]Physical Therapy, University of Alberta, Edmonton, AB, Canada; [3]Cardiac Sciences, University of Calgary, Calgary, AB, Canada

Left ventricular (LV) volume estimated using ventricular dimensions or surface markers have shown increasing volume during isovolumic relaxation, despite closed mitral and aortic valves. The goal of this study is to explain and interpret this volume increase in the context of ventricular relaxation. We measure a 4.6 mL mean increase in LV volume, which is correlated with changes in principle myocardial strains and compensated for by the descent of the mitral leaflets towards the apex. The motion of the leaflets and conformational changes in the LV during isovolumic relaxation likely reflect LV pressure decline and the development of ventricular suction.

Wednesday 13:30-15:30 Computer 28

13:30 ***3560*. Interventricular Synchrony in Chronic Thrombo-Embolic Pulmonary Hypertension Recovers After Endarterectomy**

Gert Jan Mauritz[1], J. Tim Marcus[1], Jochem Bosboom[1], Anton Vonk Noordegraaf[1]

[1]VU University Medical Center, Amsterdam, Netherlands

The aim of this study is to assess whether the Left-Right (L-R) mechanical synchrony in Chronic Thrombo-Embolic Pulmonary Hypertension recovers after pulmonary endarterectomy. Nine patients were included, and underwent MRI myocardial tagging at baseline before, and 1 year after endarterectomy. The L-R delay in peak myocardial circumferential shortening decreased from 95 ± 61 ms at baseline, to 2 ± 47 ms after endarterectomy ($p < 0.05$). Cardiac output increased from 3.7 ± 0.9 lit/min, to 4.8 ± 0.6 lit/min ($p<0.01$). The L-R resynchronization and functional RV recovery are in line with reverse RV remodeling after endarterectomy.

14:00 ***3561*. Effect of Physiological Variation of Heart Rate on Quantitative Cardiac T2 Mapping**

Marion de Roquefeuil[1,2], Anne Menini[1,2], Jean-Marie Escanyé[3], Pierre-Yves Marie[3], Jacques Felblinger[1,2]

[1]U947, INSERM, Vandoeuvre-lès-Nancy, France, France; [2]IADI, Nancy-Université, Nancy, France, France; [3]Department of Nuclear Medicine, CHU, Nancy, France

Heart Rate (HR) variation is around 30 % during healthy subject breath-holds necessary for cardiac MR acquisition. As MR system is synchronized with R peaks, image contrast depends on HR evolution. Especially, cardiac T2 mapping used in heart transplantations and pathologies follow up is biased by HR variation. We propose a method to compensate this systematic error and to improve diagnostic quality: a RR-adjusted corrective factor applied on SE signal in k-space.

14:30 **3562. Cardiac Torsion and Strain in Fatigued Primary Biliary Cirrhosis Patients Investigated by 3T Cardiac Tagging Show Evidence of Accelerated Ageing Processes**

Kieren Grant Hollingsworth[1], David Emerys Jones[2], Roy Taylor[1], Guy A. MacGowan[3], Julia Lindsay Newton[4], Andrew Mark Blamire[1]
[1]Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [2]Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [3]Cardiology, Freeman Hospital, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [4]Institute for Ageing and Health, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom

Primary biliary cirrhosis (PBC) is an autoimmune liver disease affecting females from middle age. After our previous observation that PBC patients have impaired cardiac energetics compared to matched controls while preserving normal cardiac morphology, the same cohort was studied with cardiac tagging at 3T to assess cardiac torsion and strain. Those PBC patients with severe fatigue were found to have significant increases in myocardial peak torsion and reduction in peak strain which have previously been seen to be typical of healthy ageing. This suggests that cardiac changes in fatigued PBC patients may reflect an accelerated ageing process.

15:00 **3563. Magnetic Resonance Imaging (Mri) Characterization of the Functional and Morphological Changes in Heart and Lung After Myocardial Infarction in Mice**

Hasan Alsaid[1], Weike Bao[1], Mary V. Rambo[1], Gregory A. Logan[1], David J. Figueroa[1], Stephen C. Lenhard[1], Charles J. Kotzer[1], Mark E. Burgert[1], Beat M. Jucker[1]
[1]GlaxoSmithKline, 709 Swedeland Rd, King of Prussia, PA, 19406, United States

In this study, MRI was used for the first time to non-invasively and serially assess cardiac dysfunction and lung congestion in a chronic heart failure model, myocardial infarction (MI), in mice. Cardiac and lung MRI were performed at baseline then every three days up to 13 days post-MI. MRI results revealed that MI induced significant pulmonary congestion/edema as detected by increased MRI signal intensity and was associated with increased lung volume and decreased cardiac function. Additionally, significant correlations were observed between lung signal intensity, lung volume, ejection fraction, left ventricular mass and lung wet weight/body weight ratio.

Thursday 13:30-15:30 Computer 28

13:30 **3564. MRI of Longitudinal Myocardial Strain Using Multislice Cine DENSE with Through-Plane Displacement Encoding**

Xiao Chen[1], Xiaodong Zhong, [1,2], Frederick H. Epstein[3]
[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States; [2]MR R&D Collaboration, Siemens Healthcare, Atlanta, GA, United States; [3]Radiology, University of Virginia, Charlottesville, VA, United States

The purpose of the present study was to develop a cine DENSE pulse sequence for quantitative imaging of longitudinal motion, where two adjacent short-axis slices are encoded for through-plane (longitudinal) displacement and are simultaneously acquired. Displacement trajectories measured from the two slices are used to calculate longitudinal strain. By acquiring both slices within a single breathhold, a fixed and consistent distance between the slices is maintained, which enables the accurate calculation of longitudinal strain from the measured longitudinal displacement fields. The sequence and theory were evaluated and demonstrated in normal volunteers.

14:00 **3565. Feasibility of CINE Myocardial T_2^* Mapping Using Susceptibility Weighted Gradient-Echo Imaging at 7.0 T**

Fabian Hezel[1], Tobias Frauenrath[1], Wolfgang Renz[2], Jeanette Schulz-Menger[1,3], Thoralf Niendorf[1,3]
[1]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, Berlin, Germany; [2]Siemens Healthcare, Erlangen, Germany; [3]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany

This study is designed to demonstrate the promise of susceptibility weighted 2D CINE FLASH and T2* Mapping of the heart at 7T.

14:30 **3566. Longitudinal Functional and Structural Characterization of Inducible Heart Specific SOD2 Knock-Out Mice by Cardiac MRI**

Thomas Kaulisch[1], Heiko G. Niessen[1], David Kind[1], Michael Neumaier[1], Julia Tillmanns[1], Lothar Kussmaul[2], Simon Melov[3], Detlef Stiller[1]
[1]In-Vivo Imaging Unit, Dept. of Drug Discovery Support, Boehringer Ingelheim Pharma GmbH & Co. KG, Biberach, BW, Germany; [2]Dept. of CNS Diseases Research, Boehringer Ingelheim Pharma GmbH & Co. KG, Biberach, BW, Germany; [3]Buck Institute for Age Research, Novato, CA, United States

Oxidative stress induced by reactive oxygen species (ROS) plays an important role in heart diseases. Because fatty acid oxidation is carried out in the mitochondria, their dysfunction will have a severe impact on cardiac function. Because ROS are usually reduced by SOD2, a new mouse model (Fsod2H) with inducible knock-down of SOD2 gene was generated. In-vivo imaging was performed from week 32 to 57 of animal age. A significant reduction of heart contractibility and an increase in heart volume were measured for tgSOD2 mice. Overall, MRI allows for longitudinal quantitative assessment of functional and structural changes in the mouse heart.

15:00 ***3567*. Quantitative Assessment of Left Ventricular Function Using Cardiac Phase-Contrast and Cine Magnetic Resonance Imaging Comparison with Pressure-Volume Loops Analysis: *In Vivo* Validation on a Swine Model**

Hung-Yu Lin[1], Fei Wang[2], Waiel Almoustadi[3], Bo Xiang[2], Trevor Lee[3], Rakesh Arora[3], Scott B. King[2], Boguslaw Tomanek[2], Darren Freed[3], Ganghong Tian[2]

[1]Institute for Biodiagnostics, National Research Council of Canada, Winnipeg, Manitoba, Canada; [2]Institute for Biodiagnostics, National Research Coincil of Canada; [3]Saint Boniface General Hospital, Winnipeg, Manitoba, Canada

Noninvasive PC-MRI and cine MRI have been recognized as a valuable and accurate technique to evaluate hemodynamics and heart function. Previous clinical studies suggest that evaluation of the passive relaxation properties serves as a useful indicator of quantitative contractility and function without the influence of relative ventricular load. To our knowledge, the correlation of LV function obtained from noninvasive PC-MRI, cine MRI and invasive P-V loops relation has not been investigated and reported. The aim of the present study was to determine the validity of PC-MRI, cine MRI in the assessment of LV function comparing with dynamic P-V loops analysis.

Myocardial Function: Experimental & Human Studies I

Hall B Monday 14:00-16:00 Computer 29

14:00 ***3568*. Transplantation of Murine Embryonic Stem Cell-Derived Cardiomyocytes Improves Cardiac Function in the Infarcted Heart**

HuaLei Zhang[1], Hui Qiao[1], Nataliya Petrenko[2], Vickas Patel[2], Bin Huang[3], Kenneth Boheler[4], Victor Ferrari[2], Rong Zhou[1]

[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Dept of Medicine(cardiovascular), University of Pennsylvania; [3]Department of Radiology, University of Pennsylvania, PA; [4]National Institute of Aging, NIH

Highly enriched embryonic stem cell derived cardiomyocytes (ESC-CMs) were obtained in large numbers for in vivo study that examined the potential of these cells in the treatment of myocardial infarction. Our data suggest that ESC-CM mediated a teratoma free myocardial repair with significant recovery of regional and global contractile function over the period of 2 months.

14:30 ***3569*. Detecting Real-Time Regional Myocardium Strain Changes Using Fast Strain-Encoded (FSENC) MRI**

Ahmed Amr Harouni[1], Tamer A. Basha[1], Monda L. Shehata[2], Nael Fakhry Osman[1,2]

[1]Electrical and computer Engineering, Johns Hopkins University, Baltimore, MD, United States; [2]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States

Many techniques have been proposed for real-time interactive cardiac MR imaging. However, most of these techniques are limited to only the anatomical information. In this work, we propose to use fast strain-Encoded functional imaging technique to acquire real-time images then use a fully automated segmentation algorithm to provide online anatomical and functional information of regional myocardial regions. This can be useful in real-time monitoring of cardiac strain changes during either stress test, valsalva exercise or interventional operations.

15:00 ***3570*. Cine DENSE MRI with Dual Displacement Encoding**

Xiao Chen[1], Alistair Young[2], Frederick H. Epstein, [1,3]

[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States; [2]Anatomy with Radiology, University of Auckland, Auckland, New Zealand; [3]Radiology, University of Virginia, Charlottesville, VA, United States

The purpose of the present study was to develop a cine DENSE sequence with dual displacement encoding, where two distinct stimulated echoes with different displacement-encoding frequencies are simultaneously stored along the longitudinal axis, and where either can be recalled at any particular time to to better accommodate a temporal sequence of images with different amounts of displacement and deformation at different times. The sequence was implemented on a 1.5T scanner and was evaluated and demonstrated by using a deformable phantom and by imaging the hearts of normal volunteers.

15:30 ***3571*. MRI Characterization of Cardiac Tissue Scaffold Materials in Vitro and in Vivo**

Daniel James Stuckey[1], Hikaru Ishii[2], Aldo R. Boccaccini[2], Carolyn A. Carr[1], Judith A. Roether[2], Qi Zhi Chen[2], Hedeer Jawad[2], Damian J. Tyler[1], Nadire N. Ali[2], Kieran Clarke[1], Sian E. Harding[2]

[1]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, Oxon, United Kingdom; [2]National Heart and Lung Institute, Imperial College, London, United Kingdom

MRI was used to test three different scaffold materials designed for myocardial tissue engineering. Scaffold location, degradation and effect on cardiac function were measured *in vivo* at 1 and 6 weeks after grafting of scaffold onto infarcted rat hearts. The rigid TiO_2-PED scaffold induced microvascular occlusion and necrosis adjacent to the scaffold, resulting in reduced cardiac function by six weeks. The PGS scaffold was not detrimental to function, but MRI showed that the material degraded between 1 and 6 weeks *in vivo*. This study demonstrates the feasibility and importance of using MRI to optimise myocardial tissue engineering strategies.

Tuesday 13:30-15:30 Computer 29

13:30 *3572*. **Measuring the Myocardial Angular Information Through the Radial Tagging**

Abbas Nasiraei Moghaddam[1], J. Paul Finn[1]
[1]Radiology, UCLA, Los Angeles, CA, United States

The angular information of the left ventricle, including the twist, shear and circumferential strain, are of fundamental importance to quantify the regional or global myocardial function . Radial tagging facilitates the measurement of this information . In particular when the density of radial taglines are sufficiently high, it was theoretically shown that the circumferential strain can be measured directly from the K-Space data . In this study we present the application of the circumferential encoding method on the actual cardiac MR images which are tightly tagged in the radial direction using our newly developed sequence. We also show the transmural differences in rotational motion of the left ventricle using these images.

14:00 *3573*. **High Spatio-Temporal Fidelity Nongated Cardiac MRI with a 3 Second Patient-Adaptive Scan**

Behzad Sharif[1], John Andrew Derbyshire[2], Yoram Bresler[1]
[1]Electrical and Computer Engineering, Coordinated Science Laboratory, University of Illinois at Urbana-Champaign, Urbana, IL, United States; [2]Translational Medicine Branch, NHLBI, National Institutes of Health, Bethesda, MD, United States

Patient-Adaptive Reconstruction and Acquisition Dynamic Imaging with Sensitivity Encoding (PARADISE), is a highly accelerated non-gated dynamic imaging scheme that enables artifact-free imaging while providing performance guarantees on achievable SNR and spatio-temporal resolution. In addition to parallel imaging, the method gains acceleration from a sparse physiologically-driven spectral support model (in x-y-f space); hence it is doubly accelerated and adaptive. In this work, we present a modification of the PARADISE method that enables high spatio-temporal fidelity nongated 2D cine imaging with short scan times (3 seconds per slice). The method uses prospective adjustments to the x-y-f-space support to accommodate short scan times.

14:30 *3574*. **Prolonged Right Ventricular Post-Systolic Isovolumic Period in Pulmonary Arterial Hypertension: A Reflection of Diastolic Dysfunction?**

Gert Jan Mauritz[1], J. Tim Marcus[1], Nico Westerhof[1], Pieter E. Postmus[1], Anton Vonk Noordegraaf[1]
[1]VU University Medical Center, Amsterdam, Netherlands

In PAH a prolonged time interval between pulmonary valve closure and tricuspid valve opening is observed. This period is assumed to measure a prolonged right ventricular (RV) relaxation, and to reflect diastolic dysfunction. In this study it was shown that this period is the consequence of a prolonged contraction of the RV free wall which continues after pulmonary valve closure causing a post-systolic contraction. In contrast the RV isovolumic relaxation period is not increased. Therefore, in clinical practice the isovolumic period between pulmonary valve closure and tricuspid valve opening is not a real measure of diastolic dysfunction in PAH patients.

15:00 *3575*. **The Impact of Myosin Heavy Chain Isoforms on Contractile Behavior of the Heart**

Yong Chen[1,2], Julian E. Stelzer[3], Xin Yu[1,2]
[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States;
[2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States;
[3]Department of Physiology and Biophysics, Case Western Reserve University

In the present study, we evaluated the impact of shift in myosin heavy chain (MHC) isoforms on in vivo ventricular function in thyroid-deficient rats. Our results show that increased expression of β-MHC not only reduced the magnitude of peak systolic strain and torsion, but also altered the timing when the myocardium reached peak systole, leading to deteriorated cardiac function in hypothyroid rat hearts.

Wednesday 13:30-15:30 Computer 29

13:30 *3576*. **Increased Left Ventricular Torsion in Hypertrophic Cardiomyopathy Mutation Carriers with Normal Wall Thickness**

Iris Rüssel[1], Wessel Brouwer[1], Tjeerd Germans[1], Paul Knaapen[1], J Tim Marcus[1], Jolanda van der Velden[1], Marco Götte[1], Albert van Rossum[1]
[1]VU University Medical Center, Amsterdam, Netherlands

Hypertrophic cardiomyopathy (HCM) is caused by mutations in mainly sarcomeric genes. Increased left ventricular (LV) torsion has been observed in patients with manifest hypertrophy, but abnormalities in myocardial contractility might already be present in HCM mutation carriers with normal wall thickness. Therefore, LV torsion and endocardial circumferential strain were studied in HCM mutation carriers using MRI tagging. Increased LV torsion and torsion to endocardial circumferential strain-ratio were found in carriers with respect to controls. The observed difference might be due to HCM-related endocardial myocardial dysfunction.

14:00 ***3577*.** **Reconstruction of Line Tagged Cardiac Images by Compressed Sensing Algorithm Using Contourlet Transform from Appropriate K-Space Sampling**

Sung-Min Gho[1], Narae Choi[1], Dong-Hyun Kim[1,2]
[1]Electrical and Electronic Engineering, Yonsei University, Shinchon-Dong, Seoul, Korea, Republic of; [2]Radiology, Yonsei University, Shinchon-Dong, Seoul, Korea, Republic of

RF tagging in cardiac imaging can be used to analyze the heart wall motion. There is always a push towards higher spatial and/or temporal resolution to enable more accurate quantification. This work is on combining line tagged cardiac imaging with the compressed sensing (CS) algorithm and exploiting the distinct k-space feature of tagged images.

14:30 ***3578*.** **Characterization of Vortex Flow in the Left Ventricle by Phase Contrast Magnetic Resonance Imaging**

Samuel Ting[1], Paaladinesh Thavendiranathan[1], Helene Houle[2], Gianni Pedrizzetti[3], Subha V. Raman[1], Mani Vannan[1], Orlando Simonetti[1]
[1]The Ohio State University, Columbus, OH, United States; [2]Siemens Medical Solutions, Mountain View, CA, United States; [3]University of Trieste, Trieste, Italy

Characterization of vortex formation and flow within the heart may be used as tool for diagnosing and understanding pathophysiological conditions of the heart. We present preliminary results demonstrating that phase contrast magnetic resonance imaging may be used to quantitatively evaluate and characterize formation of vortices within blood flow in the left ventricle of the heart.

15:00 ***3579*.** **Quantitative Assessment of Atrioventricular Plane Displacement in Normals and Diastolic Heart Failure-A Cine MRI Study.**

Reena Anand[1], Sohae Chung[1], Sharath Bhagavatula, Leon Axel[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States

In conventional cine MRI, it is observed that the atrioventricular (AV) plane of the heart descends towards the apex during systole and moves back towards the atrium during the diastole. The displacement of the AV plane through the cardiac cycle is an expression of the systolic and diastolic performance of the heart, so that it can be used to detect early diastolic dysfunction. In this study, we have investigated the potential of MRI measurement of left AV plane displacement as a means to assess diastolic dysfunction.

Thursday 13:30-15:30 Computer 29

13:30 ***3580*.** **Combination of Through-Plane Tissue Phase Mapping and SPAMM for 3D Cardiac Motion Assessment**

Anja Lutz[1], Axel Bornstedt[1], Robert Manzke[2], Gerd Ulrich Nienhaus[3], Volker Rasche[1]
[1]University Hospital of Ulm, Ulm, BW, Germany; [2]Philips Research Europe, Hamburg; [3]Institute of Technology, University of Karlsruhe, Germany

Cardiac motion assessment can be performed by tagged imaging combined with HARP analysis and with tissue phase mapping (TPM). The tagging approach enables fast assessment of the in-plane motion component, where TPM can be applied for full assessment of the motion vector in 3D but requires at least fourfold measurement time. In this contribution tagging is combined with TPM for 3D + time motion assessment. There is no information loss of the through plane motion, when tag lines are applied. The combination can be used to reduce imaging time for motion encoding in 3D.

14:00 ***3581*.** **MRI Compatible Treadmill**

Eric L. Foster[1], Mihaela Jekic[1,2], Jacob A. Bender[1,2], John W. Arnold[3], Subha V. Raman[1,4], Orlando P. Simonetti[1,5]
[1]Dorothy M. Davis Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States; [2]Biomedical Engineering, The Ohio State University; [3]Agricultural Technical Institute, The Ohio State University; [4]Internal Medicine, The Ohio State University; [5]Internal Medicine and Radiology, The Ohio State University

Treadmill exercise testing in conjunction with MRI may offer improved diagnosis of heart disease compared to current modalities; however, traditional treadmills can not operate safely within the MR environment. An MR compatible treadmill was developed using hydraulic drive and elevation systems and fiber-optic data transmission, allowing the treadmill to be positioned immediately adjacent to the MR examination table. The treadmill successfully passed MR safety and compatibility tests. Six healthy volunteers were exercised to peak cardiovascular stress and transferred to the MR table. Real time cine imaging was completed within 38±6.4 s, meeting the AHA guideline of imaging within 60 s.

14:30 ***3582*.** **Early Diastolic Strain-Velocity Temporal Relationship Assessment Using SPAMM-PAVE**

Ziheng Zhang[1], Donald P. Dione[1], Peter B. Brown[1], Erik M. Shapiro[1], Chengqing Wu[2], Robert Todd Constable[1], Albert J. Sinusas[1], Smita Sampath[1]
[1]Yale University School of Medicine, New Haven, CT, United States; [2]Yale University School of Public Health, New Haven, CT, United States

A novel MR imaging technique, spatial modulation of magnetization with polarity alternated velocity encoding (SPAMM-PAVE), is presented to investigate the left ventricular early diastolic strain-velocity relationships. This technique provides simultaneous measurements of 1-D myocardial displacement and chamber blood velocity with a high temporal resolution of 14 ms, sensitive to early diastolic events undetectable by current state-of-the-art methods. The reliability of the measurement is demonstrated by an intra-subject study of a normal volunteer. The interplay of regional volumetric changes in the left ventricle in response to filling patterns is investigated through comparing the regional strain and blood inflow velocity curves in 8 normal volunteer studies.

15:00 ***3583*.** **4CH TX/RX Surface Coil for 7T: Design, Optimization and Application for Cardiac Function Imaging**

Matthias Alexander Dieringer[1,2], Wolfgang Renz, [1,3], Tomasz Lindel, [1,4], Frank Seifert, [1,4], Tobias Frauenrath[1], Helmar Waiczies, [1,4], Florian von Knobelsdorff-Brenkhoff[5], Davide Santoro[1], Werner Hoffmann[4], Bernd Ittermann, [1,4], Jeanette Schulz-Menger[2,5], Thoralf Niendorf[1,2]
[1]Berlin Ultrahigh Field Facility, Max-Delbrueck-Center for Molecular Medicine, Berlin, Germany; [2]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany; [3]Siemens Healthcare, Erlangen, Germany; [4]Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany; [5]CMR-Unit Charité Campus Buch, Berlin, Germany

Practical impediments of ultra high field cardiovascular MR (CVMR) can be catalogued in exacerbated magnetic field and radio frequency (RF) inhomogeneities, susceptibility and off-resonance effects, conductive and dielectric effects in tissue, and RF power deposition constraints, which all bear the potential to spoil the benefit of CVMR at 7T. Therefore, a four element cardiac transceive surface coil array was developed. Cardiac imaging provided clinically acceptable signal homogeneity with an excellent blood myocardium contrast. Subtle anatomic structures, such as pericardium, mitral and tricuspid valves and their apparatus, papillary muscles, and trabecles were accurately delineated.

Myocardial Function: Experimental & Human Studies II

Hall B Monday 14:00-16:00 Computer 30

14:00 ***3584*.** **Left Ventricular Dyssynchrony: Effect of Age, Ejection Fraction, Mass and Cardiovascular Disease**

Daniela Foell[1], Bernd Jung[2], Elfriede Schilli[3], Felix Staehle[2], Christoph Bode[3], Michael Markl[2]
[1]Cardiology , University Hospital , Freiburg, Germany; [2]Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany; [3]Cardiology, University Hospital, Freiburg, Germany

MR tissue phase mapping (TPM) was employed to study the relationships of age, heart rate, left ventricular (LV) ejection fraction (EF), and LV-mass with myocardial dyssynchrony among 95 subjects with normal and pathological cardiac function. Compared to age-matched controls significantly ($p<0.01$) enhanced myocardial dyssynchrony was found in patients with hypertensive heart disease (n=18) and dilated cardiomyopathy (n=12) with most prominent changes if left bundle branch block was present (n=7). Multiple regressions revealed significant relationships of dyssynchrony with LV-EF, LV-mass, and age. As sensitive markers for LV dysfunction, both radial systolic and long-axis diastolic dyssynchrony were superior to systolic long-axis dyssynchrony.

14:30 ***3585*.** **MR Assessment of Left Ventricular Strain After Repair of Tetralogy of Fallot**

Karen G. Ordovas[1], Marcus Carlsson[2], Elyse Foster[3], Alison Meadows[4], Alastair Martin[4], Michael Hope[4], Loi Do[4], Charles Higgins[4], Maythem Saeed[4]
[1]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States; [2]Clinical Physiology, Lund University, Lund, Sweden; [3]Cariology, UCSF, San Francisco, CA, United States; [4]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States

15:00 *3586*. **Assessment of Cardiac Function and Infarct Size Following Myocardial Infarction in Mitochondrial Cyclophilin-D Knockout Mice**

Anthony N. Price[1], Shiang Y. Lim[2], Johannes Riegler[1], Derek M. Yellon[2], Derek J. Hausenloy[2], Mark F. Lythgoe[1]

[1]Centre for Advanced Biomedical Imaging, Department of Medicine and UCL Institute of Child Health, University College London, London, United Kingdom; [2]The Hatter Cardiovascular Institute, University College London Hospital and Medical School, London, United Kingdom

Coronary heart disease (CHD) remains one of the leading causes of morbidity and mortality worldwide. A principal symptom of CHD is myocardial infarction (MI), which leads to a complex process of ventricular remodelling and ultimately heart failure. Novel treatment strategies which are capable of limiting myocardial infarct size, preventing LV remodelling and preserving cardiac function are needed to improve clinical outcomes. The inhibition of mitochondrial cyclophilin-D (CypD), has been reported to reduce infarct size in pre-clinical studies. Here we present the first MRI assessment of cardiac function and infarct size in $CypD^{-/-}$ mice at 48 hours following myocardial infarction.

15:30 *3587*. **Healthy Ageing in Females Is Associated with Altered Cardiac Energetics Related to Both Systolic and Diastolic Function: A Comparison of MRS, Cardiac Tagging and Cine Imaging**

Kieren Grant Hollingsworth[1], David Emerys Jones[2], Julia Lindsay Newton[3], Bernard D. Keavney[4], Guy A. MacGowan[5], Andrew Mark Blamire[1]

[1]Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [2]Institute of Cellular Medicine, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [3]Institute for Ageing and Health, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [4]Institute of Human Genetics, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [5]Cardiology, Freeman Hospital, Newcastle upon Tyne, Tyne and Wear, United Kingdom

It is unclear whether there are relationships between cardiac energetics and age-related decline of systolic and diastolic function. 25 healthy females with no previous history of cardiac disease were recruited, covering the age range 18-65. Phosphorus spectroscopy, cine imaging and cardiac tagging were carried out. PCr/ATP ratio was found to decline significantly with age, most strongly in the over 60 group. E/A ratio, peak circumferential strain and torsion recoil rates declined with age, with the first two significantly associated with the PCr/ATP ratio. This suggests that both systolic and diastolic function are associated with energetic changes in ageing.

Tuesday 13:30-15:30 Computer 30

13:30 *3588*. **γ-Sarcoglycan Deficiency Reduces Cardiac Function and T2 in Old Mice**

Sean Charles Forbes[1], Sean Germain[2], Nathan Bryant[3], Glenn A. Walter[3]

[1]Department of Physical Therapy, University of Florida, Gainesville, FL, United States; [2]Department of Pediatrics, University of Florida, United States; [3]Department of Physiology and Functional Genomics, University of Florida, United States

Limb Girdle muscular dystrophy Type 2C is characterized by a deficiency in γ-sarcoglycan, a protein associated with the dystrophin-glycoprotein complex on the cell membrane. In this study, the effects of a lack of γ-sarcoglycan (*Sgsg-/-*) and dystrophin (*mdx*) on cardiac function and myocardium T2 in old mice were examined. The findings indicate that *Sgsg-/-* and *mdx* have a reduced left ventricular ejection fraction compared to age-matched controls, with no differences in *Sgsg-/-* and *mdx*. Also, a shorter T2 was observed in the myocardium of *Sgsg-/-* compared to controls, suggesting an increased prevalence of fibrosis in *Sgsg-/-*.

14:00 *3589*. **Development and Validation of 3 Tesla Functional Cardiac Magnetic Resonance Imaging in Preterm and Term Newborns**

Alan Groves[1], Gaia Chiesa[2], Giuliana Durighel[2], Stephen Goldring[2], Julie Fitzpatrick[2], Sergio Uribe[3], Reza Razavi[4], Jo Hajnal[2], A David Edwards[2]

[1]Institute of Clinical Sciences, Imperial College , London, United Kingdom; [2]Institute of Clinical Sciences, Imperial College, London, United Kingdom; [3]Division of Imaging Sciences, King's College , London, United Kingdom; [4]Division of Imaging Sciences, King's College, London, United Kingdom

The ability to reliably monitor and support the circulation in preterm and term newborns may have a key role in optimising outcome in this population. Cardiac magnetic resonance (CMR) imaging has the potential to significantly advance understanding of cardiac function in sick preterm and term infants. In this work we describe optimisation of cine and phase contrast CMR imaging in newborn infants; assess repeatability of CMR methods and compare this to existing echocardiographic methods; and describe preliminary normative values for cardiac output and systemic flow volume in stable preterm and term infants.

14:30 *3590*. **The Effect of K-Space Trajectory on Strain-Encoded Cardiac MRI**

Elsayed H. Ibrahim[1], Wolfgang Rehwald[2], Sven Zuehlsdorff[2], Richard D. White[1]

[1]University of Florida, College of Medicine, Jacksonville, FL, United States; [2]Siemens AG Healthcare Sector, Cardiovscular MR R&D, Chicago, IL, United States

Strain encoding (SENC) is a newly-developed MRI technique for measuring myocardial strain in the through-plane direction. It requires simple post-processing and gives resolution on the pixel level. With conventional SENC sequence, two separate scans are required to obtain the strain images. Such approach increases scan time and could result in image misregistration in post-processing.

Non-Cartesian k-space trajectories are becoming more popular because they allow for large undersampling with acceptable image quality. In this work, SENC was combined with radial k-space acquisition using interleaved SENC tunings and radial undersampling. Scan time was reduced to one breath-hold with comparable image quality.

15:00 ***3591***. **High Resolution, Functional Real-Time Cardiac MR Imaging Using a Combination of Compressed Sensing and Parallel Imaging**

Tobias Wech[1], Marcel Gutberlet[1], Daniel Stäb[1], Dietbert Hahn[1], Herbert Köstler[1]
[1]Institute of Radiology, University of Wuerzburg, Wuerzburg, Bavaria, Germany

To achieve a sufficient temporal and spatial resolution in functional cardiac MRI, real time acquisition has to be accelerated by a factor of 8 – 10 compared to Fourier MRI. In this work, a combination of compressed sensing and parallel imaging has been implemented, tested in a simulation using undersampled data of a segmented cine acquisition and finally applied to in-vivo data sampled in real time. The reconstructions for the real time acquisition and for the simulated data result in high resolution images with an excellent SNR and do not show any visible artefacts.

Wednesday 13:30-15:30 Computer 30

13:30 ***3592***. **Association Between Left Ventricle Sympathetic Innervation and Torsion in Patients with Type 1 Diabetes**

Scott David Swanson[1], Gisela C. Mueller[1], David Raffel[1], Dorthea Happ[1], Claire S. Duvernoy[2,3], Rodica Pop-Busui[4]
[1]Department of Radiology, University of Michigan, Ann Arbor, MI, United States; [2]Cardiology Section, VA Ann Arbor Health Care System, United States; [3]Department of Internal Medicine, University of Michigan; [4]Department of Internal Medicine; Division of Metabolism, Endocrinology and Diabetes, , University of Michigan

We compare left ventricular torsion as measured by cardiac MR tagging with sympathetic denervation as measure by PET and find that increased torsion is correlated with denervation.

14:00 ***3593***. **Myofiber Developmental Plasticity in Fetal and Adult Pig Hearts Delineated with Diffusion Tensor MRI**

Lei Zhang[1], Huiying Zhang[1], Gregory M. Lanza[1], Samuel A. Wickline[1], Junjie Chen[1]
[1]Washington University School of Medicine, St. Louis, MO, United States

Cardiac function in pre and post-natal stages are different because of reduced workload of right ventricle relative to left ventricle after birth. We hypothesize that myocardial fiber structure in fetal hearts differs from that of adult hearts as a response to the change of cardiac function. Diffusion tensor MRI was used to quantitatively evaluate myofiber structure in mid-gestation, pre-born and adult pig hearts. Helix angle and transverse angle in septum and LV/RV fusion sites were compared between the three groups. Our results showed that contributions of RV myofibers to septum was higher in fetal pig hearts than adult pig hearts. The current observations were in agree with change of cardiac function and reflect the plasticity of myocardial fiber development in response to programmed differential contractile functions before and after birth.

14:30 ***3594***. **Accelerated Simultaneous Multi-Slice Cardiac Cine Imaging Using a Combination of CAIPIRINHA and Compressed Sensing**

Daniel Stäb[1], Tobias Wech[1], Christian Ritter[1], Dietbert Hahn[1], Herbert Köstler[1]
[1]Institute of Radiology, University of Wuerzburg, Wuerzburg, Bavaria, Germany

A combination of CAIPIRINHA simultaneous multi-slice imaging with Compressed Sensing is presented. A technique is generated, effectively accelerating the imaging procedure in slice and phase encoding direction. Several slices are excited simultaneously and shifted with respect to each other in the FOV using RF phase cycles, while k-space is undersampled randomly in incoherent fashion. In the reconstruction process, Compressed Sensing is used to eliminate incoherent artifacts, while a parallel imaging reconstruction separates the simultaneously excited slices. The method shows potential for high quality multi-slice imaging with high acceleration factor.

15:00 ***3595***. **SNR Evaluation of 32 Channel Cardiac Coils in DENSE MRI at 1.5 and 3T**

Andreas Sigfridsson[1,2], Henrik Haraldsson[1,2], Tino Ebbers[1,2], Hans Knutsson, [23], Hajime Sakuma[4]
[1]Clinical Physiology, Linköping University, Linköping, Sweden; [2]CMIV, Linköping University, Linköping, Sweden; [3]Biomedical Engineering, Linköping University, Linköping, Sweden; [4]Radiology, Mie University, Tsu, Mie, Japan

The in-vivo SNR for DENSE MRI was evaluated for 32 channel cardiac coils compared to standard 5 and 6 channel coils at 1.5 and 3T. On average, the 32 channel coils provided 50% higher SNR. The SNR improvement was more pronounced at 3T than at 1.5T, and closest to the chest wall. The higher SNR provides the opportunity for DENSE imaging in a longer portion of the cardiac cycle.

Thursday 13:30-15:30 Computer 30

13:30 ***3596***. **Clinical Cardiac Imaging at 7 Tesla: A Validation Study.**

Joseph J. Suttie[1], Lance DelaBarre[2], Greg J. Metzger[2], Pierre Francois van de Moortele[2], Carl J. Snyder[2], Peter Weale[3], Stefan Neubauer[1], Matthew D. Robson[1], J Thomas Vaughan[2]

[1]Department of Cardiovascular Medicine, University of Oxford, Oxford Centre for Clinical Magnetic Resonance Research, Headington, Oxfordshire, United Kingdom; [2]University of Minnesota, Radiology Center for Magnetic Resonance Research, Minneapolis, MN, United States; [3]Cardiovascular MR Research and Development, Siemens Healthcare, Chicago, IL, United States

Clinical cardiac imaging at 7 T is attractive for spectroscopy, coronary and perfusion imaging. It offers improved signal and contrast to noise, provided technical challenges of ECG and artifacts can be overcome. This study compares SSFP and FLASH imaging at different field strengths: 1.5, 3 and 7 Tesla.

14:00 ***3597***. **Quantifying Right Ventricular Motion and Deformation Using 3D Cine DENSE MRI**

Daniel Alejandro Auger[1], Xiaodong Zhong[2], Ernesta Meintjes[1], Fred Epstein[3], Bruce Spottiswoode[1,4]

[1]MRC/UCT Medical Imaging Research Unit, University of Cape Town, Cape Town, Western Cape, South Africa; [2]MR R&D Collaborations, Siemens Medical Solutions, Atlanta, GA, United States; [3]3Departments of Radiology and Biomedical Engineering, University of Virginia, , Charlottesville VA, United States; [4]Radiology, University of Stellenbosch, Cape Town, South Africa.

Displacement encoding with stimulated echoes (DENSE) is a quantitative MRI technique used for measuring myocardial displacement and strain at a high spatial resolution. Studies quantifying the motion of the right ventricle (RV) have been limited by the RV's thin wall, asymmetric geometry and complex motion. A free-breathing navigator gated spiral 3D cine DENSE sequence has recently been developed, thus providing a well suited tool for capturing the complex behavior of the RV. This study involves analyzing the RV's 3D motion and strain at a previously unattainable spatial resolution. The results are consistent with previous studies using myocardial tagging.

14:30 ***3598***. **Diffusion Tensor Imaging of Healthy and Cryo-Injured Pig Hearts**

Patricia Dreessen de Gervai[1], Victor Yang, Uta Sboto-Frankenstein, Valery Kupriyanov, Lawrence Ryner

[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada

Diffusion Tensor Magnetic Resonance Imaging (DTI) was used to assess myocardial architecture in healthy and in injured excised pig hearts in which cryo-ablation was used to produce targeted infarctions. Using the lesion and penumbral region as seed points, fibers were not detectable in the infarct region, FA was reduced and ADC values increased compared to healthy excised hearts. The penumbral region contained traceable fibers although FA and ADC values were affected. This work suggests that the changes in fiber architecture, FA and ADC involve not only the infarct area but also the adjacent tissue.

15:00 ***3599***. **Retrospective Self-Gated Free-Breathing Radial 3D Cine SSFP CMR Using Self-Calibrated GRAPPA: A Feasibility Study**

Noel C. Codella[1], Pascal Spincemaille[2], Jing Liu[2], Martin Prince[2], Yi Wang[2]

[1]Physiology, Cornell Weill Medical College, New York, NY, United States; [2]Radiology, Cornell Weill Medical College

In this study, a 3D free-breathing self-calibrated radial GRAPPA cine-SSFP pulse sequence was developed to overcome the limitations of 2D breath-hold imaging. Radial k-space sampling was employed to provide z-profile self-navigator to monitor respiratory motion, and to allow for GRAPPA self-calibration.

Myocardial Function: Experimental & Human Studies III

Hall B Monday 14:00-16:00 Computer 31

14:00 ***3600***. **Quantification of 3D Cardiac Motion in Mice Using Multi-Phase DENSE MRI**

Yong Chen[1,2], Jia Zhong[1,2], Xin Yu[1,2]

[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States

In the current study, we developed a multi-phase DENSE imaging method for quantification of 3D myocardial motion in mice. Only five acquisitions were required to quantify both in-plane and longitudinal displacements on one slice. The results showed strong agreement with 2D DENSE methods.

14:30 ***3601*. Analysis of Cardio-Respiratory Motion of the Heart Using GRICS (First Insights)**

Pierre-André Vuissoz[1,2], Freddy Odille[3], Brice Fernandez, [1,4], Maelene Lohezic, [1,4], Adnane Benhadid[1,2], Damien Mandry[2,5], Jacques Felblinger[1,6]

[1]Imagerie Adaptative Diagnostique et Interventionnelle, Nancy-Université, Nancy, France; [2]U947, INSERM, Nancy, France; [3]Centre for Medical Image Computing, University College London, London, United Kingdom; [4]Global Applied Science Lab., GE healthcare, Nancy, France; [5]Departments of Radiology, University Hospital Nancy, Nancy, France; [6]CIC801, INSERM, Nancy, France

Clinical assessment of MRI data (e.g. myocardium function) is usually performed with breath-hold acquisitions. However, cardiac functional parameters are affected by breath-hold. The generalized reconstruction technique GRICS allows free-breathing acquisition protocols, and corrects for motion artifacts by inherently establishing a motion model. Here we show how this model can be used to decouple cardiac and respiratory motion, based on the available ECG and respiratory sensors. In 5 healthy volunteers, we analyzed the respective cardiac and respiratory contribution, in terms of motion vectors, in various regions of interest from the heart, enabling new insights in thoracic motion analysis.

15:00 ***3602*. Highly-Accelerated Real-Time Cine MRI Using Compressed Sensing and Parallel Imaging**

Li Feng[1], Ricardo Otazo[2], Monvadi B. Srichai[2,3], Ruth P. Lim[2], Ding Xia[2], Daniel K. Sodickson[2], Daniel Kim[2]

[1]Sackler Institute of Graduate Biomedical Sciences, New York University School of Medicine, New York, NY, United States; [2]Radiology, New York University School of Medicine, New York, NY, United States; [3]Medicine, New York University School of Medicine, New York, NY, United States

Real-time cine MRI is a necessary cardiac MRI pulse sequence for patients with reduced breath-hold capacity and/or arrhythmia. Currently, dynamic parallel imaging methods, such as TSENSE and TGRAPPA, can be used to achieve an acceleration rate (R) of 2-3, which typically yields relatively low spatial and temporal resolution. We propose to use a joint acceleration technique that combines compressed sensing (CS) and parallel imaging (PI) to exploit joint sparsity for randomly undersampled multicoil data. This study describes highly-accelerated (R>4) real-time cine MRI using the joint CS-PI technology and shows encouraging results using this technology.

15:30 ***3603*. Quantitative Comparison of Left Ventricular Cardiac Volume, Mass and Function Obtained at 7 Tesla with "gold Standard" Values at 1.5 Tesla.**

Anne Brants[1], Maarten Versluis[1], Albert de Roos[1], Jos Westenberg[1], Andrew Webb[1]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands

Recent advances in coil technology have enabled cardiac imaging to be performed at 7T, with high spatial resolution cine-imaging showing particular promise. However, there has been no quantitative assessment of clinically-relevant derived measures of cardiac mass, volume or function. In this current study, ten healthy volunteers underwent cardiac scans at both 1.5T, the gold standard for such measures, and 7T. Values of end-systolic and end-diastolic volumes, ejection fraction, stroke volume an left ventricular end diastolic mass showed no statistical difference between 1.5 and 7T, providing strong validation for the continuing development of high-field cardiac imaging.

Tuesday 13:30-15:30 Computer 31

13:30 ***3604*. Evaluating Left Ventricular Wall Motion Abnormalities Using Centerline Trajectory Mapping**

Ting Song[1,2], Alexander I. Bustamante[3], Jeffrey A. Stainsby[4], Maureen N. Hood[2,5], Vincent B. Ho[2,5]

[1]GE Healthcare Applied Science Laboratory, Bethesda, MD, United States; [2]Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD, United States; [3]Cardiology, National Navy Medical Center, Bethesda, MD, United States; [4]GE Healthcare Applied Science Laboratory, Toronto, ON, Canada; [5]Radiology, National Navy Medical Center, Bethesda, MD, United States

This paper presents Centerline Trajectory Mapping (CTM) method as a quantitative tool for characterization of focal and global wall motion abnormalities using long axis views of the left ventricle. Evaluation of CTM with myocardial delayed enhancement imaging and echocardiography with great consistency in wall motion abnormality detection. The proposed method does not add any extra scans to existing clinical cardiac MR routine and can be utilized in retrospective studies.

14:00 ***3605*. Orientation and Magnitude of the Left Ventricular Principal Strains Are Sensitive to Ischemic Injury**

Chun Xu[1], Kevin Koomalsingh[1], Gamaliel Isaac[2], Joseph H. Gorman[2], Robert C. Gorman[2], Lawrence Dougherty[2], James Pilla[2]

[1]University of Pennsylvania , Philadelphia, PA, United States; [2]University of Pennsylvania, Philadelphia, PA, United States

Accurate assessment of regional and global left ventricular (LV) functions is critical for ischemic heart disease. The orientation and the magnitude of the myocardial principal strains have been shown to be sensitive to ischemic development. This study presents a method to fully characterize the alterations in the magnitude and orientations of principal strains in a pig left ventricle. The computaed decreases in principal strains due to introduced infarct are confirmed by implanted markers and perfusion image, indicating impaired

transmural thickening and circumferential shortening. Characterization of the remote, border zone and infarct 3D strain is paramount in understanding infarct expansion and in the development of therapies to mitigate remodeling.

14:30 ***3606*. Cardiac Valve Position Prediction in CINE-BSSFP Images Using SURF**

Hendrikus Joseph Alphons Crooijmans[1], Philippe C. Cattin[2], Oliver M. Weber[1,3], Klaus Scheffler[1]

[1]Division of Radiological Physics, Department of Medical Radiology, University of Basel Hospital, Basel, Switzerland; [2]Medical Image Analysis Center (MIAC), University of Basel, Basel, Switzerland; [3]Siemens Healthcare, Zürich, Switzerland

The interest point detector and region descriptor SURF finds features in every image/phase of a series of CINE-bSSFP images. By the help of user input, the best feature is selected in a Matlab program and corresponding features are automatically detected. If no feature is found within preset limits, it is created by linear interpolation. User indicated points of interest are described as a function of the position and diameter of the feature (all in the first image/phase), and can therefore be repositioned based on the corresponding features in the succeeding images/phases. This method provides reliable fast online valve position detection.

15:00 ***3607*. Comparison of Left Function Assessment Using Phonocardiogram and Electrocardiogram Triggered 2D SSFP CINE MR Imaging at 1.5 T and 3.0 T**

Tobias Frauenrath[1], Meike Becker[2,3], Fabian Hezel[1], Gabriele A. Krombach[2], Ute Kremer[2], Jeanette Schulz-Menger[1,3], Thoralf Niendorf[1,3]

[1]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, 13125 Berlin, Germany; [2]Department of Radiology, University Hospital, RWTH, 52074 Aachen, Germany; [3]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, 13125 Berlin, Germany

As high-field cardiac MRI (CMR) becomes more widespread the propensity of ECG to distortions and mistriggering increases and with it the motivation for a cardiac triggering alternative. Hence, this study explores the suitability of acoustic cardiac triggering (ACT) for left ventricular (LV) function assessment in healthy subjects at 1.5T and 3.0T.

Wednesday 13:30-15:30 Computer 31

13:30 ***3608*. Improved Myocardial Mechanics as Assessed by MRI Generated Pressure-Volume Loops Following AAV6-Mediated βARKct Gene Delivery.**

James J. Pilla[1], Jabaris D. Swain, Michael G. Katz, Anthony Fargnoli, Marina Sumaroka, Catherine Tomasulo, Mihail Petrov, Rose Nolen-Walston, JanLee Jensen, Hansell Stedman, Walter J. Koch[2], Joseph Rabinowitz[2], Charles R. Bridges

[1]University of Pennsylvania, Philadelphia, PA, United States; [2]Thomas Jefferson University

Genetic modulation of ventricular function and remodeling may offer a novel therapeutic strategy for patients with acute ischemic left ventricular (LV) dysfunction. We hypothesize that âARKct gene therapy will amplify the cardiac response to a beta-adrenergic agonist resulting in improved function and efficiency as measured by MRI. MRI generated PV loops demonstrated that âARKct expression improves global LV systolic performance and efficiency relative to controls. These results in a normal ovine subject, using a novel, cardiac-specific gene delivery platform (MCARDTM) are predictive of long term efficacy in a clinically relevant large animal HF model.

14:00 ***3609*. Comparison of Magnetic Resonance Imaging and Doppler Echocardiography for the Evaluation of Diastolic Function in Patients with Hypertrophic Cardiomyopathy**

Yeon Hyeon Choe[1], Eun Young Kim[2]

[1]Radiology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of; [2]Radiology, Samsung Medical Center, Seoul, Korea, Republic of

Diastolic function parameters (mitral inflow velocities, deceleration time, E/A ratio) using phase contrast MRI showed good correlation with that of echocardiography in patients with hypertrophic cardiomyopathy. Analysis of pulmonary vein flow velocity was feasible on MRI and give additional information on diastolic function analysis.

14:30 ***3610*. Evaluation of Patients with Systemic Sclerosis Prior to Hematopoietic Stem-Cell Transplantation Using Cardiac Magnetic Resonance Imaging**

Amir H. Davarpanah[1], Aya Kino[1], Kirsi Taimen[1], Philip Hodnet[1], Cormac Farrelly[1], Jeremy Collins[1], Sanjiv Shah[2], Karin Dill[1], Richard Burt[3], James Carr[1]

[1]Department of Radiology, Cardiovascular Imaging, Northwestern University, chicago, IL, United States; [2]Department of Cardiology, Northwestern University, chicago, IL, United States; [3]Department of Immunotherapy, Northwestern University, chicago, IL, United States

Using time to peak systole (TPS) from volumetric assessment of right ventricle, may have an important role in detecting both the presence and severity of pulmonary hypertension (PH); It may apply to patients with systemic sclerosis overall, in whom early detection of PH is of significant clinical importance.

15:00 ***3611*. An Optimal Physiologic Model for Study of Murine Cardiac Function Under Inhalational Anesthesia**

Christakis Constantinides[1], Richard Mean[1], Laurence W. Hedlund[2]
[1]Mechanical and Manufacturing Engineering, University of Cyprus, Nicosia, Cyprus; [2]Radiology, Duke University Medical Center, Durham, NC, United States

While cardiac mechanical functional studies initially focused on large mammals and the human, the mouse emerged as the preferred animal species for research in recent years. Albeit evidence supports that bioenergetically and hemodynamically the mouse scales linearly with larger mammals and humans, important physiological questions still remain for the appropriateness of this model for extrapolation of conclusions to man. Since the complete characterization of the mouse and human genomes in 2002 and 2003 respectively, there has been a plethora of transgenic mouse studies targeting the cardiovascular system. Equally important were non-invasive imaging studies of such animals for phenotypic and genotypic screening, often conducted under inhalational anesthesia. Anesthetics, however, are known to cause severe cardio-depression with adverse physiological effects on hormonal release, centrally to the heart and peripherally to the vasculature, at the cellular level, affecting calcium entry through L-type Ca2+ channels, the calcium binding sensitivity of the contractile proteins to calcium, and on conduction and excitability. The objective of this study was to determine the isoflurane dose in normal mice for optimal physiological status (respiration, cardiac function, and metabolism) for a period of 1-2 hours post-induction, facilitating migration of such work to the non-invasive imaging platform of MRI, with tremendous potential for future basic science towards the phenotypic screening of transgenic mice and translational research.

Thursday 13:30-15:30 Computer 31

13:30 ***3612*. The Patho-Physiological Sensitivity of Cardiac MR Elastography: Preliminary Results.**

Thomas Elgeti[1], Mark Beling[2], Dieter Klatt[1], Sebastian Papazoglou[1], Sebastian Hirsch[1], Kerstin Riek[1], Bernd Hamm[1], Jürgen Braun[3], Ingolf Sack[1]
[1]Institut für Radiologie, Charité Universitätsmedizin , Berlin, Germany; [2]Klinik und Poliklinik für Kardiologie, Charité Universitätsmedizin , Berlin, Germany; [3]Institut für Medizinische Informatik und Biometrie, Charité Universitätsmedizin , Berlin, Germany

MR Elastography (MRE) is capable to directly measure tissue stiffness. This is particularly interesting for cardiac applications, since the cardiac shear modulus changes over the cardiac cycle. It is known, that increasing myocardial stiffness yields decrease of wave amplitudes in MRE. Therefore, left ventricular shear wave amplitudes were measured in 11 healthy volunteers and 11 patients with relaxation abnormalities. It is observed, that shear wave amplitudes are significantly lower in the left ventricle of patients. This result indicates the sensitivity of amplitude-based cardiac MRE to identify increased myocardial stiffness.

14:00 ***3613*. Relationship Between Mitral Velocity and Mitral Flow Time-Profiles During Ventricular Filling**

June Cheng-Baron[1], Jessica M. Scott[2], Ben T. Esch[2], Mark J. Haykowsky[2], John V. Tyberg[3], Richard B. Thompson[1]
[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada; [2]Physical Therapy, University of Alberta, Edmonton, AB, Canada; [3]Cardiac Sciences, University of Calgary, Calgary, AB, Canada

It has been shown that blood velocity waveforms measured at the conventional mitral leaflet tips location do not match mitral flow waveforms. In this study we quantify the relationship between velocity profiles at several points along the inflow path and volumetric flow, illustrating the dependence of commonly derived diastolic parameters (E/A ratio, deceleration time) on the measurement approach. Velocity profiles and derived parameters vary significantly over small (1 cm) intervals and are distinct from flow profiles. Velocity-time curves above the conventional leaflet tip location (in the atrium) are less susceptible to measurement error and are most similar to flow curves.

14:30 ***3614*. Cine DENSE and Manganese-Enhanced Cardiac MRI Demonstrate That ENOS Does Not Play a Determining Role in Modulating the Effects of ß-Adrenergic Stimulation**

Moriel H. Vandsburger[1], Brent A. French[1], Xiaodong Zhong[1,2], Christopher M. Kramer[1], Frederick H. Epstein[1]
[1]University of Virginia, Charlottesville, VA, United States; [2]MR R&D Collaborations, Siemens Healthcare, Atlanta, GA, United States

Dynamic manganese-enhanced MRI and cine DENSE MRI can be used to probe calcium flux and contractile function in vivo in the mouse heart. Using these methods, we sought to elucidate the role of endothelial nitric oxide synthase (eNOS) in modulating calcium flux and contractile function. Counter to the prevailing opinion, which suggests that eNOS inhibits basal calcium flux, we found that eNOS does not play a role in modulating either calcium flux or contractile function at baseline, during β-adrenergic stimulation, or during muscarinic inhibition of β-adrenergic stimulation.

15:00 ***3615*. Adaptive Method for Black Blood Cardiac Imaging in End-Systolic Rest Improves Visualization of the Right Ventricular Wall**

Brice Fernandez[1,2], Julien Oster[2,3], Maelene Lohezic[1,2], Damien Mandry[2,4], Olivier Pietquin, [2,5], Pierre-André Vuissoz[2,3], Jacques Felblinger[2,3]

[1]Global Applied Science Lab., GE Healthcare, Nancy, France; [2]IADI lab., Nancy-Université, Nancy, France; [3]U947, INSERM, Nancy, France; [4]Departement of Radiology, CHU Nancy, Nancy, France; [5]IMS Research Group, Supelec, Metz, France

Conventional Double Inversion Recovery Fast Spin Echo (DIR-FSE) sequence provides detailed anatomical information in cardiac MRI. However, the preparation time required to cancel blood signal is too long to acquire DIR-FSE during the end-systolic rest. To overcome this constraint, two methods are described. The first one relies on the assumption that the RR intervals are constant whereas the second method is based on an adaptive RR interval prediction algorithm. These approaches were evaluated on 14 healthy volunteers; results demonstrated the robustness of the adaptive method with a better delineation of the right ventricle wall than with the conventional DIR-FSE.

Myocardial Perfusion: Experimental Models & Human Studies

Hall B Monday 14:00-16:00 Computer 32

14:00 ***3616*. A New Quantitative Imaging Biomarker for Identifying Critical Coronary Artery Stenosis with Myocardial BOLD MRI**

Sotirios A. Tsaftaris[1,2], Xiangzhi Zhou[2], Debiao Li[2,3], Rohan Dharmakumar[2]

[1]Electrical Engineering and Computer Science, Northwestern University, Evanston, IL, United States; [2]Radiology, Northwestern University, Chicago, IL, United States; [3]Biomedical Engineering, Northwestern University, Evanston, IL, United States

Blood-oxygen-level dependent (BOLD) MRI may be used for detecting myocardial oxygenation changes secondary to coronary artery stenosis (CAS). Under pharmacological stress, areas of the myocardium supplied by a stenotic coronary artery appear hypointense relative to healthy regions in BOLD images. The purpose of this work is to present a fundamentally new approach for visualizing and quantifying regional myocardial BOLD signal changes. This approach, tested in canines, relies on the statistical identification of myocardial pixels affected by CAS, correlates strongly with true flow measurements, and most importantly, leads to a significant increase in sensitivity to microvascular flow changes compared to previous approaches.

14:30 ***3617*. Comparison of Systolic and Diastolic Myocardial Perfusion by Dynamic Contrast Enhanced MRI**

Aleksandra Radjenovic[1], John D. Biglands[1], Abdulghani Larghat[1], John P. Ridgway[1], Michael Jerosch-Herold[2], John P. Greenwood[1], Sven Plein[1]

[1]School of Medicine, University of Leeds, Leeds, England, United Kingdom; [2]Brigham and Women’s Hospital, Harvard Medical School, Boston, MA, United States

Dynamic contrast-enhanced MRI was performed in 17 volunteers to simultaneously assess systolic and diastolic myocardial blood flow (MBF). At rest transmural MBF estimates were similar in systole and diastole (1.6 ± 0.42 vs 1.7 ± 0.49 ml/g/min, $p>0.05$). During adenosine-induced hyperaemia, MBF was significantly lower in systole than diastole (4.3 ± 0.93 vs 5.7 ± 1.7 ml/g/min, $p < 0.0001$). Subendocardial MBF was higher than subepicaridal MBF, apart from systole at stress where this relation was reversed. In conclusion, estimates of hyperaemic MBF differ significantly between systole and diastole, following the expected physiological pattern of preferential diastolic filling.

15:00 ***3618*. Mouse Myocardial First-Pass Perfusion Imaging**

Bram F. Coolen[1], Rik PM Moonen[1], Leonie EM Paulis[1], Tessa Geelen[1], Larry de Graaf[1], Klaas Nicolay[1], Gustav J. Strijkers[1]

[1]Biomedical NMR, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands

A method that allows myocardial first-pass perfusion measurements in mice is presented. Using a combination of segmented saturation-prepared FISP acquisition and GRAPPA parallel imaging allows a temporal resolution of one image every three heart beats with an acquisition time of less than 16 ms. First-pass perfusion images showed the influx of contrast agent into the myocardium with sufficient temporal resolution to derive semi-quantitative perfusion values. These were found significantly lower in a mouse with myocardial infarction compared to healthy control mice.

15:30 ***3619*. Theory-Based Single-Point T_1 Mapping for Quantitative Analysis of First-Pass Cardiac Perfusion MRI: A Validation Study**

Elodie Breton[1], Daniel Kim[1], Sohae Chung[1], Leon Axel[1]

[1]Research Radiology - Center for Biomedical Imaging, New York University Langone Medical Center, New York, NY, United States

Quantitative analysis of first-pass contrast-enhanced cardiac perfusion MRI requires the signal-time curve be converted to Gd-DTPA concentration-time curve. A theory-based single-point T_1 measurement method has been proposed and validated in phantoms at 1.5T. In this study at 3T, the sensitivity to B_1 variations and blood inflow of the single-point T_1 mapping method was first evaluated

depending on its linear or centric k-space trajectory. Then, the centric k-space trajectory T_1 mapping pulse sequence was validated in vivo against a multi-point saturation recovery T_1 measurement method in the left ventricular myocardium and cavity.

Tuesday 13:30-15:30 Computer 32

13:30 ***3620*. Optimization of Spiral Pulse Sequences for First-Pass Myocardial Perfusion Imaging**

Michael Salerno[1], Christopher M. Kramer[2], Christopher Sica[3], Craig H. Meyer[4]
[1]Department of Medicine, Cardiology, University of Virginia, Charlottesville, VA, United States; [2]Department of Radiology, University of Virginia, Charlottesville, VA; [3]Biomedical Engineering, Hershey Medical Center, Hershey, PA; [4]Biomedical Engineering, University of Virginia, Charlottesville, VA

Optimized Spiral Pulse Sequences may have advantages for clinical myocardial perfusion imaging. The goal of this project was to evaluate how variations in the readout duration per interleaf, number of spiral interleaves, and spatial resolution affect the image quality and artifacts for first-pass myocardial perfusion imaging using spiral trajectories in human subjects.

14:00 ***3621*. A Fully Quantitative Pixel Based Approach for Measuring Myocardial Blood Flow in First-Pass Contrast-Enhanced Perfusion MRI: Microspheres Validation in Dogs and Feasibility Study in Humans**

Li-Yueh Hsu[1], Daniel W. Groves[1], Anthony H. Aletras[1], Peter Kellman[1], Andrew E. Arai[1]
[1]National Institutes of Health, Bethesda, MD, United States

We developed a fully quantitative method to estimate myocardial blood flow (MBF) in first-pass contrast-enhanced perfusion MR images at the pixel level. The results were validated in an animal model and show that the MR perfusion estimates correlated with microspheres over a wide range of absolute MBF. To test feasibility in humans, the method was also applied to clinical perfusion MR images to estimate pixel-wise MBF at rest and during stress.

14:30 ***3622*. First-Pass Cardiac Perfusion Imaging of the Infarcted Rat Heart**

Daniel James Stuckey[1], Carolyn A. Carr[1], Stephanie Meader[1], Damian J. Tyler[1], Kieran Clarke[1]
[1]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, Oxon, United Kingdom

We developed a first-pass cardiac perfusion imaging method which identified regions of perfusion deficit in the infarcted rat heart. Seven days after infarction, cine-MRI was combined with first-pass imaging, which acquired one image per heartbeat during Gd-DTPA bolus. Perfusion deficit at 7 days was larger in rats that went on to develop greater cardiac impairment by 42 days, and provided a more accuracy early indicator of the extent of myocardial infarction than ejection fraction. First-pass MRI will be useful for evaluation of rodent models of human disease and experimental therapies, including cytokine and stem-cell mediated angiogenesis in the infarcted heart.

15:00 ***3623*. Myocardial Perfusion MRI at 3.0T with Sliding-Window Conjugate-Gradient HYPR for the Detection of Coronary Artery Disease**

Heng Ma[1], Lan Ge[2], Dong Xu[1], Qing Tang[1], Han Li[1], Yu Zhang[1], Jiabin Liu[1], Qi Yang[1], Jing An[3], Lixin Jin[4], Renate Jerecic[4], Xiangying Du[1], Kuncheng Li[1], Debiao Li[2]
[1]Xuanwu Hospital, Capital Medical University, Beijing, China; [2]Radiology, Northwestern University, Chicago, IL, United States; [3]Siemens Mindit Magnetic Resonance Ltd, Shenzhen, China; [4]Siemens Ltd, Healthcare Sector, China

SW-CG-HYPR is a promising method to improve the myocardial perfusion MR imaging with reduced acquisition window, increased spatial coverage, improved spatial resolution and SNR. In this work, 10 patients with suspected CAD were scanned at 3.0T with SW-CG-HYPR. Our initial results show that myocardial perfusion MRI at 3.0T with SW-CG-HYPR is feasible in a clinical population, and has high image quality and diagnostic accuracy in patients with suspected CAD.

Wednesday 13:30-15:30 Computer 32

13:30 ***3624*. Myocardial Perfusion Imaging with Variable Density Spiral Trajectories**

Michael Salerno[1], Christopher M. Kramer[2], Craig H. Meyer[3]
[1]Department of Medicine, Cardiology, University of Virginia, Charlottesville, VA, United States; [2]Department of Radiology, University of Virginia, Charlottesville, VA; [3]Biomedical Engineering, University of Virginia, Charlottesville, VA

Variable density (VD) spiral trajectories are an efficient method for data acquisition and may be advantageous for first pass myocardial perfusion imaging. By only partially correcting the variable density, k-space is weighted by a smooth function which reduces Gibbs Ringing. This strategy is employed to further reduce dark-rim artifacts for spiral myocardial perfusion imaging.

14:00 ***3625*. Rapid Quantification of Arterial Input Function and Myocardial T1 Changes in Mice During Contrast Agent Injection**

Wen Li[1,2], Wei Li[1,2], Chris Flask[2,3], Mark Griswold[2,3], Xin Yu[1,2]
[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States; [3]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States

A modified ECG-triggered saturation recovery Look-Locker (MSRLL) method was developed for quantification of arterial input function via rapid T1 mapping in dynamic contrast enhanced MRI (DCE-MRI) studies. High temporal resolution (< 2 min) was achieved by acquiring only the low spatial frequency lines. High spatial frequency lines acquired before contrast were used to generate composite images with higher spatial resolution. Validation was performed by comparing T1 values measured with SRLL and MSRLL method in both phantom and in vivo mouse heart. The in vivo application of MSRLL in DCE-MRI studies was demonstrated in mouse heart. These results suggest that MSRLL may provide a robust method for rapid T1 mapping of blood and myocardium in cardiac DCE-MRI studies.

14:30 ***3626*. The Contribution of Cardiac Motion to Dark Rim Artifacts in Myocardial Perfusion Scans**

Li Zhao[1], Michael Salerno[2], Christopher M. Kramer, [23], Craig H. Meyer[1,3]
[1]Biomedical Enginnering, 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

The Dark Rim artifacts in adenosine stress perfusion imaging are not completely understood, with Gibb's ringing and cardiac motion thought to be contributing factors. In this work we provide strong support to the idea that dark rim artifacts come from motion by experimental data, and it also shows that these artifacts are more significant in some portions of the cardiac cycle than in others. Moreover, a 1D motion model is developed and used to predict how dark rim artifacts vary over the cardiac cycle.

15:00 ***3627*. A Comprehensive MR Examination of the Heart in Less Than 25 Minutes Using a Semi-Automated Image Acquisition Prototype**

Michaela Schmidt[1], Giso von der Recke[2], Peter Speier[3], Saurabh Shah[4], Carmel Hayes[3], David Hardung[2], Heyder Omran[5], Edgar Mueller[6]
[1]MR Application Development, Healthcare Sector, Siemens AG , Erlangen, Germany; [2]St.-Marien-Hospital , Bonn, Germany; [3]MR Application Development, Healthcare Sector, Siemens AG, Erlangen, Germany; [4]MR R&D, Healthcare Sector, Siemens AG, Chicago, IL, United States; [5]St.-Marien-Hospital, Bonn, Germany; [6]MR Application Development, Healthcare Sector, Siemens AG, erlangen, Germany

In this study we evaluated a prototype designed for simplicity and speed in CMR examinations. Sixty five patients with suspected ischemic heart disease were imaged with the prototype. The prototype offers, among others, user guidance and patient-centric parameters, simplified, marker-based localization of the heart and automatic FOV calculation. Two users were experienced in and one user was inexperienced in CMR imaging. Without reducing the accuracy and quality of the result, examination times below 25 minutes could be achieved for the experienced users, the beginner managed to successfully complete cardiac examinations with excellent image quality in around 30 minutes.

Thursday 13:30-15:30 Computer 32

13:30 ***3628*. High Resolution 3D Cardiac Perfusion Imaging Using Compartment-Based *k-T* PCA**

Viton Vitanis[1], Robert Manka, [1,2], Henrik Pedersen[3], Peter Boesiger[1], Sebastian Kozerke[1]
[1]Institute for Biomedical Engineering, ETH Zurich, Zurich, Switzerland; [2]German Heart Institute Berlin, Berlin, Germany; [3]Functional Imaging Unit, Glostrup Hospital, Glostrup, Denmark

k-t PCA is an extension of *k-t* SENSE aiming at improving reconstruction of non-periodic dynamic images. It is based on a decomposition of the training and undersampled data into a temporally and a spatially invariant term using principal component analysis. In this abstract, a compartment based *k-t* PCA reconstruction approach is presented, which aims at improving highly undersampled, high-resolution 3D myocardial perfusion imaging by constraining the temporal content of different compartments in the image series based on the bolus arrival times and prior knowledge about the perfusion curves.

14:00 ***3629*. Highly Accelerated 3D SSFP First-Pass Myocardial Perfusion at 3T Using a 32-Channel Coil**

Matteo Milanesi[1], Thomas K. Foo[2], Luca Marinelli[2], Christopher J. Hardy[2], Dan W. Rettmann[3], Wei Sun[4], Stephen Garnier[4], Ersin Bayram[4], Piergiorgio Masci[1], Vincenzo Positano[1], Luigi Landini[5], Massimo Lombardi[1]
[1]"G. Monasterio" Foundation, Pisa, Italy; [2]Global Research Center, General Electric, Niskayuna, NY, United States; [3]Applied Science Laboratory, GE Healthcare, Rochester, MN, United States; [4]GE Healthcare, Milwaukee, WI, United States; [5]Department of Information Engineering, University of Pisa, Italy

This study presents a new highly accelerated 3d saturation recovery first-pass perfusion using balanced steady state free precession (Fiesta) pulse sequence. Saturation was carried out through a 8ms adiabatic BIR4 radio frequency pulse. Acquisition was carried out at

3Tesla using a 32 channel cardiac coil, which allow 4-fold acceleration factor. Good image quality and CNR was obtained in three subjects anticipating a clinical validation of this pulse sequence

14:30 ***3630*.** **Myocardial T1 During Multiple Bolus Injections**

Christian Stehning[1], Timothy Lockie[2], Eike Nagel[3], Masaki Ishida[3], Sven Plein[3]
[1]Philips Research Europe, Hamburg, Germany; [2]Cardiovascular Division, King's College, London, United Kingdom; [3]Division of Imaging Sciences, King's College, London, United Kingdom

MR first pass perfusion imaging via the dynamic enhancement after intravenous contrast injection has become a valuable clinical tool for the assessment of myocardial perfusion. The aim of the present study was to investigate whether such a saturation effect of myocardial T1 has to be taken into account in MR-based perfusion studies involving multiple injections of Gd-DTPA.

15:00 ***3631*.** **Magnetic Resonance Quantification of Myocardial Perfusion with a Minimally Constrained Deconvolution Model**

Omar El-Sherif[1,2], Robert Z. Stodilka[1,2], Nathan A. Pack[3,4], Edward VR Dibella[3,4], James A. White[5], Robert Terry Thompson[1,2], Frank S. Prato[1,2]
[1]Imaging, Lawson Health Research Institute, London, Ontario, Canada; [2]Medical Biophysics, University of Western Ontario, London, Ontario, Canada; [3]Department of Bioengineering, University of Utah, Salt Lake City, UT, United States; [4]Radiology, Utah Center for Advanced Imaging Research, Salt Lake City, UT, United States; [5]Cardiology, London Health Sciences Centre, London, Ontario, Canada

We introduce a novel minimally constrained myocardial perfusion analysis technique. The technique has been implemented on dynamic contrast enhanced magnetic resonance images, obtained from 10 patients with hypertrophic cardiomyopathy. Regional myocardial perfusion estimates were directly compared to both the Fermi perfusion model and a 2 compartment perfusion model. The results indicate that there is discrepancy between Fermi and 2 compartment models during stress exams. However our technique correlates well with the Fermi model during both stress and rest exams.

Myocardial Visibility: Experimental Models

Hall B Monday 14:00-16:00 Computer 33

14:00 ***3632*.** **Imaging of Inflammation Using VSOP and T2* Mapping in a Mouse Model of Myocardial Infarction**

Andrea Protti[1], Alexander Sirker[1], Xuebin Dong[1], Marcelo Andia[2], Ajay M. Shah[1], Rene Botnar[2]
[1]Cardiovascular Division, King's College London BHF Centre of Excellence, London, United Kingdom; [2]Division of Imaging Sciences, King's College London BHF Centre of Excellence, London, United Kingdom

In this work, we sought to investigate the merits of a very small superparamagnetic iron oxide particle (VSOP) for direct imaging of inflammation in a mouse model of MI and to quantify T2* using multi echo gradient echo images. The combined use of a very small iron-oxide particle, VSOP, and the use of short to long TE acquisition to generate T2* mapping allowed the quantitative assessment of VSOP uptake in the infarct zone.

14:30 ***3633*.** **Studying Indirect Ca^{2+} Alterations Following Myocardial Infarction in a Murine Model Using T_1-Mapping Manganese-Enhanced MRI**

Benjamin Waghorn[1,2], Jimei Liu[1], Nathan Yanasak[1], Tom C.-C. Hu[1,2]
[1]Department of Radiology, Medical College of Georgia, Augusta, GA, United States; [2]Nuclear and Radiological Engineering and Medical Physics Programs, Georgia Institute of Technology, Atlanta, GA, United States

Intracellular calcium (Ca^{2+}) overloading that occurs during myocardial ischemia-reperfusion is known to exacerbate injuries. This study demonstrates the use of cardiac T_1-mapping manganese-enhanced MRI for identifying and quantifying regional differences in tissue Mn^{2+}, and therfore inferred Ca^{2+}, handling that occur after a myocardial infarction (MI) in the murine model. Regional alterations in Mn^{2+} efflux were detected, suggesting changes in NCX activity and altered Mn^{2+} content in ischemic tissue, consistent with changes in Ca^{2+} handling post-MI. This technique could potentially be developed to provide and indirect *in vivo* assessment of Ca^{2+} handling alterations.

15:00 ***3634*.** **MR Tagging on Healthy and MI Mice Model, an EF Vs Strain Study**

Andrea Protti[1], Alexander Sirker[1], Ajay M. Shah[1], Rene Botnar[2]
[1]Cardiovascular Division, King's College London BHF Centre of Excellence, London, United Kingdom; [2]Division of Imaging Sciences, King's College London BHF Centre of Excellence, London, United Kingdom

In this study we sought to investigate radial and circumferential strain in a mouse model of myocardial infarction (MI) 3 weeks post left anterior diagonal (LAD) coronary artery ligation and healthy control mice using 2D SPAMM technique. Strain was correlated with ejection fraction (EF) and left ventricular (LV) infarct size. MR tagging analysis provided important information on LV regional contraction and allowed assessment of wall motion alterations in MI mice.

15:30 *3635*. **From Men to Mice: Theoretical Considerations for Edema Imaging at Ultra-High Magnetic Fields**

Jurgen E. Schneider[1], Steffen Bohl[1], Erica Dall'Armellina[1], Stefan K. Piechnik[1], Matthew D. Robson[1], Stefan Neubauer[1]
[1]Cardiovascular Medicine, University of Oxford, Oxford, Oxon, United Kingdom

T2-weighted magnetic resonance imaging (T2w-MRI) has been shown to visualize and to quantify edema in the acutely infarcted myocardium of humans and animal models. Based on relaxation time measurements, we quantitatively demonstrate that the achievable T2-contrast between normal and ischemia-reperfusion injured myocardium in mice at 9.4T is only 60% of the contrast in patients with acute myocardial infarction undergoing CMR at 3T.

Tuesday 13:30-15:30 Computer 33

13:30 *3636*. **Feasibility of 3D Late Enhancement Imaging in Mice with Totally Occluded Left Anterior Ascending (LAD) Artery on a Clinical 1.5T MR Scanner**

Christian Kremser[1], Jakob Völkl[2], Bernhard Haubner[2], Michael Schocke[1], Bernhard Metzler[2]
[1]Dept. of Radiology, Innsbruck Medical University, Innsbruck, Tyrol, Austria; [2]Dept. of Internal Medicine III (Cardiology), Innsbruck Medical University, Innsbruck, Tyrol, Austria

Delayed enhancement cardiac magnetic resonance imaging is frequently used to detect and quantify the size of myocardial infarction. In this study we demonstrate the feasibility of 3D late enhancement imaging in a mouse model on a clinical 1.5T whole body MR scanner and compare the obtained results with 2D sequences as used for clinical applications and histologic sections.

14:00 *3637*. ***Ex Vivo* and *in Vivo* MR Imaging of Ischemia Reperfusion Injury in Mouse Hearts Using Microparticles of Iron Oxide Targeting VCAM-1**

Erica Dall'Armellina[1], Craig A. Lygate[1], Martina McAteer[1], Steffen Bohl[1], Lee-Anne Stork[1], Stefan Neubauer[1], Robin P. Choudhury[1], Jurgen E. Schneider[1]
[1]Cardiovascular Medicine, University of Oxford, Oxford, Oxon, United Kingdom

Ischemia-reperfusion (IR) injury is an important cause of tissue damage in vascular syndromes of the heart, but sensitive markers of early inflammation in reversible myocardial injury are lacking. Our study demonstrates that antibody-conjugated microparticles of iron oxide (MPIO) targeting VCAM-1 enable molecular MR imaging of endothelial activation in murine IR hearts.

14:30 *3638*. **A Fast Black Blood Sequence for 4D Cardiac MEMRI of Mouse Heart**

William Lefrançois[1], Sylvain Miraux, Guillaume Calmettes, François Vigneron[2], Jean-Michel Franconi, Philippe Diolez, Eric Thiaudière
[1]Résonance Magnétique des Systèmes Biologiques, UMR 5536 CNRS-Univ. Bordeaux 2, Bordeaux, Gironde, France, Metropolitan; [2]INSERM U828, Avenue du Haut Lévêque, Bordeaux, France

This study aimed to develop a new method enabling a fast time-resolved cine 2D and cine 3D (4D) black blood imaging of mouse heart. This sequence has been applied to Manganese-Enhancement MRI (MEMRI) studies i.e. with Mn^{2+} infusion to improve contrast. This new method provided time- and space-resolved 3D images, respectively $(200\ \mu m)^3$ and one image every 12 ms, for the first time within 30 minutes only. Lastly, associated to manganese infusion, this sequence appeared to be particularly adequate for studying cardiac pathologies such as ischemia on animal models.

15:00 *3639*. **Black-Blood Preparation Improves Accuracy in Murine Phase-Contrast Cine MRI at Ultra-High Mag-Netic Fields**

Erica Dall'Armellina[1], Bernd Jung[2], Hannah Barnes[3], Stefan Neubauer[1], Michael Markl[2], Jurgen E. Schneider[1]
[1]Cardiovascular Medicine, University of Oxford, Oxford, Oxon, United Kingdom; [2]Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [3]University of Oxford, Cardiovascular Medicine, Oxford, Oxon, United Kingdom

Tissue Phase Mapping (TPM) is a well-established technique to assess regional cardiac function in humans and in animal models such as mice. While TPM-studies in humans required suppression of the dominant blood signal in order to provide an accurate measurement of myocardial velocities, the murine studies were conducted without blood suppression. We show that bright-blood contrast can impact on both, absolute velocities and motion pattern, which can potentially and erroneously be identified as a local impairment of cardiac function.

Wednesday 13:30-15:30 Computer 33

13:30 *3640*. **Triethylenetetramine Treatment in Diabetic Heart Failure: An Animal Trial**

Jun Lu[1,2], Beau Pontre[3], Stephen Pickup[4], Bernard SY Choong[1], Mingming Li[1], Hong Xu[5], Anthony RJ Phillips[1], Garth JS Cooper[6], Alistair A. Young[7]
[1]School of Biological Sciences, University of Auckland, Auckland, New Zealand; [2]NCIECP, Auckland University of Technology, Auckland, New Zealand; [3]Centre for Advance MRI, University of Auckland, Auckland, New Zealand; [4]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United

States; [5]Chemistry & Chemical Engineering, Shenzhen University, Shenzhen, Guangdong, China; [6]Department of Pharmacology, Oxford University, Oxford, United Kingdom; [7]Department of Physiology, University of Auckland, Auckland, New Zealand

End stage diabetes is often associated with heart failure, which is the leading cause of death. We are the first to investigate the heart function in STZ-induced diabetic rats longitudinally with and without triethylenetetramine (TETA) treatment using High Field MRI. Gradient echo cine method was used to determine cardiac function. We found that the cardiac ejection fraction decreased with prolonged diabetic status and oral TETA treatment improves ejection fraction in diabetic rats. The results suggest that TETA treatment is beneficial to diabetic heart failure and warrant further clinical investigation.

14:00 ***3641*****.** **Manganese-Enhanced MRI Combined with Delayed Enhancement MRI Detects Injured Border Zone Myocardium in a Pig Ischemia-Reperfusion Model**

Rajesh Dash[1], Jaehoon Chung[1], Yuka Matsuura[1], Fumiaki Ikeno[1], Jennifer Lyons[1], Tomohiko Teramoto[1], Alan C.Y. Yeung[1], Michael V. McConnell[1,2], Todd J. Brinton[1], Phillip Harnish[3], Phillip C. Yang[1]

[1]Division of Cardiovascular Medicine, Stanford University Medical Center, Stanford, CA, United States; [2]Department of Electrical Engineering, Stanford University , Stanford, CA, United States; [3]Eagle Vision Pharmaceutical Corporation, Exton, PA, United States

Manganese-enhanced MRI (MEMRI) detects Mn^{2+} uptake into viable cells, a distinct mechanism from gadolinium delayed enhancement MRI (DE-MRI). We tested whether combined DE-MRI plus MEMRI would delineate peri-infarct border zone injury in a pig ischemia-reperfusion (IR). Pigs were imaged by cardiac MRI 3 weeks post-IR. 3D DE-MRI scar volume correlated with histopathologic scar volume, but MEMRI scar volume was significantly smaller than DE-MRI scar volume. The border zones of DE-MRI scar, which were also positive by MEMRI, showed decreased SNR compared to remote zone MEMRI SNR. Combined MEMRI and DE-MRI may identify injured border zone myocardium in ischemic cardiomyopathy.

14:30 ***3642*****.** **Diffusion Tensor Shape Measurements of Infarcted Myocardium in Porcine Models Using Three Phase Geometric Analysis**

Yin Wu[1,2], Ed Xuekui Wu[2,3]

[1]Institute of Biomedical and Health Engineering, Shenzhen Institute of Advanced Technology, Shenzhen, Guangdong, China; [2]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong; [3]Dept. of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong

Previous DTI studies on infarcted LV myocardium structure usually investigated diffusivity and diffusion anisotropy. In current study, diffusion tensor shape with a combination of linear, planar and spherical measures are examined and illustrated on a three-phase space in porcine models. Results show that the measurements of tensor shape have significant alteration in infarcted myocardium and are more sensitive to detect subtle change of diffusion properties than conventionally used parameters. Infarct location shows no apparent influence on myocardium structural degradation. This study gives insights into myocardium structural alteration and demonstrates potential application of DTI in detecting infarcted heart remodeling.

15:00 ***3643*****.** **Whole Mount Heart Histology: A New Gold Standard for Myocardial Damage Validation in Experimental Cardiac MRI Studies?**

Yuesong Yang[1], Kela Liu[1], Dan Wang[1], Mihaela Pop[1], Jay Detsky[1], Yingli Lu[1], Alexander J. Dick[1], Martin J. Yaffe[1], Graham A. Wright[1]

[1]Imaging Research, Sunnybrook Health Sciences Centre, University Of Toronto, Toronto, Ontario, Canada

Triphenyltetrazolium chloride (TTC) stain is commonly used for the validation of myocardial damage in experimental cardiac MRI studies using various animal species such as mice, dogs and pigs. However, subtle myocardial damage, border zone or infarct heterogeneity associated with myocardial infarction (MI) is difficult to recognize on TTC stains. In this study, we investigated the feasibility of whole-mount heart histology that preserved the 3D morphology with a digital display at the microscopic level as a new alternative in the validation of myocardial damage in a porcine model of MI in experimental cardiac late-enhancement (LE) MRI studies.

Thursday 13:30-15:30 Computer 33

13:30 ***3644*****.** **Comparison of Scar Morphology by 3D Multi-Contrast Late Enhancement MRI, 3D DW-MRI and Histology in a Pig Model of Chronic Infarct**

Mihaela Pop[1], Venkat Ramanan, Yuesong Yang, Nilesh Ghugre, Beiping Qiang, Elliot R. McVeigh[2], Alexander J. Dick[3], Graham A. Wright

[1]Medical Biophysics, Sunnybrook Research Institute, University of Toronto, Toronto, ON, Canada; [2]Biomedical Engineering, Johns Hopkins University, United States; [3]Cardiology, Sunnybrook Research Institute

Accurate assessment of the scar extent and tissue remodeling during healing is very important. To better understand the scar morphology associated with chronic infarct in a porcine model, we have developed and tested (ex vivo) a 3D pulse sequence based on multi-contrast late enhancement (MCLE) and a non-contrast 3D diffusion-weighted DW sequence, and compare the results against histopathology. We have found that 3D MCLE identifies fine heterogeneity of scar, and compares well the classification of pathology to that from apparent diffusion coeficient maps using DW-MRI.

14:00 ***3645***. **Respiratory Self-Gated 2D Cine Balanced SSFP Myocardial Edema Imaging: Preliminary Study in Canines**

Swati Gupta[1], Xiangzhi Zhou[2], Xiaoming Bi[3], Saurabh Shah[3], Sven Zuehlsdorff[3], Andrew Larson[2], Debiao Li[2], Rohan Dharmakumar[2]
[1]Department of Biomedical Engineeering, Northwestern University, Chicago, IL, United States; [2]Department of Radiology, Northwestern University, Chicago, IL, United States; [3]Siemens Medical Solutions, Chicago, IL, United States

Myocardial edema imaging with bSSFP approaches have been recently demonstrated. In this work, we investigated the utility of respiratory self-gated (RSG) 2D cine bSSFP for acquiring free-breathing myocardial edema images using a canine model subjected to ischemia-reperfusion injury. Early results show that RSG bSSFP imaging is capable of generating edema contrast similar to breath-held bSSFP imaging.

14:30 ***3646***. **Repair of Cardiac Damage Using Intrapericardial Drug Delivery by Means of MR-Trackable Alginate Beads**

Yamin Yang[1], Marco L.H. Gruwel[2], Patricia Gervai[3], Jiankang Sun[3], Olga Jilkina[1], Eugene Gussakovsky[1], Valery Kupriyanov[1]
[1]Cardiac, NRC-CNRC Institute for Biodiagnostics, Winnipeg, MB, Canada; [2]MRTechnology, NRC-CNRC Institute for Biodiagnostics, Winnipeg, MB, Canada; [3]MRRD, NRC-CNRC Institute for Biodiagnostics, Winnipeg, MB, Canada

Re-establishment of a vascular network is an important step in the repair of damaged myocardium. For this purpose vascular growth factors were applied at the site of injury. To prolong action of these peptides, growth factors were incorporated in alginate beads. However, visualization of the beads is not an easy task.

15:00 ***3647***. **Comprehensive and Serial Evaluation of Myocardial Structure, Function and Perfusion in Reperfused Infarct**

Maythem Saeed[1], Alastair J. Martin[1], Loi Do[1], David Saloner[1], Mark Wilson[1]
[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, Ca, United States

MR imaging was used to 1) assess the changes in LV volumes, ejection fraction, LV mass, regional wall thickness, and 3D wall strain as well as myocardial structure, edema, microvascular obstruction and intramyocardial haemorrhage in reperfused infarct in a single imaging session, to ensure image co-registration and 2) compare LV changes over 10 weeks. MR imaging provides comprehensive and serial characterization of evolved infarct. Myocardial edema, microvascular obstruction and hemorrhage are transient features of reperfusion injury. Based on the MR pulse sequences used it appears five weeks is enough time to arrest fibrosis, but not LV dilation, in reperfused infarct.

Myocardial Viability: Human Models

Hall B Monday 14:00-16:00 Computer 34

14:00 ***3648***. **Incremental Benefit of Cardiovascular MRI in the Evaluation of Patients with Systemic Embolism**

Monvadi B. Srichai[1], Amelia M. Wnorowski[1], Itzhak Kronzon[1], Leon Axel[1], Ambika Nayar[1], Gila Perk[1], Allison G. Hays[2], Mark Fisch[1], Vivian S. Lee[1]
[1]NYU School of Medicine, New York, NY, United States; [2]Johns Hopkins, Baltimore, MD, United States

Echocardiography is often the sole imaging technique used for evaluation cardiac sources of embolism. However, studies have demonstrated that up to 40% of patients with ischemic strokes often have no identifiable etiology. Contrast enhanced MRI with MRA identified a cardiovascular source of embolism in an additional 20% of patient in this cohort that was undetected by echocardiography, and hence provides a valuable adjunctive diagnostic imaging method for evaluation of patients with a potential cardiovascular source of embolism, particularly in patients with a negative echocardiography study or who are unable to undergo transesophageal echocardiography.

14:30 ***3649***. **Rapid Quantification of Systolic and Diastolic Transverse T1ρ Relaxation Times in the Human Left Ventricle**

Gerald A. Zsido II[1], Julio Chirinos[2], Larry Dougherty[3], Kevin Koomalsingh[4], James J. Pilla[2,4], Walter RT Witschey[1,4], Hee Kwon Song[2], Joseph H. Gorman III[4], Robert C. Gorman[4], Ravinder Reddy[1]
[1]Radiology, University of Pennsylvania, Center for Magnetic Resonance and Optical Imaging, Philadelphia, PA, United States; [2]University of Pennsylvania, Division of Cardiovascular Medicine, Philadelphia, PA, United States; [3]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [4]Surgery, University of Pennsylvania, Philadelphia, PA, United States

A technique for rapid quantification of 1H relaxation times in the human myocardium during systole and diastole was developed. The technique makes use of a T1ρ spin locking pulse cluster, followed by a short, multiecho, radial acquisition, from which k-space-weighted image contrast reconstruction is performed. An 8-fold acceleration of data acquisition was obtained in vivo, compared to a similar set of fully sampled data. In 3 subjects, each scanned 4 times; a significant difference between left ventricular systolic and diastolic relaxation times was measured.

15:00 **_3650_. Three Dimensional Black Blood MRI with Extensive Cardiothoracic Coverage: A Feasibility Study in Healthy Volunteers**

Thanh D. Nguyen[1], Keigo Kawaji[2], Pascal Spincemaille[1], Beatriu Reig[1], Matthew D. Cham[1], Martin R. Prince[1], Yi Wang[1]
[1]Radiology, Weill Cornell Medical College, New York, NY, United States; [2]Biomedical Engineering, Cornell University, Ithaca, NY, United States

Black blood (BB) MRI is useful for morphologic assessment in cardiovascular diseases. While a 3D BB imaging sequence of the whole heart and chest similar to the whole-heart coronary artery imaging approach is highly desirable, commonly used BB preparation techniques rely on blood washout and do not work well in large imaging volumes. The purpose of this study is to develop a free-breathing balanced SSFP sequence for BB imaging of the whole chest using flow-independent T2prep inversion recovery preparation. This sequence was found to provide excellent blood suppression and good BB image quality within a large cardiothoracic volume.

15:30 **_3651_. Detecting Cardiac Involvement in Systemic Sarcoidosis Using a Multi-Contrast Late-Enhancement MRI Technique: Preliminary Results**

Yuesong Yang[1], Kim Connelly[1], Jay Detsky[1], Sumaya Al-helali[1], Gideon Paul[1], Rhonda Walcarius[1], Graham A. Wright[1], Alexander J. Dick[1]
[1]Imaging Research and Cardiology, Sunnybrook Health Sciences Centre, University Of Toronto, Toronto, Ontario, Canada

Sarcoidosis is a systemic disease with a predilection for pulmonary involvement. Although clinical cardiac involvement occurs only in 5-7% of patients with systemic sarcoidosis, the incidence of autopsy-proven disease ranges from 20% to 47%. The presence of cardiac involvement is important to recognize, as it can lead to conduction disturbance and ventricular arrhythmias. Early detection of cardiac involvement with suitable treatment plays a critical role in the prevention of sudden death in these patients. A newly developed multi-contrast late-enhancement (MCLE) MRI has shown the potential to identify subtle myocardial damages in myocardial infarction. In this study we investigated this MCLE technique in the determination of cardiac involvement in systemic sarcoidosis and compared it with conventional IR-FGRE imaging.

Tuesday 13:30-15:30 Computer 34

13:30 **_3652_. Free-Breathing Delayed-Enhancement 3D MRI with and Without Phase-Sensitive Inversion-Recovery**

Yasuo Amano[1], Masaki Tachi[1], Yoshio Matsumura[1], Yuriko Suzuki[2], Shinichiro Kumita[1], Yasutomo Katsumata[2]
[1]Radiology, Nippon Medical School, Tokyo, Japan; [2]Philips Electronics Japan, Tokyo, Japan

This study demonstrated that phase-sensitive inversion-recovery technique was feasible for free-breathing 3D delayed-enhancement MRI at 3.0T, because it significantly improved the confidence for the presence of the hyperenhancing myocardium and the image contrast between the myocardium and blood. However, the 3D MRI without PSIR could not be omitted in some patients, because of its fewer image artifacts and no deterioration of the image quality.

14:00 **_3653_. Clinical Evaluation of a Cardiac T1 Mapping Method Using a Reduced Number of Sample Times**

Ting Song[1,2], Vincent B. Ho[2,3], Glenn Slavin[1], Maureen N. Hood[2,3], Jeffrey A. Stainsby[4]
[1]GE Healthcare Applied Science Laboratory, Bethesda, MD, United States; [2]Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD, United States; [3]Radiology, National Navy Medical Center, Bethesda, MD, United States; [4]GE Healthcare Applied Science Laboratory, Toronto, ON, Canada

A Modified Look-Locker with saturation recovery sequence was evaluated on nine patients using different data sampling schemes. The proposed sequence enables flexibility in sampling schemes and an approach comparing a typical 16 heartbeat data acquisition with 8 samples of the signal recovery is compared to an approach that samples only 4 points during the signal recovery in 8 heartbeats. T1 values in normal myocardial tissue pre- and post-contrast, and infarcted myocardial tissue post-contrast, are measured and quantified on patients and volunteers. Accurate T1 estimates can be obtained using reduced data sampling.

14:30 **_3654_. Quantitative Detection of Myocardial Edema Using a Breath-Hold T2 Mapping Pulse Sequence**

Mansi Shah[1], Monvadi B. Srichai[2,3], Robert Donnino[3], Daniel Kim[2]
[1]New York University School of Medicine, New York, NY, United States; [2]Radiology, New York University School of Medicine, New York, NY, United States; [3]Medicine, New York University School of Medicine, New York, NY, United States

Clinical evaluation of myocardial edema with conventional T2-weighted imaging is challenging because of non-uniform signal intensities associated with surface coil. We propose to quantitatively detect myocardial edema using a breath-hold T2 mapping pulse sequence. The accuracy of the T2 mapping pulse sequence was validated against qualitative T2-weighted imaging in seven patients with clinical evidence of heart disease. The T2 mapping pulse sequence was correlated against delayed contrast-enhanced imaging in a

patient with acute myocardial infarction. Future research include comprehensive evaluation of T2 values with specific cardiac conditions and the clinical utility of T2 mapping for assessment of myocardial edema

15:00 ***3655*.** **Triple Inversion Recovery Imaging of Myocardial Infarction**

Larry Kramer[1], Catalin Loghin[2], Eduardo Matta, Martin Pilat, Naveen Garg, Khader Hasan
[1]Diagnostic Imaging, UTHSC-Houston, Houston, TX, United States; [2]Cardiology, UTHSC-Houston

Triple Inversion Recovery Imaging of the ventricular myocardium is sensitive to myocardial edema due to injury from a severe vascular event. Transmural myocardial infarcts were accurately identified relative to delayed contrast enhancement in 81% of positive cases of myocardial edema. The absence of edema in a patient with initial symptoms of chest pain and a positive electrocardiogram or coronary catheterization suggests a favorable functional outcome.

Wednesday 13:30-15:30 Computer 34

13:30 ***3656*.** **Highly Accelerated Single Breath-Hold Myocardial T_2^* Mapping Using Susceptibility Weighted Fast Spin-Echo Imaging**

Fabian Hezel[1], Gabriele Krombach[2], Sebastian Kozerke[3], Thoralf Niendorf[1,4]
[1]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, Berlin, Germany; [2]Department of Diagnostic Radiology, University Hospital, RWTH Aachen, Aachen, Germany; [3]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [4]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany

Myocardial T2* mapping is proven value for the assessment of myocardial iron content and tissue oxygenation. This study examines the feasibility of highly accelerated fast-spin echo based T2* mapping. Acceleration is accomplished by (i) inner volume imaging, (ii) regional saturation slab based blood suppression,(iii) partial Fourier and (iv) k-t BLAST. A four-fold acceleration is feasible without compromising image quality and the accuracy of calculated T2* values.

14:00 ***3657*.** **Contrast Optimization for LGE Imaging of Left Atrium**

Sathya Vijayakumar[1], Eugene G. Kholmovski[1], Nassir F. Marrouche[2]
[1]UCAIR, Department of Radiology, University of Utah, Salt Lake City, UT, United States; [2]Department of Cardiology, University of Utah, Salt Lake City, UT, United States

While imaging the left atrial wall to assess procedure outcome of RF ablation therapy in the heart, it is necessary to have optimal contrast between scar and blood and scar and normal myocardium. In this work, we present a technique to get optimal contrast between scar and both blood and myocardium using phase sensitive reconstruction and an appropriate choice of inversion time TI.

14:30 ***3658*.** **Reducing Motion Sensitivity in Free Breathing DWI of the Heart with Localized Principal Component Analysis**

Stanislas Rapacchi[1], Pierre Croisille, [1,2], Vinay Pai[3], Denis Grenier[1], Magalie Viallon[4], Peter Kellman[3], Nathan Mewton, [1,2], Han Wen[3]
[1]CREATIS, Université Lyon 1, INSA Lyon, Villeurbanne, France; [2]Hopital Cardiologique et Pneumologique L. Pradel, Lyon, France, France; [3]LCE/NHLBI/NIH, United States; [4]Hopital Cantonal Universitaire de Genève, Switzerland

Free breathing in vivo cardiac Diffusion Weighted Imaging (DWI) is highly sensitive to physiologic motion. To cope with this issue, we designed a DWI protocol which repeats image acquisition multiple times with incremental trigger delays to cover a large time window in diastole. After registration, a localized Principal Component Analysis (PCA) is employed to reduce inter images myocardium deformation, thus improving final image quality. Then temporal Maximal Intensity Projection (tMIP) (3) is used to find the diffusion weighted intensity for each pixel. We present the benefits of our method and preliminary results in healthy and diseased volunteers.

15:00 ***3659*.** **Delineating Myocardial Edema and Hemorrhage Using T2, T2*, and Diastolic Wall Thickness Post Acute Myocardial Infarction at 2 Early Time Intervals**

Mohammad Imran Zia[1], Nilesh R. Ghugre[1], Gideon A. Paul[1], Jeffrey A. Stainsby[1], Venkat Ramanan[1], Kim A. Connelly[1], Graham A. Wright[1], Alexander J. Dick[1]
[1]Sunnybrook Health Sciences Centre, Toronto, ON, Canada

Our goal was to demonstrate myocardial edema using T2 spiral and diastolic wall thickness (DWT) and myocardial hemorrhage using T2* in patients post acute myocardial infarction (AMI) at 48 hours and 3 weeks. Assessing the presence and evolution of edema and myocardial hemorrhage early post AMI demonstrates distinct patterns. If myocardial hemorrhage is present, then early scans are affected by the competing effects of T2*, counteracting an increased T2 signal. This may be important in accurately quantifying AAR and identifying those patients most likely to suffer deleterious left ventricular remodeling.

Thursday 13:30-15:30 Computer 34

13:30 ***3660*. Monitoring Iron Chelation Effect in Hearts of Thalassaemia Patients with Improved Sensitivity Using Reduced Transverse Relaxation Rate (RR2)**

Jerry S. Cheung[1,2], Wing-Yan Au[3], Shau-Yin Ha[4], Jens H. Jensen[5], Dan Kim[5], Abby Y. Ding[1,2], Iris Y. Zhou[1,2], Hua Guo[5], Truman R. Brown[6], Winnie C.W. Chu[7], Darshana D. Rasalkar[7], Pek-Lan Khong[8], Gary M. Brittenham[9], Ed X. Wu[1,2]

[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [3]Department of Medicine, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [4]Department of Pediatrics and Adolescent Medicine, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [5]Department of Radiology, New York University School of Medicine, New York, United States; [6]Department of Radiology, Columbia University, New York, United States; [7]Department of Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Hong Kong SAR, China; [8]Department of Diagnostic Radiology, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [9]Department of Pediatrics, Columbia University, New York, United States

Accurate MRI characterization of myocardial iron is needed to improve the diagnosis and management of thalassaemia patients with transfusional iron overload. This study aimed to demonstrate that a new transverse relaxation index, the reduced R2 (RR2) that is estimated from non-monoexponential multi-echo CPMG signal decay and sensitive to ferritin iron, could detect the myocardial iron changes immediately following 1-week iron chelation suspension in thalassaemia patients at 3T.

14:00 ***3661*. Quantitative T1 and T2 Measurements of Tissue Characteristics in Myocardial Infarction – Pilot Results at 3T**

Stefan K. Piechnik[1], Erica Dall'Armellina[1], Vanessa M. Ferreira[1], Lowri E. Cochlin[2], Jürgen E. Schneider[1], Stefan Neubauer[1], Matthew D. Robson[1]

[1]Cardiovascular Medicine, OCMR, Oxford University , Oxford, Oxfordshire, United Kingdom; [2]Dept of Physiology, Anatomy and Genetics, Oxford University, Oxford, Oxfordshire, United Kingdom

We present preliminary results of T1- and T2-mapping at 3T in sub-acute myocardial infarction to demonstrate the ability of quantitative CMR in delineating myocardial tissue changes following an ischemic event.

14:30 ***3662*. Free-Breathing, Single Shot Fat-Water Separated Cardiac Imaging with Motion Corrected Averaging**

Peter Kellman[1], Diego Hernando[2], Saurabh Shah[3], Christophe Chefd'hotel[4], Z-P Liang[2], Andrew E. Arai[1]

[1]National Institutes of Health, Bethesda, MD, United States; [2]University of Illinois, Urbana, IL, United States; [3]Siemens Medical Solutions, Chicago, IL, United States; [4]Siemens Corporate Research, Princeton, NJ, United States

A rapid fat/water separated imaging protocol has been developed for free-breathing cardiac applications for cases where patients have difficulty breath-holding or have significant arrhythmias. The method combines a 2 echo GRE acquisition and parallel imaging, and may be used with repeated measurements and motion corrected averaging to further improve image quality. The method has been applied to both pre-contrast and late enhancement imaging.

15:00 ***3663*. Navigator Guided High-Resolution Single-Shot Black-Blood TSE Images Using ZOOM and Sensitivity Encoding (SENSE) on a 32 Channel RF System**

Raja Muthupillai[1], Amol Pednekar[2], Claudio Arena[1], Scott D. Flamm[1], Benjamin Y. Cheong[1]

[1]Diagnostic and Interventional Radiology, St. Luke's Episcopal Hospital, Houston, TX, United States; [2]Philips Healthcare

We demonstrate that by using a judicious combination of reduced FOV imaging (ZOOM), Sensitivity Encoding (SENSE), and half-scan, it is feasible to obtain diagnostic quality single-shot (SSH) dual-inversion recovery prepared black blood(BB) turbo spin echo(TSE) images with minimal image blurring during normal respiration. The results of the study, performed on 8 asymptomatic subjects, show that SSH T2-TSE images acquired using ZOOM+SENSE under navigator triggering, yield images with quality that is comparable to conventional multi-shot BB-TSE images acquired over a 14-16 heart beat breathhold.

Coronary Artery & Vessel Wall Imaging

Hall B Monday 14:00-16:00 Computer 35

14:00 ***3664*. Retrospective Estimation of 3D Respiratory Motion Vectors in Coronary MRI**

Alan Christopher O'Connor[1], Mehdi Hedjazi Moghari[1], Peng Hu[1], Dana C. Peters[1], Warren J. Manning[1], Reza Nezafat[1], Roger Ware Brockett[2]
[1]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States; [2]SEAS, Harvard University, Cambridge, MA, United States

Navigator correction methods were developed to increase the gating window size possible for free-breathing cardiac MRI and consequently reduce scan time. These methods typically rely on a generic scale-factor between measured diaphragm motion and heart motion. We present a novel scheme for estimating patient-, direction-, and coil-specific motion vectors directly from the scan data to correct for phase errors caused by respiratory motion of the heart.

14:30 ***3665*. Quantitative Assessment of Right Coronary Artery MRI Using Quadrature RF Coils at 7 Tesla, Incorporating a Direct Comparison of Results to Those Acquired at 3 Tesla.**

Saskia van Elderen[1], Maarten Versluis[1], Jos Westenberg[1], Harsh Agarwal[2], Nadine Smith[1], Matthias Stuber[3], Albert de Roos[1], Andrew Webb[1]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Johns Hopkins University; [3]Department of Radiology, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Lausanne, Switzerland

Using a quadrature RF coil with dimensions optimized for reliable navigator gating, this study with ten volunteers shows that 7T right coronary angiograms can be acquired with improved vessel sharpness compared to those obtained at 3T using identical imaging parameters.

15:00 ***3666*. The Influence of Sublingual Nitroglycerin on Contrast -Enhanced Whole-Heart Coronary Magnetic Resonance Angiography at 3.0-T**

Bin Sun[1], ZhiYong Chen[2], LiXin Jin[3], Qing Duan
[1]Radiology, FuJian Medical University Union Hospital, FuZhou, FuJian, China; [2]Radiology, FuJian Medical University Union Hospital, China; [3]Siemens Healthcare, MR Collaboration NE Asia, China

This article describes the influence of sublingual nitroglycerin spray on the lumen diameter, number of side branches visualized, average vessel length of 3.0-T contrast-enhanced whole-heart coronary magnetic resonance angiography. Twenty-four patients were prospectively included in this study: 12 were examined without sublingual nitroglycerin, and 12 were examined after the administration of sublingual nitroglycerin. Two blinded observers quantitatively assessed lumen diameter and length in the RCA, LAD and LCX. The number of acute marginal branches and septal branches was counted. The number of clinical side effects was evaluated. Sublingual nitroglycerin spray significantly dilates the coronary arteries and allows more side branches to be visualized at 3.0-T contrast-enhanced whole-heart CMRA without increasing resolution or increasing the number of side effects.

15:30 ***3667*. 3T Coronary MRA Using 3D Multi-Interleaved Multi-Echo Acquisition and VARPRO Fat-Water Separation**

Saurabh Shah[1], Xiaoming Bi[1], Diego Hernando[2], Peter Weale[1], Sven Zuehlsdorff[1], Sonia Nielles-Vallespin[3], Peter Kellman[4]
[1]Siemens Healthcare, Chicago, IL, United States; [2]University of Illinois at Urbana-Champaign, Urbana, IL, United States; [3]Royal Brompton And Harefield NHS Foundation Trust, London, United Kingdom; [4]National Institutes of Health / NHLBI, Bethesda, MD, United States

A 3D free-breathing navigator-gated multi-interleaved multi-echo GRE sequence is implemented with VARPRO fat-water separation and utilized in targeted acquisition of coronary arteries at 3T. This approach achieves reliable fat-suppression across field-of-view and provides clear depiction of coronaries for enhanced visualization.

Tuesday 13:30-15:30 Computer 35

13:30 ***3668*. Prospective Respiratory Navigator Gated RF Excitation in Whole-Heart Coronary MRA at 3T**

Jing Yu[1,2], Michael Schär, [23], Harsh Agarwal, [2,4], Matthias Stuber[2,5]
[1]Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States; [2]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States; [3]Philips Healthcare, Cleveland, OH, United States; [4]Department of Electrical and Computer Engineering, John Hopkins University, Baltimore, MD, United States; [5]Department of Radiology, University Hospital Center and University of Lausanne (CHUV), Lausanne, VD, Switzerland

One of the challenges in coronary MRA is insufficient SNR. To improve the blood-pool SNR in prospective respiratory navigator gated whole-heart coronary MRA, radiofrequency excitations of the gradient echo readout train are suspended in real-time, when the respiratory position is outside the predefined gating window. Phase encoding is adapted to deposit the increased signal in central k-space and to minimize signal variation of adjacent k-space profiles. Consistent with the numerical simulation, in vivo experiments

demonstrated 35% improvement in blood-pool SNR, without compromising scan time or spatial resolution. The SNR advantage affords great potential towards better depiction of the coronary arteries.

14:00 ***3669*. Coronary Sinus Flow Quantification at 3T and Cold Pressor Test for Non Invasive Evaluation of Coronary Endothelial Function**

Pierre-Julien Moro[1,2], Alexis Jacquier[1], Frank Kober[1], Jean-Louis Bonnet[2], Patrick Cozzone[1], Monique Bernard[3]
[1]Centre de Résonance Magnétique Biologique et Médicale, CNRS UMR 6612, Université de la Méditerranée, Faculté de Médecine, Marseille, France; [2]Cardiology, CHU Timone, Marseille, France; [3]Centre de Résonance Magnétique Biologique et Médicale, CNRS UMR 6612, Université de la Méditerranée , Faculté de Médecine, Marseille, France

The purpose of this study was to assess a non invasive measure of coronary endothelial function. Coronary sinus flow was measured in 14 volunteers at rest and during cold pressor test (CPT) using non breath-hold velocity encoded phase contrast cine MRI. Myocardial blood flow (MBF) significantly increased by 55 ± 38 % during CPT compared to the rest examination ($p<0.0001$); coronary blood flow was 0.66 ± 0.22 ml/min/g at baseline and 1.03 ± 0.41 ml/min/g after CPT. This non invasive measure may help to detect changes in endothelial function which occur early in a variety of cardiovascular diseases.

14:30 ***3670*. Prospective Projection-Based Respiratory Whole-Heart Coronary MRI with Patient-Specific Tracking Factor**

Mehdi Hedjazi Moghari[1], Peng Hu[1], Christian Stoeck[2], Jouke Smink[3], Dana C. Peters[1], Beth Goddu[1], Lois Goepfert[1], Warren J. Manning[1], Reza Nezafat[1]
[1]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States; [2]University and ETH, Biomedical Engineering, Zurich, Switzerland; [3]Philips-Healthcare, Best, Netherland

The impact of correct subject-dependent slice tracking factor in whole-heart coronary imaging is studied in this paper. In preparation phase, two projection-based respiratory navigators are positioned at the diaphragm edge and center of heart to calculate the slice tracking factor. The projection-based navigator at the diaphragm with the estimated scale factor is employed for the whole-heart coronary image reconstruction. The constructed images outperform the ones acquired with the pencil beam navigator with the constant scale factor 0.6.

15:00 ***3671*. Feasibility Study of Motion Pre-Analysis Method for Whole-Heart Magnetic Resonance Coronary Angiography (Wh Mrca) at Different Breathing Levels**

Shigehide Kuhara[1], Tomohisa Okada[2], Ayako Ninomiya[1], Toshikazu Kamae[2], Shotaro Kanao[2], Tetsuo Sato[3], Kotaro Minato[3], Kaori Togashi[2]
[1]MRI Systems Division, Toshiba Medical Systems, Otawara-Shi, Tochigi, Japan; [2]Department of Diagnostic Radiology, Kyoto University Hospital, Kyoto, Japan; [3]Nara Institute of Science and Technology, Nara, Japan

We have developed the Motion Pre-Analysis Method to determine the appropriate RMC coefficient before WH MRCA (Whole Heart Magnetic Resonance Coronary Angiography) examinations and investigated coefficients between motions of the diaphragm and the heart at different breathing levels by using an inflatable blood pressure cuff placed under an abdominal band. The results of this study suggest that the RMC coefficient may change for each person and abdominal pressures applied. The image quality was slightly improved by using the pre-analyzed RMC coefficient. It is therefore expected that this Motion Pre-Analysis Method would improve visualization of WH MRCA examinations.

Wednesday 13:30-15:30 Computer 35

13:30 ***3672*. Local Inversion Spiral Coronary Vessel Wall Imaging: A Comparison Between 1.5T and 3T**

Sarah Anne Peel[1], Tarique Hussain[1], Gerald Greil[1], Tobias Schaeffter[1], René M. Botnar[1]
[1]Division of Imaging Sciences, King's College London, London, United Kingdom

In this study we sought to compare the 3D spiral coronary vessel wall imaging using the local inversion pre-pulse technique on 1.5T and 3T systems. Imaging at 1.5T resulted in consistent image quality and good blood suppression. While SNR was improved at 3T, image quality was more consistent and artifact level lower at 1.5T. Although excellent coronary vessel wall images can be acquired at 3T, improvements in shimming and f0 determination are required to improve overall robustness compared to 1.5T.

14:00 ***3673*. The Use of Biofeedback with MCLAWS to Guide Respiration and Provide Inspiratory and Expiratory Images from a Single Navigator-Gated 3D Coronary MRA Acquisition.**

Permi Jhooti[1], Jennifer Keegan[2], Klaus Scheffler[1], David Firmin[2]
[1]Radiological Physics, University of Basel, Basel, Switzerland; [2]CMR Unit, Royal Brompton Hospital, United Kingdom

The mCLAWS technique produces whole heart images in the fastest possible time for a given respiratory pattern and gating window, as well as image datasets at end expiration and end inspiration. The end inspiratory images are generally poorer quality than the end expiratory images because the end inspiratory position is usually more variable and the end inspiratory pause shorter. We have implemented a respiratory biofeedback ‘game’ with a multi-navigator mCLAWS technique to regularise the subjects’ breathing patterns and to enable the acquisition of high quality end inspiratory and end expiratory images from a single whole heart acquisition.

14:30 ***3674*. High Resolution 3D Spiral Coronary Vessel Wall Imaging with >99% Respiratory Efficiency Using Beat to Beat Respiratory Motion Correction: Quantitative Comparison with Navigator Gated 2D Spiral and Turbo Spin Echo Imaging**

Andrew David Scott[1,2], Jennifer Keegan, [1,2], David N. Firmin, [1,2]
[1]National Heart and Lung Institute, Imperial College, London, Greater London, United Kingdom; [2]Cardiovascular Magnetic Resonance Unit, The Royal Brompton Hospital, London, Greater London, United Kingdom

High resolution 3D coronary artery wall imaging potentially enables the assessment of the full 3D extent of a plaque, but is time consuming when used with navigator gating. We compare 3D spiral right coronary artery wall imaging with a highly efficient beat-to-beat respiratory-motion-correction technique using localized tracking of the fat around the artery (99.6% respiratory efficiency) with navigator gated (39% efficient) 2D spiral and 2D turbo spin echo techniques. The techniques were compared quantitatively using vessel wall thickness. The improved respiratory efficiency of the beat-to-beat respiratory-motion-correction technique facilitates high resolution 3D coronary wall imaging within a reasonable duration.

15:00 ***3675*. MR Imaging of Myocardial Scar and Coronary Vein Anatomy in Patients Awaiting Cardiac Resynchronization Therapy Using a High-Relaxivity Contrast Agent.**

Simon Graham Duckett[1], Matthew Ginks[1], Benjamin R. Knowles[1], Amedeo Chiribiri[1], Stephen Sinclair[1], Gerry Carr-White[2], Aldo Rinaldi[2], Rene Botnar[1], Eike Nagel[1], Reza Razavi[1], Tobias Schaeffter[1]
[1]Kings College London, London, United Kingdom; [2]Guy's and St Thomas's Hospital

As Cardiac resynchronization therapy is becoming more widely available for the treatment of patients with heart failure, there has been increased interest in imaging the coronary sinus and its tributaries. Previous studies using CMR have mainly focused on using intravascular contrast agents (CA), which give no useful information about myocardial scar, and require a separate MR-exam to assess scar and viability. Most of these studies patients with normal left ventricular function have been recruited. We present a single CMR examination imaging the coronary venous anatomy and myocardial scar in patients with HF using a high-relaxivity contrast agent.

Thursday 13:30-15:30 Computer 35

13:30 ***3676*. Non-Invasive Quantification of Atherosclerotic Plaque Inflammation and Neovascularity in a Rabbit Model Using Bright-Blood Dynamic Contrast-Enhanced MRI**

John A. Ronald[1], Yuanxin Chen[2], Kem A. Rogers[2], William S. Kerwin[3], Brian K. Rutt[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Anatomy and Cell Biology, University of Western Ontario, London, Ontario, Canada; [3]Radiology, University of Washington, Seattle, WA, United States

Atherosclerotic plaques enriched in inflammatory cells and neovessels are prone to rupture, the life-threatening event underlying heart attacks and stroke. Here we performed the first successful bright-blood dynamic contrast enhanced MR imaging of rabbit atherosclerotic plaques that resemble mid-stage plaques in humans and show that the transfer constant, Ktrans, correlates well with histopathological measures of both macrophage (r=0.4438, p=0.011) and neovessel density (r=0.4186, p=0.027). This is an important extension of this technique, which through necessity has been proven useful for advanced human disease only, and holds promise for its use in assessing the effects of anti-angiogenic/anti-inflammatory therapies in earlier plaques.

14:00 ***3677*. Whole Heart T1 Weighted Coronary Plaque MR Imaging at 3T Using 32channel Cardiac Coils**

Hideki Miyagi[1], Hajime Sakuma[1], Shingo Kato[1], Kakuya Kitagawa[1], Motonori Nagata[1], Takase Shinichi[1], Sigfridsson Andreas[1], Masatoshi Miyahara[2], Mashio Nakamura[2], Yoshihide Mitani[3], Hiroyuki Ohashi[3]
[1]Department of Radiology, Mie University Hospital, Tsu, Mie, Japan; [2]Department of Cardiology, Mie University Hospital, Tsu, Mie, Japan; [3]Department of Pediatrics, Mie University Hospital, Tsu, Mie, Japan

Whole heart 3D T1-weighted TSE images were acquired with 3T MR imager and 32-channel cardiac coils in 10 patients with Kawasaki disease who had coronary artery aneurysms and 5 patients with coronary artery disease (CAD). Hyperintense coronary plaque (HIP) was observed in 5 of 10 patients with Kawasaki disease and 4 of 5 CAD patients. On MDCT and IVUS, HIP corresponded to thrombus along the vessel wall or positive remodeling plaque with ultrasound attenuation. 3T T1-weighted coronary plaque MRI allows for noninvasive screening of HIP in the entire coronary artery tree with an averaged imaging time of < 10 minutes.

14:30 ***3678*. Evaluating Anti-Inflammatory Efficacy of Pioglitazone in a Rabbit Model of Atherosclerosis with Multimodality Imaging**

Stephen D. Dickson[1], Esad Vucic[1,2], Claudia Calcagno[1], James HF Rudd[1], James Lin[1], Jessica Mounessa[1], Michelle Roytman[1], Zahi A. Fayad[1,2]
[1]Radiology, Mount Sinai School of Medicine, New York, NY, United States; [2]Medicine, Mount Sinai School of Medicine, New York, NY, United States

Dynamic contrast enhanced (DCE) MRI and F18-fluorodeoxyglucose (FDG) PET/CT was performed on control and pioglitazone-treated atherosclerotic New Zealand White Rabbits at three time points over three months. After three months, treated animals showed decreased MRI contrast agent uptake in plaque as well as decreased FDG signal as compared to controls. Macrophage specific immuno-histochemistry validated anti-inflammatory observations.

15:00 *3679*. **Toward a Novel Implantable Contrast Agent for Enhanced MRI Definition of the Vein Graft Wall: Long-Term Stability Assessment of Gd-DTPA Immobilized Contrast-Enhanced (ICE) MRI**

Dimitris Mitsouras[1,2], Praveen K. Vemula, [23], Peng Yu, [2,4], Ming Tao, [2,4], Binh T. Nguyen, [2,4], Jeffrey Karp, [23], Keith C. Ozaki, [2,4], Robert V. Mulkern, [2,5], Frank J. Rybicki[1,2]

[1]Dept of Radiology, Brigham and Women's Hospital, Boston, MA, United States; [2]Harvard University, Cambridge, MA, United States; [3]Dept of Medicine, Brigham and Women's Hospital, Boston, MA, United States; [4]Dept of Surgery, Brigham and Women's Hospital, Boston, MA, United States; [5]Dept of Radiology, Children's Hospital, Boston, MA, United States

Nearly half of 500,000 vein grafts implanted annually in the US fail. Although MR has enormous potential to assess remodeling and track disease progression, it is severely limited by excessive scan times required to resolve the graft wall (<1mm thickness). Our long-term goal is the development of an implantable MR contrast agent, immobilized on the vein graft surface ex vivo at the time of operation, used to enhance both the MR signal and tissue contrast available for subsequent imaging. We demonstrate for the first time such long-term signal enhancement using a modified Gd-DTPA complex successfully immobilized on the vein surface.

Vessel Wall Imaging (Non-Coronary)

Hall B Monday 14:00-16:00 Computer 36

14:00 *3680*. **3D Contrast-Enhanced Flow-Insensitive Peripheral Vessel Wall Imaging**

Jingsi Xie[1], Zhaoyang Fan[1], Debiao Li[1]

[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States

Develop a 3D contrast-enhanced flow-insensitive vessel wall imaging technique

14:30 *3681*. **Quantitative Analysis of DCE-MRI to Identify and Characterize Plaque at Early Stages (AHA I-III)**

Zhuoli Zhang[1], Nicole Mascheri[1], Jose Agraz[1], Zhaoyang Fan[1], Richard Tang[1], Xiaoming Bi[2], Peter Weale[2], Debiao Li[1]

[1]Northwestern University, Chicago, IL, United States; [2]Siemens Healthcare , Chicago, IL, United States

Atherosclerotic disease is thought to begin shortly after birth. Through the years, plaques grow slowly, with variable morphologic aspects and properties at different stages of development. The American Heart Association (AHA) has established criteria by which plaques are classified according to content and structure. It is important to differentiate young stable plaques with a low extracellular lipid content that are not dangerous (types I–III) from unstable more dangerous types (IV-Vc). However, the molecular mediators of atherosclerosis at type I-III are an area of great interest in basic science. Characterization of plaque using MRI at a very early stage is very important for understanding disease process, choosing appropriate prevention and treatment strategies. Dynamic contrast-enhanced MRI (DCE-MRI) may play an important role to identify and characterize plaque at type I-III.

15:00 *3682*. **Contrast Kinetics of Gadolinium Uptake May Discriminate Stable from Vulnerable Atherosclerotic Plaque**

Alkystis Phinikaridou[1], Christopher Sucato[1], Stephan Anderson[2], James A. Hamilton[1]

[1]Physiology & Biophysics, Boston University, Boston, MA, United States; [2]Radiology, Boston University, Boston, MA, United States

We used a rabbit model of controlled atherothrombosis to test whether in vivo MRI can distinguish between plaques that disrupt after pharmacological triggering (vulnerable) and those that do not (stable). We employed in vivo dynamic contrast enhanced MRI to study the contrast kinetics of gadolinium (Gd-DTPA) in a quantitative manner, which could help to understand the mechanism of gadolinium uptake and derive standardized criteria that could permit a differentiation of stable from vulnerable atherosclerotic plaques.

15:30 *3683*. **Carotid Plaque Burden Measurement Using Ultrafast 3D Black-Blood MRI**

Niranjan Balu[1], Vasily Yarnykh[1], Baocheng Chu[1], Jinnan Wang[2], Thomas Hatsukami[1], Chun Yuan[1]

[1]University of Washington, Seattle, WA, United States; [2]Philips Research North America

Black-blood MRI is an established tool for carotid atherosclerotic plaque burden measurement. Accuracy of measurement can be improved by moving to isotropic imaging but can be challenging for patient compliance due to long scan times. In this work plaque assessment by an ultrafast isotropic 3D black-blood sequence (3D-MERGE) covering the entire cervical carotid arteries within 2 minutes is validated on patients with significant carotid plaque. 3D-MERGE provides good blood suppression and comparable plaque burden measurements to existing MRI protocols. Thus it provides a promising new tool for fast and accurate plaque burden assessment in patients with atherosclerotic plaque.

Tuesday 13:30-15:30 Computer 36

13:30 ***3684*. Carotid Plaque Imaging with an Eight-Channel Transmit/Receive RF Array at 7 Tesla: First Results in Patients with Atherosclerosis.**

Tobias Breyer[1,2], Oliver Kraff[1,2], Stefan Maderwald[1,2], Andreas Bitz[1,2], Stephan Orzada[1,2], Mark E. Ladd[1,2], Elke R. Gizewski[1,2], Harald H. Quick, [23]

[1]Institute of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Nordrhein-Westfalen, Germany; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University of Duisburg-Essen, Essen, Germany; [3]Institute of Medical Physics, Friedrich-Alexander-University Erlangen-Nürnberg, Erlangen, Germany

Atherosclerosis is one leading cause of morbidity. In this study we implemented and adapted a plaque imaging protocol from 1.5 to 7 Tesla with use of a custom-built eight-channel transmit/receive RF array for the first time in human patients with hemodynamically relevant atherosclerosis. This approach allows for MR angiographic imaging without administration of gadolinium contrast comparable to contrast-enhanced MR angiography at lower field strengths. Plaque imaging at 7 Tesla requires different sequences compared to lower field strengths but allows a qualitatively comparable depiction of different intraplaque components, calcifications, vessel wall thickness and the luminal surface compared to lower field strenghts.

14:00 ***3685*. Targeted Multi-Contrast Vessel Wall Imaging of Bilateral Peripheral Artery Disease**

Niranjan Balu[1], Jinnan Wang[2], Xihai Zhao[1], Thomas Hatsukami[1], Chun Yuan[1]

[1]University of Washington, Seattle, WA, United States; [2]Philips Research North America

Assessment of vessel wall involvement in peripheral arteries and veins can significantly improve the management of peripheral arterial disease (PAD) and deep vein thrombosis (DVT). The diffuse and bilateral disease in PAD requires bilateral large coverage. Assessment of lesion composition additionally requires multi-contrast imaging. However scan times for current black-blood MRI techniques can be prohibitively long. To address this issue we demonstrate a targeted high resolution multi-contrast imaging protocol combining bilateral isotropic large coverage 3D black-blood MRI for screening and optimized high-resolution 2D black-blood MRI. One case of DVT was identified out of six subjects scanned and characterized by multi-contrast imaging within a 30 minute scan time.

14:30 ***3686*. Sex Differences of High-Risk Carotid Atherosclerotic Plaque in Asymptomatic Patients with Varying Levels of Stenosis -In Vivo 3.0T MRI Study**

Hideki Ota[1,2], Mathew J. Reeves[3], David C. Zhu[2], Arshad Majid[4], Alonso Collar[5], Nikunj Chauhan, Chun Yuan[6], J.Kevin DeMarco[2]

[1]Diagnostic Radiology, Tohoku University, Sendai, Miyagi, Japan; [2]Radiology, Michigan State University, East Lansing, MI, United States; [3]Epidemiology, Michigan State University, East Lansing, MI, United States; [4]Neurology & Ophthalmology, Michigan State University, East Lansing, MI, United States; [5]Ingham Cardiothoracic & Vascular Surgeons, Lansing, MI, United States; [6]Radiology, University of Washington, Seattle, WA, United States

The purpose of this study was to evaluate prevalence of complicated, high-risk carotid plaque characteristics in both men and women with a broad range of carotid artery stenosis. A total of 230 arteries (51% men) in 132 patients having 0-99% carotid stenosis were included for the analysis. After adjusting for baseline demographic characteristics as possible confounders, presence of complicated AHA VI plaque, lipid-rich/necrotic core, intraplaque hemorrhage were significantly more common in men than women. Increasing MRA stenosis was also associated with these high-risk plaque features. The present results indicate that the development of atherosclerosis appears different between men and women.

15:00 ***3687*. In Vivo Detection of Vulnerable Atherosclerotic Plaque by Magnetic Resonance Imaging**

alkystis phinikaridou[1], Frederick L. Ruberg, Hallock J. Kevin, Ye Qiao[2], Ning Hua, Jason Viereck, James A. Hamilton

[1]physiology and biophysics, boston university, boston, ma, United States; [2]Johns Hopkins

We used a rabbit model of controlled atherothrombosis to test whether in vivo MRI can distinguish between plaques that disrupt after pharmacological triggering (vulnerable) and those that do not (stable). In vivo MRI revealed that stable and vulnerable plaques had similar percent of stenosis, but vulnerable plaques more frequently showed: (1) positive remodeling, in which the plaque remains hidden within the vessel wall; and (2) enhanced gadolinium uptake associated with histological features of neovascularization, inflammation, and necrosis. These findings suggest that in vivo MRI may be used for localization of plaques that are prone to disruption prior to acute events.

Wednesday 13:30-15:30 Computer 36

13:30 ***3688*.** **3D Flow-Insensitive Vessel Wall Imaging Using T2PREP PSIR with SSFP**

Jingsi Xie[1], Xiaoming Bi[2], Zhaoyang Fan[1], Himanshu Bhat[1], Saurabh Shah[2], Sven Zuehlsdorff[2], Debiao Li[1]
[1]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Siemens Healthcare, Chicago, IL, United States

This work develops a 3D flow-insensitive technique for peripheral vessel wall imaging.

14:00 ***3689*.** **The Value of Carotid Plaque MRI in the Selection of Choosing Stent-Treatment for Carotid Atherosclerosis Patients**

Yan Song[1], Cheng Zhou, Min Chen, Nan Luo, Jiachun Liu, Lijun Wang, Yuan Fu, Xiangyang Ma[2], Chun Yuan[3]
[1]Department of Radiology, Beijing Hospital, Beijing, China; [2]Philips Global Clinical Research Board, Greater China Region; [3]Department of radiology, University Washington, Seattle, United States

The purpose was to evaluate the efficiency of carotid plaque MRI in stent-treatment decision for patients with carotid atherosclerosis comparing with DSA. A total of 17 symptomatic and 37 asymptomatic carotid arteries were evaluated by MRI and DSA. Images were evaluated for luminal stenosis and fibrous cap (FC) rupture, and the stent treatment decision was based on these criterions. Intraplaque hemorrhage and calcification were also evaluated by MRI. The result was that MRI was superior to DSA in determining stent treatment, especially for asymptomatic patients with carotid artery narrowing of less than 70% for its ability to detect FC rupture.

14:30 ***3690*.** **Comparison of Direct Thrombus Imaging to Multi-Contrast MRI for Assessment of Carotid Atheroma**

Victoria Eleanor Louise Young[1], Umar Sadat[1], Andrew J. Patterson[1], Martin J. Graves[1,2], Tjun Y. Tang[1], Peter J. Kirkpatrick[3], Jonathan H. Gillard[1]
[1]University Department of Radiology, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom; [2]Department of Medical Physics, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom; [3]Department of Neurosurgery, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom

Multi-contrast MRI is used for detection of complex carotid plaque, however, it is time consuming. Direct thrombus imaging (DTI) has been used previously to detect intraplaque haemorrhage. The aim of this study was to assess whether DTI could be used independent of other sequences to demonstrate complex disease. 55 patients with carotid stenosis (>30%) were imaged at 1.5T using a 4 channel phased-array carotid coil. Independent observers reviewed the multi-contrast imaging and DTI separately. DTI was found to be highly sensitive/specific for detecting complex plaque. DTI can be used independent of other imaging to identify complex plaque.

15:00 ***3691*.** **Large Field-Of-View Submillimeter Isotropic Resolution Bilateral Peripheral Vessel Wall MRI Using 3D Fast Spin Echo with Flow-Insensitive Blood Suppression at 3 Tesla**

Thanh D. Nguyen[1], Keigo Kawaji[2], Pascal Spincemaille[1], Martin R. Prince[1], Yi Wang[1,2]
[1]Radiology, Weill Cornell Medical College, New York, NY, United States; [2]Biomedical Engineering, Cornell University, Ithaca, NY, United States

Black blood (BB) MRI can be used to characterize vessel wall and quantify ateresclerotic plaque burden in patients with peripheral vascular disease. T2prep inversion recovery (T2IR) has been shown to provide flow-insensitive BB contrast for 2D peripheral vessel wall MRI at 1.5T at the cost of reduced wall SNR The aim of this study is to achieve a considerable increase in T2IR BB imaging efficiency to obtain large field-of-view bilateral peripheral coverage with sub-millimeter isotropic resolution in reasonable scan time using SNR-efficient volumetric 3D fast spin echo acquisition at 3T. The developed sequence was capable of providing large volumetric coverage, excellent arterial and venous blood suppression and fat suppression, as well as good vessel wall visualization in healthy volunteers.

Thursday 13:30-15:30 Computer 36

13:30 ***3692*.** **Improved Human Carotid Intraplaque Hemorrhage Imaging Using a Slab-Selective Phase-Sensitive Inversion-Recovery (SPI) Sequence**

Jinnan Wang[1], Marina S. Ferguson[2], Niranjan Balu[2], Chun Yuan[2], Thomas S. Hatsukami[2], Peter Boernert[3]
[1]Clinical Sites Research Program, Philips Research North America, Seattle, WA, United States; [2]University of Washington; [3]Philips Research Europe

Intraplaque hemorrhage (IPH) plays a critical role in the evolution of carotid atherosclerotic disease. In this study, a Slab-selective Phase-sensitive Inversion-recovery (SPI) technique, which combines both phase sensitive (PS) imaging and a specially designed IR turbo field echo (TFE) sequence, is proposed to improve the IPH contrast and blood suppression efficiency in human carotid IPH imaging. Significantly improved IPH contrast and blood suppression were found in the in vivo atherosclerotic patient scanning.

14:00 **3693. DWI of Carotid Atheroma - Detection of Lipid Rich Necrotic Core**

Victoria Eleanor Louise Young[1], Andrew J. Patterson[1], Umar Sadat[1], David J. Bowden[1], Martin J. Graves[1,2], Andrew N. Priest[1,2], Tjun Y. Tang[1], Jeremy N. Skepper[3], Peter J. Kirkpatrick[4], Jonathan H. Gillard[1]

[1]University Department of Radiology, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom; [2]Department of Medical Physics, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom; [3]Multi-imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [4]Department of Neurosurgery, Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom

Lipid-rich necrotic core (LR/NC), which is difficult to identify on MRI, has importance in predicting risk of clinical events. Previous studies using diffusion-weighted imaging (DWI) for ex-vivo imaging have demonstrated a potential role for DWI. The aim of this study was to examine if DWI can be applied in vivo to differentiate LR/NC from fibrous cap. 28 patients with confirmed carotid atheroma were imaged at 1.5T using a dedicated 4 channel phased-array carotid coil and ADC maps produced. A significant difference was found between the ADC values for LR/NC and fibrous cap. DWI may provide addition information for plaque classification.

14:30 **3694. Signal Evolution of Intraplaque Hemorrhage in Asymptomatic and Symptomatic Carotid Plaque: A Long-Term in Vivo High-Resolution Magnetic Resonance Imaging Follow-Up Study**

Jianming Cai[1], Qingjun Wang[1], Yong Wang[1], Youquan Cai[1], Lin Ma[1], Chun Yuan[2]

[1]Radiology, Chinese PLA General Hospital, Beijing, China; [2]Radiology, University of Washington, Seattle, WA, United States

By using in vivo multi-contrast high-resolution MRI, we performed a long-term follow-up study on asymptomatic and symptomatic carotid intraplaque hemorrhage (IPH) to observe difference in signal evolution within each group and between the two groups. In the present study, each patient with eligible IPH was given a carotid MRI examination on a 3.0-T MRI scanner every 6 months during a total 3 years period. Our findings show that asymptomatic and symptomatic carotid IPH demonstrated a different MRI signal evolution. The repeated IPH may be more common in the symptomatic plaque than in the asymptomatic plaque.

15:00 **3695. Prospective Self-Gating to Eliminate Motion Artifacts in 3D Carotid Artery Wall Imaging**

Zhaoyang Fan[1,2], Sven Zuehlsdorff[3], Peng Lai[4], YiuCho Chung[3], Jose Agraz[1,2], Debiao Li[1,2]

[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Biomedical Engineering, Northwestern University, Evanston, IL, United States; [3]Cardiac MR R&D, Siemens Healthcare, Chicago, IL, United States; [4]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States

Self-gating technique has recently been used in a 3D variable-flip-angle TSE sequence to exclude data acquired during swallowing, yet two shortcomings remain. First, a single self-gating (SG) line acquired immediately before readout in each TR may not be adequate to detect motion if the readout duration is considerably long. Second, real-time update of the reference line used for the cross-correlation analysis is necessary given potentially involuntary "drift" during 3D imaging. This work demonstrated that two SG lines, acquired immediately before and after readout during each TR, in combination with real-time update of the reference line make swallowing-motion gating more robust.

Flow Quantification & Vessel Function

Hall B Monday 14:00-16:00 Computer 37

14:00 **3696. 3D Flow Characteristics in Ventricular Assist Devices: Impact of Valve Geometry and Operating Conditions**

Christoph Benk[1], Ramona Lorenz[2], JÃ¼rgen Hennig[2,3], Friedhelm Beyersdorf[1], Jan G. Korvink,[3,4], Michael Markl[2]

[1]Dept. of Cardiovascular Surgery, University Hospital, Freiburg, Germany; [2]Dept. of Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany; [3]FRIAS, Freiburg Institute for Advanced Studies, Freiburg, Germany; [4]Laboratory for Simulation, IMTEK - Institute of Microsystem Technology, Freiburg, Germany

The use of paracorporeal ventricular assist devices (PVAD) has become a well-established procedure for patients with cardiogenic shock or who need biventricular support. However, implantation of Ventricular assist devices (VADs) is often associated with severe complications such as thrombosis inside the VAD and subsequent embolic events. It was therefore the purpose of this study to use flow sensitive 4D MRI for a detailed analysis of local and global 3D flow dynamics in a clinical routine VAD to study the effect of different system adjustments and valve designs on flow patterns.

14:30 ***3697*. Time-Resolved Spin-Labeled Balanced SSFP Cineangiography for Visualizing Intracardiac Shunt**

Federico E. Mordini[1], Ioannis Koktzoglou[1], Robert R. Edelman[1]
[1]Radiology, NorthShore University HealthSystem, Evanston, IL, United States

Existing methods for intracardiac shunt evaluation have important technical limitations. We developed a time-resolved spin-labeled cineangiographic technique (SLC) to image tagged blood within the heart for visualization of intracardiac shunt. Ten subjects with known atrial septal defects (ASD) were evaluated. Tagged inflowing blood was depicted with high signal intensity (SI) while non-tagged blood was suppressed. Flow was visualized crossing the atrial septum both inplane and throughplane. In conclusion, SLC is a non-contrast, non-velocity dependent method for visualizing RF-tagged blood flowing through cardiac chambers. SLC successfully depicted intracardiac shunting in all patients. SLC has potential use in the detection and pre-procedural assessment of ASD.

15:00 ***3698*. Evaluation of Diastolic Function with Flow Quantification Phase Contrast Cardiac Magnetic Resonance Imaging**

Jeremy Douglas Collins[1], Philip Anthony Hodnett[1], Timothy Anthony Scanlon[1], Amir H. Davarpanah[1], Aya Kino[1], Karin Dill[1], Sven C. Zuehlsdorff[2], James C. Carr[1]
[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Radiology, Siemens Healthcare, MR Research and Development, Chicago, IL, United States

Cardiac magnetic resonance is the reference standard for assessment of infiltrative heart disease and systolic function. The ability to assess diastolic dysfunction would enable comprehensive assessment of cardiac function. We evaluated 36 patients and 4 volunteers with flow quantification phase contrast imaging, comparing to Doppler echocardiography. Phase contrast imaging correctly classified all patients with grade I diastolic dysfunction. Differentiating patients with grade II dysfunction from normal diastolic function was not possible, although stratification based on E wave deceleration time was promising. A dedicated acquisition to assess the E’ lateral annulus velocity may be useful in this regard.

15:30 ***3699*. Highly Accelerated Cine Phase-Contrast Flow Measurements Using *k-T* PCA with Spatial Compartments**

Daniel Giese[1,2], Verena Knobloch[1], Henrik Pedersen[3], Tobias Schaeffter[2], Sebastian Kozerke[1,2]
[1]Institute for Biomedical Engineering, Univeristy and ETH Zurich, Zurich, Switzerland; [2]Division of Imaging Sciences, King's College London, London, United Kingdom; [3]Functional Imaging Unit, Glostrup Hospital, Glostrup, Denmark

In this work, we present an extension of k-t PCA taking into account temporal correlations in spatial compartments. The compartment method is shown to significantly outperform conventional k-t PCA at high reduction factors. Using the approach up to 10- fold net acceleration of single-directional phase-contrast velocity mapping in the ascending and descending aorta is demonstrated with excellent agreement relative to fully sampled data even if only a single receive coil is available.

Tuesday 13:30-15:30 Computer 37

13:30 ***3700*. Carotid Artery Wall Shear Stress: Distribution, Correlation with Geometry and Effect of Atherosclerosis**

Michael Markl[1], Timo Zech[2], Simon Bauer[1], Felix Wegent[2], Aurelien F. Stalder[1], Christoph Strecker[2], Andreas Harloff[2]
[1]Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany; [2]Neurology, University Hospital, Freiburg, Germany

The purpose of this study was to assess the physiological distribution of absolute wall shear stress and oscillatory shear index in the entire carotid bifurcation in healthy volunteers (n=64 carotid bifurcations) and to evaluate their dependence on individual bifurcation geometry. Further, the distribution of critical wall parameters was compared with findings in patients with moderate internal carotid artery (ICA) stenosis before (n=6) and after surgical recanalization (n=11). Bifurcation geometry predicted exposure to critical wall parameters and may thus be an indicator for the risk of developing flow-mediated atherosclerosis. Carotid artery stenosis and treatment altered the distribution of critical wall parameters.

14:00 ***3701*. 3-Component Phase-Contrast MRI WSS Vectors in the Carotid Bifurcation Are Concurrent with Local Atherosclerotic Plaque Risk Hypotheses**

Alex J. Barker[1], Fuxing Zhang[2], P E. Gates[3], L A. Mazzaro[4], A Stalder[1], J Fulford[3], C J. Lanning[4,5], M Markl[1], Robin Shandas[4,5]

[1]Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Mechanical Engineering, University of Colorado, Boulder, CO, United States; [3]Peninsula Medical School, University of Exeter, United Kingdom; [4]Center for Bioengineering, University of Colorado at Denver Health Sciences, CO, United States; [5]Division of Cardiology, The Children's Hospital, CO, United States need to fill this out

14:30 ***3702*. Onset Time of Retrograde Flow in the Pulmonary Artery in Pulmonary Arterial Hypertension Patients: An Estimator for Pulmonary Arterial Pressure?**

Frank Helderman[1], Gert Jan Mauritz[1], J. Tim Marcus[1], Kirsten Andringa[1], Nico Westerhof[1], Anton Vonk Noordegraaf[1]

[1]VU University Medical Center, Amsterdam, Netherlands

The objective was to assess if mean pulmonary artery pressure (mPAP) could be estimated using a standard 2D MR phase-contrast velocity quantification in the main pulmonary artery. Included were 37 Pulmonary Arterial Hypertension (PAH) patients vs 8 controls. Onset time of the retrograde flow (Retrograde Onset Time = ROT) as fraction of cardiac cycle time, and cross sectional area (CSA) of the main pulmonary artery were measured. Regression analysis revealed an association between mPAP and ROT ($r=0.74$; $p<0.001$), and between mPAP and CSA ($r=0.68$; $p<0.001$). The early retrograde flow in PAH is explained with a recirculation zone.

15:00 ***3703*. Time-Resolved 3D MR Velocity Mapping of the Great Hepatic Vessels at 3T: Simultaneous Visualization of Arterial and Venous Hemodynamics and Comparison with Ultrasound**

Zoltan Csatari[1], Zoran Stankovic[1], Peter Deibert[2], Wulf Euringer[1], Wolfgang Kreisel[2], Mathias Langer[1], Michael Markl[1]

[1]Department of Diagnostic Radiology and Medical Physics, University Hospital Freiburg, Freiburg, Baden Württemberg, Germany; [2]Gastroenterology, University Hospital Freiburg, Freiburg, Baden Württemberg, Germany

Flow-sensitive 4D-MRI allows the detailed depiction and quantification of the great hepatic vessels including the portal venous system as well as the coeliac trunc at the same time. As expected our results demonstrate differences in blood flow characteristics between the portal venous system and the arteries. In accordance with the literature lower values for velocities and higher values for areas were measured by MRI, but linear regression analysis showed an excellent agreement between MRI and the reference standard Doppler Ultrasound ($r = 0{,}72$; $p < 0.001$). In consideration of these results our findings underline that 4D-MRI could be an alternative, user indipendent method to Doppler US in investigating normal and pathological hemodynamics of the great hepatic vessels.

Wednesday 13:30-15:30 Computer 37

13:30 ***3704*. Combined PCMRI and CFD Hemodynamics in a Flow-Model and in the Thoracic Aorta**

Aurelien F. Stalder[1,2], Zhenyu Liu[3], Ramona Lorenz[2], Juergen Hennig[2,4], Jan Gerrit Korvink, [4,5], Michael Markl[2]

[1]Dept. of Radiology, Xuanwu Hospital, Capital Medical University, Beijing, China; [2]Dept. of Diagnostic Radiology - Medical Physics, University Hospital, Freiburg, Germany; [3]Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Science, Changchun, China; [4]Freiburg Institute for Advanced Studies (FRIAS), Freiburg, Germany; [5]Dept. of Microsystems Engineering, University of Freiburg, Germany

Both flow-sensitive 4D MRI and computational fluid dynamics (CFD) have successfully been applied to analyze complex 3D flow. However, both modalities suffer from limitations related to measurements (MRI) or model assumptions (CFD). In this study, we compared both modalities in a model in vitro and in the complex 3D blood flow of the thoracic aorta in vivo. Although discrepancies were observed, overall coherent patterns were observed. The further potential of the method is illustrated by calculating detailed Wall Shear Stress maps using very fine boundary layer mesh. The combination of 4D flow-sensitive MRI and CFD may be used to enhance the assessment of blood flow in vivo.

14:00 ***3705*. Visualization and Quantification of Increased Tangential Velocities in Ascending Aortic Aneurysms Using 4D Phase Contrast**

Benjamin R. Landgraf[1], Kevin M. Johnson[2], Erik T. Bieging[1], Oliver Wieben[2], Christopher J. François[1]

[1]Radiology, University of Wisconsin - Madison, Madison, WI, United States; [2]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States

Complex blood flow patterns in the ascending aorta have been associated with the pathophysiology of various cardiovascular diseases, including ascending aortic aneurysms. Helical and vortical flow in patients with aneurysms present an increased tangential force that could lead to further aortic dilation, dissection, or rupture. Characterization and quantification of these flow patterns could help predict disease progression. This study investigates several hemodynamic parameters of the ascending aorta in 11 normal volunteers

and 13 patients, including peak and mean velocities, calculation of a tangential percentage of velocity, and characterization of flow patterns.

14:30 ***3706*. Long Term Follow-Up of Patients Status Post Valve-Sparing Aortic Surgery with 4D-Flow**

Thomas A. Hope[1], Michael D. Hope[1], D Craig Miller[2], Michael Markl[3], John-Peder E. Kvitting[2], Charles B. Higgins[1], Robert J. Herfkens[4]

[1]Department of Radiology, University of California San Francisco, San Francisco, CA, United States; [2]Department of Cardiothoracic Surgery, Stanford University, Stanford, CA, United States; [3]Department of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [4]Department of Radiology, Stanford University, Stanford, CA, United States

12 patients status post valve sparing correction of ascending aortic aneurysms were imaged with 4D flow and were followed up for an average of 5 years. One patient had abnormal flow patterns in the ascending and descending aorta. Subsequently during the follow-up period, this patient developed a Stanford Type B aortic dissection. This is the first long-term follow-up study to correlate adverse outcomes to in vivo visualized abnormal flow patterns using MRI. Although this study is limited due to the small number of patients, it does suggest that abnormal flow patterns in the thoracic aorta may provide prognostic information.

15:00 ***3707*. Elevated Aortic Wall Shear Stress in a Subgroup of Patients with Bicuspid Valves**

Michael D. Hope[1], Thomas A. Hope[1], Thomas H. Urbania[1], Karen G. Ordovas[1], Alison K. Meadows[1], Marcus T. Alley[2], Charles B. Higgins[1]

[1]Radiology, UCSF, San Francisco, CA, United States; [2]Stanford Radiology

4D Flow demonstrates significantly higher aortic wall shear stress in a subgroup of BAV patients with eccentric systolic flow jets. Studies have shown that only a subset of BAV patients have aortic dilation, and that those with dilation develop asymmetric aneurysms of the AsAo at the location where we have demonstrated elevated vWSS. As altered WSS can give rise to pathologic endothelial gene expression and extracellular matrix remodeling, we may have identified the mechanism that places a subgroup of BAV patients at risk for asymmetric AsAo aneurysm.

Thursday 13:30-15:30 Computer 37

13:30 ***3708*. Vortex Core Detection and Visualization Using 4D Flow-Sensitive MRI**

Aurelien F. Stalder[1,2], Alex Frydrychowicz[3], Andreas Harloff[4], Qi Yang[1], Jelena Bock[2], Juergen Hennig[2], Kuncheng Cheng Li[1], Michael Markl[2]

[1]Dept. of Radiology, Xuanwu Hospital, Capital Medical University, Beijing, China; [2]Dept. of Diagnostic Radiology - Medical Physics, University Hospital, Freiburg, Germany; [3]Dept. of Radiology, University of Wisconsin-Madison, Freiburg, Germany; [4]Dept. of Neurology, University Hospital, Freiburg, Germany

4D flow-sensitive MRI was used with 3D flow visualization techniques and a vortex core detection algorithm to detect patterns of swirling flow in the aorta, the carotid arteries as well as intracranial arteries in volunteers and patients. While aneurysms presented strong vortex cores, weaker vortex cores were identified in the healthy aortic arch and the healthy internal carotid artery. The vortex core detection provided a fast and simple way to detect locations of swirling flow within 4D flow-sensitive MRI datasets.

14:00 ***3709*. Age Relation of Aortic Wall Compliance in Marfan Syndrome: Evaluation with Velocity-Encoded MRI**

Jos J.M. Westenberg[1], Arthur J.H.A. Scholte[2], Zuzana Vaskova[3], Rob J. van der Geest[1], Maarten Groenink[4], Gerda Labadie[1], Pieter J. van den Boogaard[1], Teodora R. Radonic[4], Yvonne Hilhorst-Hofstee[5], Lucia J.M. Kroft[1], Albert de Roos[1], Johan H.C. Reiber[1]

[1]Radiology, Leiden University Medical Center, Leiden, Zuid-Holland, Netherlands; [2]Cardiology, Leiden University Medical Center; [3]Radiology, St. Anne's University Hospital, Brno, Czech Republic; [4]Cardiology, Academic Medical Center, Amsterdam, Netherlands; [5]Clinical Genetics, Leiden University Medical Center

The purpose of this study is to describe age relation of aortic wall compliance, expressed in Pulse Wave Velocity, Distensibility and Stiffness Index, with Velocity-Encoded MRI in Marfan syndrome. Twenty-five patients with Marfan syndrome and twenty-five age-matched healthy volunteers are examined and measures for compliance are compared. In Marfan, the Pulse Wave Velocity is generally increased in the aortic arch, distal aorta and total aorta. Distensibility is decreased. Only the Stiffness Index is not statistically significantly different. Age-related change in compliance is best expressed in increasing Pulse Wave Velocity.

14:30 ***3710*. Aortic Compliance Evaluation: Comparison of Time Delay Algorithms**

Yi Wang[1], Edwin Estrada[1], Jianping Zhang[2]

[1]Research and Education, St. Francis Hospital, Roslyn, NY, United States; [2]Applied Mathematics and Statistics, State University of New York, Stony Brook, NY, United States

Aortic pulse wave velocity (PWV), a measurement of the flow pulse traveling along aorta as a surrogate for aortic compliance, can be assessed using a single breath-hold through-plane phase contrast imaging technique. Accurate determination of the time delay between flows in ascending and descending aorta is critical in PWV assessment. Various approaches have been studied, including measuring the intervals between flow onset points, between maximal flow points, and between parallel upslopes after least squares fittings. We compared five automated approaches for time delay detection and evaluated their effects on aortic compliance and their relationship to age in 186 normal volunteers.

15:00 ***3711***. **Improved Simulation of 3D Flow Characteristics in a Pressure Controlled in Vitro Model System**

Ramona Lorenz[1], Christoph Benk[2], Jelena Bock[1], Jan Korvink[3], Michael Markl[1]
[1]Dept. of Diagnostic Radiology, University Hospital, Freiburg, Germany; [2]Dept. of Cardiovascular Surgery, University Hospital, Freiburg, Germany; [3]Dept. of Microsystems Technology, IMTEK, Freiburg, Germany

In-vitro model systems provide a useful tool for the systematic evaluation of hemodynamic changes associated with geometric vascular modifications. However, realistic in-vivo in-flow and boundary conditions are necessary for accurate flow simulations. This paper presents a novel approach for an in-vitro model setup which includes a pulsatile pump chamber in combination with flexible and monitored pressure control using an adjustable mock loop to simulate physiological pre- and after load conditions. In contrast to measurements without pressure control an improved generation of qualitative and quantitative flow characteristics compared to in-vivo flow conditions could be achieved.

Image Post-Processing

Hall B Monday 14:00-16:00 Computer 38

14:00 ***3712***. **Investigation of Myocardium Structure of Postinfarct Porcine Model Using Superquadric Glyphs**

Yin Wu[1,2], Ed Xuekui Wu[2,3]
[1]Institute of Biomedical and Health Engineering, Shenzhen Institute of Advanced Technology, Shenzhen, Guangdong, China; [2]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong; [3]Dept. of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong

Previous DTI studies on infarcted LV myocardium structure usually explored myocardial fiber orientation, diffusivity or diffusion anisotropies. In current study, superquadric glyphs were applied on infarcted porcine model. Diffusion tensor shape and laminar sheet structure were examined for the first time to describe infarcted myocardium structural alteration. Results show that significant change of diffusion tensor shape occurred in both infarct and adjacent regions. Apparent alteration of laminar sheet structure was observed in adjacent and remote regions. The current study demonstrates the ability of superquadric glyphs to detect myocardium structural degeneration and provides supplemental information for infarcted heart remodeling.

14:30 ***3713***. **Multiecho Dixon Fat and Water Separation Method for Diagnosing Pericardial Disease**

Amir H. Davarpanah[1], Aya Kino[1], Kirsi Taimen[1], Philip Hodnet[1], Jeremy Collins[1], Cormac Farrelly[1], Saurabh Shah[2], Sven Zuehlsdorff[2], James Carr[1]
[1]Department of Radiology, Cardiovascular Imaging, Northwestern University, chicago, IL, United States; [2]Siemens Medical Solutions, chicago, IL, United States

The VARPRO method (multi-echo gradient echo sequence with iterative fat/water decomposition reconstruction)for fat/water separation performs better than the standard fat saturation protocol currently used at our institution. The water image from this method presents with a more uniform fat suppression.

15:00 ***3714***. **Automated Evaluation of Left Ventricular Diastolic Function Using Velocity-Encoded Magnetic Resonance Imaging: Conventional and New Parameters**

Emilie Bollache[1], Stéphanie Clément-Guinaudeau[2], Ludivine Perdrix[3], Magalie Ladouceur[1,3], Muriel Lefort[1], Alain De Cesare[1], Alain Herment[1], Benoît Diebold[1,3], Elie Mousseaux[1,2], Nadjia Kachenoura[1]
[1]INSERM U678, UPMC, Paris, France; [2]Radiology department, APHP, European Hospital Georges Pompidou, Paris, France; [3]Echocardiography department, APHP, European Hospital Georges Pompidou, Paris, France

Phase-contrast (PC) Magnetic Resonance (MR) is not used in clinical routine to assess diastolic function, because of the lack of automated analyses. Thus, our aim was to develop a process to automatically analyze PC data. Automated segmentation of PC images and analysis of velocity and flow rate curves to derive diastolic parameters were developed and tested on 25 controls. Segmentation was successful in all subjects. Our conventional parameters were consistent with those previously presented in literature and our new parameters highly correlated with high prognosis value parameters. Our process may provide a valuable addition to the established cardiac MR tools.

15:30 ***3715***. **Unsupervised and Reproducible Image-Based Identification of Cardiac Phases in Cine SSFP MRI**

Sotirios A. Tsaftaris[1,2], Xiangzhi Zhou[2], Richard Tang[2], Rohan Dharmakumar[2]
[1]Electrical Engineering and Computer Science, Northwestern University, Evanston, IL, United States; [2]Radiology, Northwestern University, Chicago, IL, United States

It is particularly important for the evaluation of cardiac phase-resolved myocardial blood-oxygen-level-dependent (BOLD) MRI studies, to robustly and reproducibly identify end-systolic (ES) and end-diastolic (ED). Most automated methods rely on identifying the minimum and maximum of the blood pool area in the Left Ventricle chamber, but they are computationally intensive, susceptible to noise, and require prior localization and segmentation of the chamber. The purpose of this work is to develop automated methods to

facilitate in the robust and reproducible evaluation of cardiac phase-resolved myocardial BOLD MRI through identification of ES and ED images.

Tuesday 13:30-15:30 Computer 38

13:30 ***3716*.** **Estimation of LV Function from Navigator Triggered, Real-Time Cardiac Cine Steady-State Free Precession (SSFP) Imaging**

Amol Pednekar[1], Benjamin Cheong[2], Raja Muthupillai[2], Claudio Arena[2]
[1]Philips Healthcare, Cleveland, OH, United States; [2]Diagnostic and Interventional Radiology, St. Luke's Episcopal Hospital, Houston, TX, United States

We propose an integrated real-time data acquisition and retrospective post-processing strategy to estimate parameters characterizing global function of the left ventricle. Our initial evaluation of feasibility of this approach in normal subjects shows that slice-by-slice LV volumes estimated using the real-time cine imaging approach are comparable to the LV volumes obtained using conventional, breathhold cardiac cine SSFP techniques. The combination of respiratory navigator triggering, real-time unsegmented SSFP cine imaging, and integrated retrospective automated processing may make this approach particularly useful in patients with severe arrhythmias, and/or severely compromised respiratory function.

14:00 ***3717*.** **ShMOLLI: Shortened Modified Look Locker Inversion Recovery for Cardiac T1 Mapping – from Theory to Normal Human Myocardium**

Stefan K. Piechnik[1], Vanessa M. Ferreira[2], Erica Dall'Armellina[2], Lowri E. Cochlin[3], Stefan Neubauer[2], Matthew D. Robson[2]
[1]Cardiovascular Medicine, OCMR, Oxford University , Oxford, Oxfordshire, United States; [2]Cardiovascular Medicine, OCMR, Oxford University, Oxford, Oxfordshire, United States; [3]Dept of Physiology, Anatomy and Genetics, Oxford University, Oxford, Oxfordshire, United States

We propose a cardiac T1-mapping method based on sequential Look-Locker measurements with conditional reconstruction of incomplete recovery periods. This new method assures that robust T1 mapping can be achieved in a 9 heartbeat breath-hold with accuracy comparable to existing methods.

14:30 ***3718*.** **Preferential Patterns of Myocardial Iron Deposition by Multislice Multiecho T2* CMR in Thalassemia Major Patients.**

Antonella Meloni[1], Vincenzo Positano[1], Alessia Pepe[1], Pasquale Pepe[1], Maria Chiara Dell'Amico[1], Cristina Salvatori[1], Petra Keilberg[1], Gianluca Valeri[2], Eliana Cracolici[3], Pier Paolo Bitti[4], Angelo Zuccarelli[5], Maria Filomena Santarelli[1], Massimo Lombardi[1]
[1]MRI Lab, "G. Monasterio Foundation" and Institute of Clinical Physiology, CNR, Pisa, Italy; [2]Azienda Ospedaliero-Universitaria Ospedali Riuniti "Umberto I-Lancisi-Salesi", Ancona, Italy; [3]Policlinico "Paolo Giaccone" , Palermo, Italy; [4]Dipartimento dei Servizi - P. O. San Francesco, Nuoro, Italy; [5]Centro trasfusionale e di microcitemia - Ospedale civile, Olbia, Italy

Multislice multiecho T2* MRI allows quantification of iron overload in the whole myocardium. A preferential pattern of iron store in anterior and inferior regions appears to be present in thalassemia major patients with severe and mild-moderate iron overload. The preserved pattern between the groups prevents attributing this datum to additive susceptibility artefacts, which are negligible in heavily iron-loaded patients. A segmental T2* CMR approach could identify early iron deposit, useful for tailoring chelation therapy and preventing myocardial dysfunction in the clinical setting.

15:00 ***3719*.** **RV Function from Cine MRI Using Contour Propagation**

Wei Feng[1], Himanshu Gupta[2], Steven Lloyd[2], Louis Dell'Italia[2], Thomas S. Denney Jr[3]
[1]Biomedical Engineering, MRI Institute, Detroit, MI, United States; [2]Division of Cardiovascular Disease, University of Alabama at Birmingham, Birmingham, AL, United States; [3]Electrical Engineering, Auburn University, Auburn, AL, United States

This abstract presents a method for computing right-ventricular volume-versus-time curves and peak ejection and filling rates from standard cardiac cine MRI. The method uses RV contours drawn semi-automatically near end-diastole and end-systole and propagates them to the remaining time frames via a non-rigid registration technique. The propagated contours are validated by comparing them to contours manually drawn by a cardiologist with Level 3 training. In addition, peak ejection and filling rates computed from both manually-drawn and propagated contours are compared.

Wednesday 13:30-15:30 Computer 38

13:30 ***3720*.** **4D Right Ventricular Strain in Pulmonary Hypertension and Normals**

Bharath Ambale Venkatesh[1], Steven G. Lloyd[2], Mustafa I. Ahmed[2], Himanshu Gupta[2], Louid Dell'Italia[2], Thomas S. Denney Jr. [1]
[1]Electrical and Computer Engineering, Auburn University, Auburn, AL, United States; [2]University of Alabama at Birmingham

Accurate assessment of right ventricular (RV) function is clinically important – particularly in patients with pulmonary hypertension (PHTN). Compared to the left ventricle (LV), however, analysis of RV function is relatively difficult because of relatively thin walls and lack of geometric symmetry. Also in PHTN, higher systolic blood pressure in the RV can cause excursion of the interventricular

septum into the LV cavity causing it to lose its geometric symmetry. This abstract presents a method for reconstructing three-dimensional biventricular strain from tagged MRI in each imaged time frame through mid-diastole. This method is validated on normal volunteers and PHTN patients.

14:00 ***3721*.** **A Novel Centerline Model for Cardiac Long Axis Wall Motion Analysis**

Ting Song[1,2], Jeffrey A. Stainsby[3], Maureen N. Hood[2,4], Vincent B. Ho[2,4]
[1]GE Healthcare Applied Science Laboratory, Rockville, MD, United States; [2]Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD, United States; [3]GE Healthcare Applied Science Laboratory, Toronto, ON, Canada; [4]Radiology, National Navy Medical Center, Bethesda, MD, United States

A novel long axis wall motion quantification model is proposed to provide a reliable and simple solution to cardiac function calculations. Using only routine clinical MR cine images, functional parameters can be quantified determined retrospectively.

14:30 ***3722*.** **Automated Synchronization of Cardiac Phases for Myocardial BOLD MRI**

Sotirios A. Tsaftaris[1,2], Xiangzhi Zhou[2], Richard Tang[2], Rachel Klein[2], Aggelos Katsaggelos[1], Rohan Dharmakumar[2]
[1]Electrical Engineering and Computer Science, Northwestern University, Evanston, IL, United States; [2]Radiology, Northwestern University, Chicago, IL, United States

It is particularly important for the evaluation of cardiac phase-resolved myocardial blood-oxygen-level-dependent (BOLD) MRI studies, to robustly and reproducibly synchronize images from rest and stress studies. The possibility of visualizing BOLD signal changes in multiple cardiac phases is expected to increase the diagnostic confidence for identifying the affected myocardial territories. The purpose of this work is to develop automated statistical methods to facilitate in the robust and reproducible evaluation of cardiac phase-resolved myocardial BOLD MRI through temporal synchronization of rest and stress images acquired at different heart rates, without resorting to LV segmentation.

15:00 ***3723*.** **Using Vector Velocity Imaging (VVI) to Measure Left Ventricular Systolic Strain and Diastolic Strain Rate in Cine MRI**

Nicholas M. Dunn[1], Subha Raman[2], Helene Houle[3], Gianni Pedrizzetti[4], Mani Vannan[2], Orlando Simonetti[2]
[1]The Davis Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States; [2]Internal Medicine, Division of Cardiovascular Medicine, The Ohio State University, Columbus, OH, United States; [3]Siemens Medical Solutions, Mountain View, CA, United States; [4]The University of Trieste, Trieste, Italy

Quantification of systolic strain and diastolic strain rate provide more sensitive indicators of myocardial dysfunction than subjective image interpretation. Vector Velocity Imaging (VVI) is a processing method developed to calculate myocardial strain and strain rate in echocardiography images. Its feasibility to calculate strain and strain rate in cine MR images was tested by analyzing short and long axis SSFP cine MR images of normal, healthy subjects and comparing the acquired values to literature values attained using other MR tissue-tagging methods. The results show that VVI may be used to calculate strain and strain rate in SSFP cine MRI.

Thursday 13:30-15:30 Computer 38

13:30 ***3724*.** **Myocardial Infarction Segmentation by GMM Clustering Method with Free-Breathing 3D Navigator-Gated DE-MRI**

Yonggang Lu[1,2], Thanh D. Nguyen[3], Noel C. F. Codella[3], Dorinna D. Mendoza[4], Jonathan Weinsaft[4], Bruce B. Lerman[5], Yi Wang[3]
[1]Wiscom Intelligent System Co.,Ltd., Nanjing, Jiangsu, China; [2]Department of Radiology , Weill Medical College of Cornell University, New York, NY, United States; [3]Department of Radiology, Weill Medical College of Cornell University, New York, NY, United States; [4]Department of Medicine, Division of Cardiology, Weill Medical College of Cornell University, New York, NY, United States; [5]Department of Medicine, Weill Medical College of Cornell University, New York, NY, United States

A GMM clustering method with a free-breathing 3D Navigator-Gated DE-MRI was proposed for myocardial infarction segmentation in this study. Compared to commonly used methods, the novel method has a superior performance of more accuracy and operator-independence in assessing myocardial infarction as demonstrated by preliminary experiments with in vivo human data.

14:00 ***3725*.** **Interstrain Comparisons of Murine Global Cardiac Mechanical Function Using MRI**

Christakis Constantinides[1], Nikolas Aristokleous[1], Konstantinos Fokianos[2], Jeff Brandenburg[3], Dimitrios Perperidis[1]
[1]Mechanical and Manufacturing Engineering, University of Cyprus, Nicosia, Cyprus; [2]Mathematics and Statistics, University of Cyprus, Nicosia, Cyprus; [3]Radiology, Duke University Medical Center, Durham, NC, United States

Quantitative characterization of ventricular function has become important for the assessment of cardiac performance in heart disease. As the manipulation of the mammalian genome becomes routine, it is now possible to generate animal models to study cardiovascular function and dysfunction. Critical to successful phenotypic screening of mouse models of the cardiovascular system using MRI are highly efficient four-dimensional (4D) acquisition protocols, and reduction of the computational image processing complexity for accurate quantification. The -goal of this study is the efficient, quantitative assessment of interstrain cardiac performance in C57BL/6J and DBA/2J mouse hearts under anesthesia, using MRI.

14:30 ***3726***. **Feasibility of Myocardial T1 Mapping from Cine-IR Images by Image Warping**

Vincenzo Positano[1], Matteo Milanesi[1], Piergiorgio Masci[1], Thomas KIng Foo[2], J C. Hardy[2], Luca Marinelli[2], Andrea Barison, [1,3], Daniele De Marchi[1], Massimo Lombardi[1], Luigi Landini[4]

[1]MRI Laboratory, "G- Monasterio" Foundation and Istitute of Clinical Physiology, Pisa, Italy; [2]Global Research Center, General Electric, Niskayuna, NY, United States; [3]Scuola Sant'Anna, Pisa, Italy; [4]Department of Information Engineering, University of Pisa, Italy

Myocardial T1 mapping from Cine-IR images is feasible by warping the myocardium signal in each frame on a standardized model, evaluating the pixel-by-pixel T1 distribution on the model, and finally warping back the resulting T1 map on each frame.

15:00 ***3727***. **Myocardial Motion Estimation from Cardiac Cine-MRI with a Phase-Based Optical Flow Method**

Marie Xavier[1], Alain Lalande[1], Paul Michael Walker[1], Jean-Christophe Eicher[2], Jean-Eric Wolf, [1,2], François Brunotte[1], Louis Legrand[1]

[1]LE2I, University of Burgundy, Dijon, France; [2]Department of Cardiology, University Hospital, Dijon, France

Generally, the evaluation of myocardial motion from cine-MRI sequences requires a visual evaluation of the regional contractile function and depends on the experience of the reader. To automatically detect local myocardial wall motion abnormalities from cine-MRI sequence, an optical flow technique based on phase information was used. First, the robustness of the technique with regards to Rician noise and to brightness variations was evaluated on synthetic images. Then, in the context of cardiac cine-MRI, a segmental decomposition of the myocardium allowed us to study the mean velocity along the cardiac cycle and gave similar values to those obtained by echocardiography.

Image Processing: Myocardium & Vascular

Hall B Monday 14:00-16:00 Computer 39

14:00 ***3728***. **Peak Angiogram Calculations from 4D Flow Imaging**

Michael Loecher[1], Kevin Johnson[1], Christopher Francois[2], Oliver Wieben[1]

[1]Department of Medical Physics, University of Wisconsin, Madison, WI, United States; [2]Department of Radiology, University of Wisconsin, Madison, WI, United States

This study aims to assess an alternative reconstruction method that utilizes the temporal information from a 4D radially encoded flow scan. The method creates and angiogram from dynamic time frames instead of a time averaged reconstruction. While the approach increases background noise, it alleviates the problem of signal drops and voids from reversing flow patterns. The utility of the algorithm was evaluated in a group of 4 volunteers and 6 patients, demonstrating improved signal consistency along the aorta.

14:30 ***3729***. **Unsupervised Reconstruction for Ungated Ghost Angiography by Clustering of Image Features**

Sotirios A. Tsaftaris[1,2], Erik Offerman[3], Robert R. Edelman[3], Ioannis Koktzoglou[3]

[1]Electrical Engineering and Computer Science, Northwestern University, Evanston, IL, United States; [2]Radiology, Northwestern University, Chicago, IL, United States; [3]Radiology, NorthShore University HealthSystem, Evanston, IL, United States

Ghost magnetic resonance angiography (MRA) has been proposed as an unenhanced and ungated method for angiography. The method requires manual post-processing to identify suitable slices in a large stack from which to create an interpretable angiogram. To maximize the contrast of the final angiogram it is necessary to eliminate slices located within the body and to carefully select the slices that contain conspicuous ghost artifacts. This time-consuming process can also introduce unwanted inter- and intra- observer variability. The purpose of this work was to completely automate the reconstruction process during ungated and non-contrast-enhanced Ghost MRA using image analysis and clustering.

15:00 ***3730***. **Level-Set Segmentation of Arterial and Venous Vessels Based on ToF-SWI Data**

Andreas Deistung[1], Michal Strzelecki[2], Andrzej Materka[2], Jürgen R. Reichenbach[1]

[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology , Jena University Hospital , Jena, Germany; [2]Institute of Electronics, Technical University of Lodz, Lodz, Poland

Non-invasive quantitative assessment of the cerebral vasculature is of high diagnostic and therapeutic interest. The pre-requisite for the quantitative description of blood vessels is voxel-wise classification into vessel and non-vessel structures. In this contribution, we use a hybrid level-set approach that relies on both boundary and region information to segment arterial and venous vessels from simultaneously acquired time-of-flight (ToF) and susceptibility weighted imaging (SWI) data to create a 3D representation of the arterial and venous vasculature.

15:30 ***3731*.** **Fast Plaque Burden Assessment of the Femoral Artery Using 3D Black-Blood MRI and Automated Segmentation**

Bernard Chiu[1], Xihai Zhao[1], Jinnan Wang[2], Niranjan Balu[1], Chun Yuan[1], William S. Kerwin[1]
[1]Radiology, University of Washington, Seattle, WA, United States; [2]Clinical Sites Research Program, Philips Research North America, Briarcliff Manor, NY, United States

Peripheral arterial disease (PAD) is a serious health issue in the western world. Recent advances in high-resolution MRI have allowed noninvasive and detailed assessment of PAD, including black-blood MRI visualization of the vessel wall. Because the length of a femoral artery is substantial, a long field of view is required to image the femoral artery. Manual outlining of wall boundaries along the entire length of the femoral artery is an arduous task. In this work, we proposed and demonstrated an automatic algorithm that is capable of accurately segmenting the lumen and wall boundaries along the majority of the femoral artery.

Tuesday 13:30-15:30 Computer 39

13:30 ***3732*.** **Hemorrhage Delineation and Blood Suppression Evaluation in Slab-Selection Phase-Sensitive Inversion-Recovery (SPI) Sequence with MRI**

Dongxiang Xu[1], Jinnan Wang[2], Williams Kerwin[1], Chun Yuan[1]
[1]Radiology, University of Washington, Seattle, WA, United States; [2]Philips Research North America, Jinnan.Wang@philips.com, Seattle, WA, United States

Intraplaque hemorrhage (IPH) into the carotid atherosclerotic plaque has shown significant association with clinical symptoms and is believed to be a major factor causing plaque instability and progression according to previous histopathological and prospective studies. With the development of magnetic resonance imaging (MRI) in clinical diagnostics, several techniques have been developed to enable and improve the IPH evaluation. However, automated hemorrhage detection has been challenging due to either low IPH contrast or poor lumen contrast. Purpose: In this study, by incorporating the improved IPH and lumen contrasts in Slab-selection Phase-sensitive Inversion-recovery (SPI) MRI sequence, we develop a novel and robust image segmentation approach to automatically locate and delineate IPH in MR data. Quantitative IPH and lumen analysis results by this automatic segmentation technique were compared to a human reader, which demonstrated highly consistent performance.

14:00 ***3733*.** **Direct and Indirect Surface Coil Correction for Cardiac Perfusion MRI**

Hui Xue[1], Sven Zuehlsdorff[2], Jens Guehring[1]
[1]Corporate Research, Siemens Corporation, Princeton, NJ, United States; [2]CMR Research and Development, Siemens Healthcare, Chicago, IL, United States

Although the first-pass myocardial perfusion MRI has proven its effectiveness in the early diagnosis of suspected ischemic heart diseases, this technique is still not routinely used. Certain technical difficulties prevent perfusion MRI from being added into the clinical workflow. Among of them includes the B1-field inhomogeneity caused by non-uniform characteristics of the receiver coils which still lacks intensive studies, when compared to perfusion imaging sequences or motion compensation. We therefore propose algorithms to perform the surface coil inhomogeneity correction (SCC) using proton density (PD) weighted images and B-Spline Free-Form Deformation (FFD).

14:30 ***3734*.** **Saturation Correction of Dynamic Contrast Enhanced MRI Uptake Curves for Quantitative Myocardial Blood Flow Measurements Using an Assumed T_1 for Blood**

John David Biglands[1], Abdulghani Larghat[1], Sven Plein[1], David L. Buckley[1], Michael Jerosch-Herold[2], Derek Magee[3], Roger Boyle[3], Aleksandra Radjenovic[1]
[1]School of Medicine, University of Leeds, Leeds, UK, United Kingdom; [2]Radiology, Brigham and Womens Hospital, Boston, MA, United States; [3]School of Computing, University of Leeds, Leeds, United Kingdom

Dynamic contrast enhanced magnetic resonance imaging of the myocardium using sufficiently high doses to be clinically useful generates uptake curves that require correction for signal saturation effects before they can be used for myocardial blood flow (MBF) estimation. Such corrections require knowledge of the native T1 of the blood and myocardium. This abstract shows that using an assumed blood T1 enables saturation correction of typical clinical datasets without the need for time consuming T1 measurements. MBF estimates from nine patients were consistent with literature values and were shown to be robust to variations in the assumed T1 of blood.

15:00 ***3735*.** **Novel MRI T2 Mapping for Improved Myocardial Tissue Characterisation**

Taigang He[1], Sanjay Prasad[1], Guang-Zhong Yang[1], Dudley Pennell[1], David Firmin[1]
[1]Royal Brompton Hospital and Imperial College London, London, United Kingdom

Synopsis: The aim of this study was to develop a novel T2 mapping method for improved myocardial tissue characterisation. The developed T2 sequence resulted in improved resolution with shorter echo time and echo spacing. The novel technique was consequently evaluated on nine human subjects. Preliminary results demonstrated that all images acquired were of good quality. Pixel wise T2 curve is well fitted and T2 mapping in the whole myocardium appeared homogeneous. This study suggests that T2 mapping may potentially be used for assessing regional disease variations across the myocardium.

Wednesday 13:30-15:30 Computer 39

13:30 ***3736*. Cardiac Diffusion MR Microscopy of Rabbit Heart**

Min Sig Hwang[1], Katja Odening[2], Ohad Ziv[2], Bum-Rak Choi[2], Gideon Koren[2], John R. Forder[1]
[1]McKnight Brain Institute, University of Florida, Gainesville, FL, United States; [2]Cardiovascular Research Center, Rhode Island Hospital Alert Medical School of Brown University, Providence, RI, United States

In this study, we explored the potential of microscopic high angular resolution diffusion imaging (MHARDI) achieving a cellular level spatial resolution as a non-invasive tool that is sensitive to subtle changes in the heterogeneous microstructure and arrangement of the cardiac tissues. Diffusion tensor images and tensor invariants acquired with two diffusion sensitizing factors were investigated. Our results suggest that MHARDI with an optimized b-value and resolution may be a powerful tool for non-invasive monitoring of electro-mechanical property and its well-coordinated function.

14:00 ***3737*. Automated Segmentation of Left Ventricle in Cine Cardiac MR Images: Experience from a Large Study**

YingLi Lu[1], Perry Radau[1], Kim A. Connelly[1,2], Alexander Dick[3], Graham A. Wright[1]
[1]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, ON, Canada; [2]Cardiology, St Michael's Hospital, Toronto, ON, Canada; [3]Cardiology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada

Purpose of this study is to develop a fully automatic left ventricle segmentation method from cine short-axis MR images and evaluate it on a large data set of 147 subjects grouped by pathology. Advantages of this method include that it: 1) does not require manually drawn contours; 2) provides not only endocardial and epicardial contours, but also papillary muscles and trabeculations¡¯ contours; 3) introduces a roundness measure that automatically locates the left ventricle; 4) simplifies the epicardial contour segmentation by mapping the pixels from Cartesian to approximately polar coordinates.

14:30 ***3738*. Three-Dimensional Myocardial Tissue Tracking and Strain Calculation for Volumetric Cine DENSE Data**

Xiaodong Zhong[1,2], Bruce S. Spottiswoode[3], Craig H. Meyer[2,4], Frederick H. Epstein[2,4]
[1]MR R&D Collaborations, Siemens Healthcare, Atlanta, GA, United States; [2]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States; [3]MRC/UCT Medical Imaging Research Unit, University of Cape Town, Cape Town, Western Cape, South Africa; [4]Radiology, University of Virginia, Charlottesville, VA, United States

This abstract introduces novel automatic algorithms for myocardial tissue tracking and strain calculation for three-dimensional (3D) cine DENSE data. Specifically, scattered data interpolation using radial basis functions (RBF) was developed for Lagrangian tissue tracking. Also, a finite-strain based algorithm was developed to calculate the deformation gradient tensor and the Lagrangian strain tensor. The algorithms were performed on 3D cine DENSE data from five healthy volunteers to obtain 3D Lagrangian displacement and strain fields. The 3D myocardial mechanics, including normal strains, twist and torsion, were consistent with previous results from myocardial tagging in healthy volunteers.

15:00 ***3739*. Towards Non-Invasive Automatic Detection of Cardiac Pathology by Strain and Rotation Analysis**

Hans C. van Assen[1], Luc M.J. Florack[2], Frank F.J. Simonis[1], Jos J.M. Westenberg[3], Gustav J. Strijkers[1], Bart M. ter Haar Romeny[1]
[1]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Noord Brabant, Netherlands; [2]Mathematics and Computer Science, Eindhoven University of Technology, Eindhoven, Noord Brabant, Netherlands; [3]Radiology, Leiden University Medical Center, Leiden, Netherlands

This paper describes a novel image processing method for automated detection of cardiac pathology. It entails tagging analysis by means of an optical flow approach. Tag fading is overcome by exploitation of tag phase - retrieved by Gabor filtering - instead of tag brightness.
The method yields both the motion field and its first order derivative structure, necessary to calculate strain and rotation. Calculation of these derived parameters thus becomes straightforward. High-resolution in-slice cardiac strain and rotation are presented for four volunteers and a patient, and clearly show deviations for a patient with known small infarctions and wall motion abnormalities.

Thursday 13:30-14:00 Computer 39

13:30 ***3740*. Comparison of Techniques for the Measurement of Tissue-Blood Partition Coefficients in Healthy and Infarcted Myocardium**

James W. Goldfarb[1,2], Wenguo Zhao[1]
[1]Saint Francis Hospital, Roslyn, NY, United States; [2]Program in Biomedical Engineering, Stony Brook University, Stony Brook, NY, United States

The purpose of this study was to investigate the temporal dynamics a two-compartment tissue-blood partition coefficient and compare it to estimates using a three-compartment model. In 25 individuals with chronic myocardial infarctions, blood Gd-concentration was modeled with a bi-exponential and myocardial tissue Gd-concentration with a three-compartment model. It was found that the measurement of the tissue-blood partition coefficient based on the ratio of T1 relaxation time differences is time dependent.. The

measurement of the tissue-blood partition coefficient using a three compartment model yields similar values between infarcted and viable myocardium. T1 relaxation differences are likely due to a third trapping compartment.

Molecular Imaging in Cardiovascular Disease & Cancer

Hall B Monday 14:00-16:00 Computer 40

14:00 ***3741*. A DNA-Targeted Gadolinium Chelate to Selectively Enhance Acutely Injured Myocardium**

Shuning Huang[1], Hushan Yuan[2], Howard Chen[3], Guangping Dai[1], Lee Josephson[2], David E. Sosnovik[1,3]
[1]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Center for Translation Nuclear and Molecular Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [3]Center for Molecular Imaging Research, Massachusetts General Hospital, Charlestown, MA, United States

Delayed enhancement of gadolinium cannot discriminate acute and chronic injury since both produce similar changes in the pharmacokinetics of small gadolinium chelates, such as Gd-DTPA. Here, we demonstrated that the acute myocardial infarction can be distinguished from both subacute and chronic myocardial injury by utilizing a DNA-targeted gadolinium chelate (Gd-TO).

14:30 ***3742*. 21 Tesla Rat Heart Magnetic Resonance Microimaging by Paramagnetic Anti-Troponin Bound Polyethylene Based Iron-Oxide Nanoparticles and Image Processing**

Rakesh Sharma[1,2], Kiran Shetty, [3]
[1]FAMU-FSU College of Engineering,, CIMAR, National High Magnetic Field Laboratory, Tallahassee, FL, United States; [2]Center of Nanomagnetics and Biotechnology, Florida State University & TCC, Tallahassee, FL, United States; [3]NHMFL, Florida State University, Tallahassee, FL, United States

The 21T MR microimaging by using first time troponin nanoparticles enhances the visualization of cardiac muscles fiber and offers technical advancement in future. Diffusion weighting offers the fiber tracking and functional analysis. Image processing offers heart probabilistic atlas and maps.

15:00 ***3743*. Optimization of Ultrashort TE Imaging for Angiography and Molecular Imaging of Iron-Oxide Nanoparticles**

Ravi Teja Seethamraju[1], Sonia Nielles-Vallespin[2], Shuning Huang[3], David E. Sosnovik[3,4]
[1]MR R and D, Siemens Medical Solutions, USA Inc., Charlestown, MA, United States; [2]Cardiovascular MR, Royal Brompton Hospital, London, United Kingdom; [3]Radiology, Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States; [4]Center for Molecular Imaging Research, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

Iron oxide based USPIOs inherently exhibit T1 shortening apart from their traditional T2 properties. This property is best utilized at ultrashort echo times. We demonstrate how a single UTE sequence can produce both angiographic images as well as molecular quantitation.

15:30 ***3744*. PEGylated Nano-Peaches: A Novel Multimodality Platform for Imaging of Atherosclerosis**

Andrei Maiseyeu[1], Georgeta Mihai[1], Marcus A. Badgeley[1], Orlando P. Simonetti[1], Jeffrey A. Deiuliis[1], Chandan K. Sen[1], Sampath Parthasarathy[1], Sanjay Rajagopalan[1]
[1]Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States

Novel "peach-like" nanoparticle (NP) contrast agents were manufactured, characterized and tested. In-vitro studies showed preferential uptake of NPs by macrophages while in-vivo studies in ApoE-deficient mice revealed protracted signal enhancement of atherosclerotic plaque. Proper design and ease of fabrication of these nanostructures makes them very versatile as either T1 or T2 MRI contrast agents. These NPs loaded with fluorescein or near-infrared emitting quantum dots represent attractive tools for multimodality imaging of atherosclerosis.

Tuesday 13:30-15:30 Computer 40

13:30 ***3745*. 3.0T MRI of Auto-Transplantation of Bone Marrow-Derived Stem-Progenitor Cells: Toward Cell-Based Repair of Injured Arteries**

Yanfeng Meng[1,2], Feng Zhang[1], Tiffany Blair[1], Huidong Gu[1], Hongqing Feng[1], Jinnan Wang[3], Chun Yuan[1], Zhaoqi Zhang[2], Bensheng Qiu[1], Xiaoming Yang[1]
[1]Radiology, University of Washington, Seattle, WA, United States; [2]Radiology, Beijing Anzhen Hospital, Beijing, China; [3]Clinical Sites Research Program, Philips Research North America, Briarcliff Manor, NY, United States

This study was to validate the feasibility of using clinical 3.0T MRI to monitor the migration of auto-transplanted bone marrow cells (BMC) to the injured arteries of near-human-sized animals. BMCs were extracted endogenously, labeled with Feridex and/or PKH26,

and then auto-transplanted back to the same animal. Post-cell transplantation 3.0T T2-MRI showed Feridex-created MR signal voids along the injured iliofemoral artery segments, which were not seen in the control arteries. Histology, including Prussian blue and dextran immunofluorescent staining as well as PKH26 fluorescence, confirmed the MRI findings. This study establishes groundwork for clinical 3.0T MRI of cell-based repair of injured arteries.

14:00 ***3746*. A Multi-Echo Technique for Positive Contrast Detection of SPIO-Labeled Cells at 9.4T**

Philip Lee[1], Johannes Riegler[2], Bingwen Zheng[1], Anthony Price[2], Mark F. Lythgoe[2], Xavier Golay[3]

[1]Singapore Bioimaging Consortium, Biomedical Sciences Institute, Singapore, Singapore; [2]Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom; [3]Institute of Neurology, University College London, London, United Kingdom

Migration of super-paramagnetic labeled cells critically affects the success of therapeutic cell studies. Detection with T2* weighted MRI is normally implemented. But direct association of signal voids with SPIOs-labeled cells is erroneous, as they could originate from magnetic field inhomogeneities or partial volume effects. This study highlights the use of a multiple-echo ultra-short echo time (MUTE) sequence for positive contrast visualization of injected mononuclear cells. 5x105 and 2.5x105 of MNCs were directly injected into the left myocardium wall at the apex and mid-ventricle respectively and the heart was subsequently excised for MRI. Subtraction between the UTE (TE=0.208ms) and ECHO (TE=2.56ms) images exploited the transverse relaxation effect of iron, generating contrast-to-noise ratio of 19.6 and 22.7 respectively.

14:30 ***3747*. In Vivo SWIFT Imaging of SPIO Labeled Stem Cells Grafted in the Heart**

Rong Zhou[1], Djaudat Idiadilitum[2], Curt Corum[2], Hualei Zhang[1], Jia Zhong[1], Hui Qiao[1], Steen Moeller[2], Michael Garwood[2]

[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

We demonstrate the first in vivo cardiac image by ECG-gated SWeep Imaging with Fourier Transformation (SWIFT). Myocardium anatomies are well-visualized on 3D SWIFT magnitude images. The positive contrast on SWIFT imaginary image facilitates the detection of SPIO-containing cells while the magnitude image provides anatomical reference without requirement for additional reference image. These data suggest that SWIFT might be an alternative to currently available positive contrast methods, attractive especially in cardiovascular applications.

15:00 ***3748*. High-Resolution MR Angiogenesis Mapping with Integrin-Targeted Ultralow Gadolinium-Manganese Nanocolloids**

Dipanjan Pan[1], Anne Schmieder[1], Angana Senpan[1], Shelton D. Caruthers[1], Samuel A. Wickline[1], Gregory M. Lanza[1]

[1]C-TRAIN and Division of Cardiology, Washington University in St. Louis, Saint Louis, MO, United States

High-resolution MR Angiogenesis Mapping with Integrin-targeted Ultralow Gadolinium-Manganese Nanocolloids

Wednesday 13:30-15:30 Computer 40

13:30 ***3749*. RGD-Functionalized Superparamagnetic Nanoemulsions for Target-Specific Imaging of Tumor Angiogenesis**

Lisette Helene Deddens[1], Peter A. Jarzyna[2], Arjan W. Griffioen[3], Zahi A. Fayad[2], Rick Michiel Dijkhuizen[1], Willem JM Mulder[2]

[1]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [2]Imaging Science Laboratories, Mount Sinai School of Medicine, New York, United States; [3]Angiogenesis Laboratory Amsterdam, VU Medical Center, Amsterdam, Netherlands

Nanoemulsions represent an attractive delivery platform for hydrophobic compounds since they improve their bioavailability and make their intravenous administration possible. This abstract demonstrates that the nanoemulsion platform, developed for passive delivery of hydrophobic compounds to tumor tissue, is also very suitable for targeted applications. Data show the applicability of αvβ3-specific RGD nanoemulsions in targeting tumor angiogenesis visualized by MRI, fluorescence microscopy and immunohistochemistry.

14:00 ***3750*. Angiogenesis and Cell Tracking with Iron Oxide-Labeled Tumor Cells: Correlation Between Cell Growth and the Formation of the Tumor Vascular Bed Using High Resolution Magnetic Resonance (MR) Angiography, T1, T2 and T2* Mapping and Histology**

Piotr A. Wielopolski[1], Gyula Kotek[1], Sandra van Tiel[1], Gabriela Doeswijk[1], Lejla Alic[2], Gabriel P. Krestin[1], Bernsen Monique[1]

[1]Radiology, Erasmus Medical Center, Rotterdam, zuid-holland, Netherlands; [2]Informatics and Radiology, Erasmus Medical Center, Rotterdam, zuid-holland, Netherlands

To correlate super paramagnetic iron oxide (SPIO) labeled tumor cell growth and distribution with high resolution magnetic resonance (MR) angiography, T1, T2 and T2* parametric mapping and histology

14:30 ***3751*. Targeted New Peptide Based Nanoparticles Toward High EGFR Expressing Cancer Cells for MRI**

Ming-Hung Chen[1], Gin-Chung Liu[2,3], Twei-Shiun Jaw[2,4], Yu-Ting Kuo[2,3], Chiao-Yun Chen[2,3], Yun-Ming Wang[1]

[1]Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan; [2]Department of Medical Imaging, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan; [3]Department of Radiology,Faculty of Medicine,College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan; [4]Department of Radiology,Faculty of Medicine,College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

In this study, the various core sizes of manganese ferrite nanoparticles (MnFe2O4) conjugated with D4 peptide (MnFe2O4-PEG-D4) were synthesized. The high relaxivity MnFe2O4 nanoparticles were obtained by thermal decomposition of Iron acetylacetonate and manganese acetylacetonate in hydrophobic solution at high boiling process. The surface of MnFe2O4 nanoparticles were coated with polyethylene glycol (PEG) and EGFR peptide ligand (D4: Leu-Ala-Arg-Leu-Leu-Thr) to improve their dispersion and ability to target EGFR. The negative signal enhancement of EGFR expressing cancer cells (SKBR-3 and PC-3) were significantly higher than that of low EGFR expressing cells (HEK-293).

15:00 ***3752*. In Vivo Detection of a PARACEST Agent in Mouse Brain Tumors**

Alex Xuexin Li[1], Mojmir Suchy[2], Chunhui Li[1], Claire Poppe[1], Joseph Gati[1], Susan Meakin[1], Robert H.E. Hudson[2], Ravi S. Menon[1], Robert Bartha[1]

[1]Robarts Research Institute, London, ON, Canada; [2]The University of Western Ontario

A methodology to detect the on-resonance paramagnetic chemical exchange effects (OPARACHEE) of a PARACEST contrast agent: Tm^{3+}-DOTAM-Glycine (Gly)-Lysine (Lys) in a mouse brain tumor model was developed. The OPARACHEE effect was isolated from the relaxation effects induced by the PARACEST agent using a control image and an OPARACHEE image. Isolated OPARACHEE contrast (1-3%) was observed in all animals. Immediately after contrast agent injection OPARACHEE contrast was observed and maintained at 1~2% in the hour following injection.

Thursday 13:30-15:30 Computer 40

13:30 ***3753*. A Targeted Nanoglobular Manganese(II) Chelate Conjugate for Magnetic Resonance Cancer Molecular Imaging**

Mingqian Tan[1], Eun-Kee Jeong[2], Zheng-Rong Lu[1]

[1]Case Western Reserve University, Cleveland, OH, United States; [2]University of Utah, Salt Lake City, UT, United States

A peptide targeted nanoglobular Mn(II)-DOTA conjugate was designed and synthesized as MRI contrast agent for cancer molecular imaging. The target specific contrast agent comprised of 2 peptides and 42 Mn(II) chelates on the surface of the G3 nanoglobule with a defined structure. The T1 and T2 relaxivities at room temperature are 3.13 and 8.14 mM-1sec-1 per Mn(II) chelate at 3T, respectively. The targeted nanoglobular contrast agent specifically bound to tumor tissue and resulted in significant tumor contrast enhancement in tumor-bearing mice as compared to a non-targeted control at a dose as low as 0.03 mmol-Mn/kg .

14:00 ***3754*. Multi-Functional Nanocontrast Agents for *In Vivo* Probing on Non-Small Cell Lung Cancer in MR and Optical Molecular Imaging**

Ching-Tang Chen[1], Chia-Hao Su[2], Yi-Chien Lu[1], Ang Yuan[3], Jyh-Horng Chen[1]

[1]Interdisciplinary MRI/MRS Lab, Department of Electrical Engineering, National Taiwan University, Taipei, Taiwan, Taiwan; [2]Center for Translational Research in Biomedical Science, Chang Gung Memorial Hospital, Kaohsiung, Taiwan; [3]Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan, Taiwan

Molecular imaging has become an indispensable technology in cancer research and clinical use. The goal of this study is to combine magnetic resonance imaging and optical imaging system with multifunctional contrast agent to detect xenograft non-small cell lung cancer (NSCLC) murine model.

High temperature solution phase reaction led to 8 nm ultrasmall superparamagnetic iron oxide (USPIO, Fe^3O^4), and the CdS-capped $CdTe_xSe_{1-x}$ alloyed quantum dot was synthesized to near-IR emitting nanoparticles. Aqueous iron oxide and near-IR quantum dot nanoparticles were conjugated with anti-epideremal growth factor receptor (EGFR) antibody as the biomedical probe to detect the NSCLC tumor. Variation of T2 relaxation time was obtained from MRI for nano-contrast agent quantification. Prussian blue staining imaging showed different targeting efficiency in A549 and CL1-0 in vitro. T2 and T2* MR imaging showed significant signal decrease (>30%) in vivo. It was proved caused by nano-probe targeting by using both histological cytochemistry staining. Multifunctional nanocontrast agent could hopefully not only serves as cancer detection and treatment but also used to predict disease prognosis in the future.

14:30 *3755*. **The Use of Cellular MRI and Magnetic Particles to Study Cancer Stem Cells**

Emeline Julie Ribot[1], Carmen Simedrea[2], Patricia McGowan[2], Ann Chambers[2], Paula J. Foster[1]

[1]Imaging Laboratories, Robarts Research Institute, London, Ontario, Canada; [2]Medical Biophysics, University of Western Ontario, London, Ontario, Canada

In this abstract, we describe technology developed in our labs for tracking stem-like cancer cells (CSC), in a mouse model of breast cancer metastasis to the brain, using MRI and magnetic particles. A human breast cancer cell line was sorted by flow cytometry into two distinct populations: CD44high/CD24low and CD44low/CD24high, representing the CSC-like and non-CSC cells, respectively. The sorted cell populations can be labeled efficiently and without toxicity with the iron agent MoldayION Rhodamine B. Labeled CSC can be detected in vivo in images of the mouse brain after injection into the left ventricle of the heart in nude mice.

15:00 *3756*. **Development of Cationic Gd(III) Chelate as Potential Tumor-Selective MRI Contrast Agent**

Chang-Tong Yang[1], Cai-Xian Yong[1], Chew-Yuan Tuang[2], Young-Tae Chang[2], Kai-Hsiang Chuang[1]

[1]Laboratory of Molecular Imaging, Singapore Bioimaging Consortium, Agency for Science,Technology and Research, Singapore, Singapore; [2]Laboratory of Bioimaging Probe Development, Singapore Bioimaging Consortium, Agency for Science,Technology and Research, Singapore, Singapore

We developed a new Gd(III) chelate by conjugating GdDO3A with 2-(diphenylphosphoryl)ethyldiphenylphosphonium cation -- Gd(DO3A-xy-TPEP)+ to form a cationic MRI contrast agent. This contrast agent has been synthesized and characterized in vitro and in vivo. In vitro cell viability showed insignificant cytotoxicity at low [Gd] concentrations up to 0.2 mM. The in vitro T1 relaxivity measured at 7.0 T is about 50% higher than that of clinically used Gd-DTPA and Gd-DOTA. In vivo imaging study in mice demonstrated longer tissue retention especially in the liver. It indicated that Gd(DO3A-xy-TPEP)+ could potentially be used to detect tumor which generally has larger negative mitochondrial transmembrane potential.

Human MRA

Hall B Monday 14:00-16:00 Computer 41

14:00 *3757*. **Clinical Evaluation of Peripheral Vascular Disease Using a Hybrid Approach: Unenhanced Quiescent Interval Single Shot and Low-Dose TWIST MR Angiography**

Philip Anthony Hodnett[1,2], Ioannis Kokztzoglou[3], Timothy Scanlon, Jeremy Collins[4], John Sheehan, Eugene Dunkle, James C. Carr, Robert Edelman

[1]Northwestern University, Chicago, IL, United States; [2]Northshore University Healthcare System, Chicago, IL, United States; [3]Northshore University Healthcare System, United States; [4]Northwestern University, United States

Imtroduction:The purpose of this study was to test the hypothesis that a hybrid technique employing a new unenhanced MRA technique, quiescent interval single shot (QISS) in combination with a low-dose time resolved (TWIST)of the calf provides comparable diagnostic accuracy to the standard hybrid approach using low-dose TWIST of the calf and high-dose stepping table CE-MRA. Materials and Methods:20 prospective patients referred for evaluation of peripheral arterial disease underwent unenhanced and combined low-dose time-resolved (TWIST)evaluation followed by standard hybrid stepping table bolus chase MRA. Results:The combined unenhanced QISS technique and low-dose time resolved (TWIST) calf study resulted in an overall sensitivity of 97.4%, specificity of 98.3%, a negative predictive value of 98.7% and a positive predictive value of 96.7% using CE-MRA as the reference standard. Cohen kappa analysis for inter-rater indicates almost perfect agreement (©§= 0.86) between the hybrid approach of unenhanced QISS and TWIST and standard hybrid CE-MRA. Conclusion: This hybrid strategy permits a dramatic reduction in contrast agent dosage with no loss of diagnostic accuracy.

14:30 *3758*. **"Does Higher R1 Relaxivity Transfer in Improved Vessel Enhancement of the Run-Off Vasculature?" - Evaluation of Macrocylic Gadolinium Chelates for Peripheral MR-Angiography at 3 T by an Inter-Individual Comparison of Gadobutrol Vs Gadoterate Meglumine, Bo**

Ulrike I. Attenberger[1], Matthias Voth[2], Andre Luckscheiter[3], Stefan Haneder[1], Stefan O. Schoenberg[4], Henrik J. Michaely[1]

[1]Department of Clinical Radiology and Nuclear Medicine, University Medical Center Manheim, Mannheim, Germany; [2]Bayer Schering AG, Berlin, Germany; [3]University of Heidelberg, Heidelberg, Germany; [4]Department of Clinical Radiology and Nuclear Medicine, University Medical Center Manheim , Mannheim, Germany

Since nephrogenic systemic fibrosis (NSF) has been linked to gadolinium-chelate administration in patients with impaired renal function, contrast agent dose and chelate stability have attracted broad attention. Numerous studies have demonstrated linear compounds to be the least stable, whereas the macrocyclic compounds are the most stable. With the approval of gadobutrol, a double concentrated macrocyclic gadolinium chelate became available, characterized by the highest R1-relaxivity among the macrocyclic gadolinium chelates. The aim of this study was to evaluate the enhancement characteristics of gadobutrol and gadoterate meglumine, both injected at a dose level of 0.07 mmol/kg BW, for peripheral MR-angiography.

15:00 *3759*. **Non Contrast MRA of the Renal Artery: Comparison of Respiratory Triggered IFIR and ECG Gated IFIR with Autovoice Guidance for Respiration**

Takayuki Masui[1], Motoyuki Katayama[1], Kimihiko Sato[1], Hiroki Ikuma[1], M Sugimura[1], M Ishii[1], Naoyuki Takei[2], Mitsuharu Miyoshi[2]
[1]Radiology, Seirei Hamamatsu General Hospital, Hamamatsu, Japan; [2]Japan Applied Science Laboratory, GE Healthcare Japan, Hino, Japan

Non-contrast (NC) MRAs including inflow inversion recovery (IFIR) FIESTA have shown promising results for demonstration of the renal arteries but might show irregularity in the most peripheral parts of the renal arteries. The purpose was to evaluate effect of autovoice guiding respiratory cycle with ECG gating (IFIR with autovoice) on the quality of NC MRA for demonstration of renal arteries in comparison with contrast MRA. MRA using IFIR with autovoice could provide best image quality of the peripheral renal arteries when autovoice successfully guided respiration. Contrast MRA might miss the optimal timing for selective visualization of the renal arteries.

15:30 *3760*. **Two-Station Time-Resolved 3D Contrast-Enhanced MRA with Real-Time Station Switching**

Casey Peter Johnson[1], Clifton R. Haider[1], Eric A. Borisch[1], Roger C. Grimm[1], Phillip J. Rossman[1], Thomas C. Hulshizer[1], Jake C. Snell[1], James F. Glockner[1], Stephen J. Riederer[1]
[1]Department of Radiology, Mayo Clinic, Rochester, MN, United States

The purpose of this work was to improve bolus-chase MRA techniques by imaging multiple stations with both high spatial and temporal resolution. A highly-accelerated (14x) CAPR acquisition, previously demonstrated for single-station MRA of the calves, was adapted for this purpose. As part of the implementation, a system was developed to reconstruct the CAPR images in real time and allow for visually-guided station switching. Vasculature of the thighs and calves of volunteers was imaged with 1.0 mm isotropic resolution and frame times as low as 2.5 seconds. High-quality arterial frames were consistently acquired in both stations while avoiding venous contamination.

Tuesday 13:30-15:30 Computer 41

13:30 *3761*. **Unenhanced ECG-Gated Fast Spin-Echo MR Digital Subtraction Angiography (MRDSA) Using SPACE with Constant Flip Angle Mode of Femoral Arteries**

Satoru Morita[1], Shinya Kojima[1], Masami Hirata[1], Masaru Suzuki[1], Kazufumi Suzuki[1], Ai Masukawa[1], Eiko Ueno[1]
[1]Department of Radiology, Tokyo Women's Medical University Medical Center East, Arakawa-ku, Tokyo, Japan

Unenhanced electrocardiographically-gated fast spin-echo-based magnetic resonance digital subtraction angiography (MRDSA) can obtain hemodynamic information of pulse wave transmission. We prospectively compared the image quality of MRDSA using sampling perfection with application optimized contrasts using different flip angle evolutions (SPACE) with constant flip angle mode and conventional half-Fourier single-shot turbo spin-echo (HASTE) sequence of femoral arteries in 10 healthy volunteers at 1.5T MRI. All quantitative and qualitative analyses of the SPACE were significantly better than those of the HASTE. We show that unenhanced electrocardiographically-gated fast spin-echo MRDSA using SPACE with constant flip angle mode provides good visual hemodynamic information of arteries.

14:00 *3762*. **Nonenhanced Time-Resolved MR Angiography for the Arteriovenous Malformation/Fistula of the Pelvis and the Lower Extremity.**

Masaaki Akahane[1], Jiro Sato[1], Shuhei Komatsu[1], Yasushi Watanabe[2], Yoshiro Satake[2], Kuni Ohtomo[1]
[1]Radiology, University of Tokyo, Bunkyo-ku, Tokyo, Japan; [2]Clinical Radiology, University of Tokyo, Bunkyo-ku, Tokyo, Japan

Nonenhanced MRA by spin-labeling technique with subtraction between labeled and non-labeled images was applied to the time-resolved study for better background suppression in any inversion time. Seven patients having arteriovenous malformations or fistulas of the pelvis or lower extremity underwent nonenhanced time-resolved MRA using respiratory-gated balanced steady state free precession (SSFP) sequence with 1.5-T scanner (Toshiba EXCELART Vantage, Japan). Inversion times (TI) were assigned as 300, 800, 1300 and 1800 ms. Nonenhanced time-resolved MRA was useful for the evaluation of hemodynamics of the arteriovenous malformation or fistula and the distinction of feeding arteries.

14:30 *3763*. **Adapted Random 3D Sampling Patterns for CE-MRA**

Florian Knoll[1], Christian Clason[2], Manuela Aschauer[3], Franz Ebner[3], Rudolf Stollberger[1]
[1]Institute of Medical Engineering, Graz University of Technology, Graz, Austria; [2]Institute for Mathematics and Scientific Computing, University of Graz, Graz, Austria; [3]Department of Radiology, Medical University Graz, Graz, Austria

Variable density 3D random sampling trajectories have great potential for subsampled CE-MR angiography techniques which deliver data sets with high contrast to noise ratio. The goal of this work was to present a parameter-free method to construct variable density

sampling patterns which are tailored to angiography. Sampling patterns are generated with the use of a probability density function that is constructed by using measured k-space data as a reference, which automatically ensures an appropriate distribution of sample points.

15:00 ***3764*. Imaging of Pulmonary Artery and Vein Using ASL Based Non-Contrast MRA Technique**

Tomoyuki Okuaki[1,2], Takeshi Ishimoto[3], Momoe Kawakami[3], Masaru Ishihara[4], Tetsuro Ogino[1], Ivan Zimine[1], Marc Van Cauteren[5], Toshiaki Miyati[6]

[1]Clinical Science, Philips Electronics Japan, Minato-ku, Tokyo, Japan; [2]Graduate School of Medical Science, Kanazawa University, Kanazawa, Japan; [3]Hyogo Brain and Heart Center, Japan; [4]Kakogawa Medical Center, Japan; [5]Philips Healthcare, Netherlands; [6]Kanazawa University Graduate School of Medical Science, Kanazawa, Ishikawa, Japan

For lung imaging, depiction of pulmonary artery (PA) and vein (PV) can be done using ASL based technique. However, visualization of PV using conventional ASL approach is challenging because tagged blood in the pulmonary artery requires several seconds to reach the vein. In this work we evaluated the possibility of simultaneous visualization of PA and PV using ASL based technique at multiple inversion times (TI). For PA, high scores were observed at TI=800ms and 1100ms respectively; For PV, highest score was observed at TI=300ms. Expected clinical application is imaging of patients with pulmonary infarction.

Wednesday 13:30-15:30 Computer 41

13:30 ***3765*. Ultra Low Dose 4D Contrast Enhanced MRA Using HYBRID HYPR Technique**

Yijing Wu[1], Kevin M. Johnson[1], Steven R. Kecskemeti[1], Charlse A. Mistretta[2], Patrick Alan Turski[3]

[1]Medical Physics, University of Wisconsin, Madison, Madison, WI, United States; [2]Medical Physics and Radiologly, University of Wisconsin, Madison, Madison, WI, United States; [3]Radiology, University of Wisconsin, Madison, Madison, WI, United States

Time resolved contrast-enhanced magnetic resonance angiography has been widely used to evaluate vascular hemodynamics. Due to recent concern of the NSF disease, eliminating or reducing Gadolinium-based contrast agent is desirable. HYBRID HYPR decouples the high spatial resolution and SNR, which require relative long scan time, from the high temporal resolution, which demands for fast data acquisitions. It used the HYPR constrained reconstruction to obtain high temporal resolution, high spatial resolution, and high SNR image series. The hypothesis of this work is that the contrast dose can be reduced using the HYBRID HYPR technique: the SNR of the HYPR images is primarily determined by the composite, which is generated using minimal mount of contrast agent (e.g. post contrast phase-contrast images) or can be acquired before contrast injection (e.g. Time-of-Flight images). High temporal and spatial resolution time resolved contrast-enhanced MRA can be obtained by using Low Dose HYBRID HYPR method with contrast dose as low as 1ml.

14:00 ***3766*. Congenital Heart Disease: Role of Time-Resolved MR Angiography**

kambiz nael[1], Michael Fenchel[1], Stefan G. Ruehm[1], J Paul Finn[1]

[1]Radiology, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States

Advances in fast imaging tools such as parallel acquisition and sparse k-space sampling methods such as time-resolved angiography with interleaved stochastic trajectories (TWIST), have the potential to improve the performance of time-resolved MR angiography (TR-MRA). In this study we evaluated the clinical usefulness of a 3D CE-MRA protocol that encompasses both high spatial and high temporal resolution acquisition in evaluation of patients with congenital heart disease (CHD). Our objective is to investigate whether TR-MRA can unravel complex functional vascular anatomy in patients with CHD and to assess the incremental diagnostic value of TR-MRA over conventional MRA in this population.

14:30 ***3767*. Evaluation of Non-Contrast Time-Spatial Labeling Inversion Pulse for Abdominal Angiography Compared to Contrast-Enhanced Angiography**

Erin Jane Kelly[1], Steve Saeger[2], David E. Neal[2]

[1]Toshiba America Medical Systems, Tustin, CA, United States; [2]Radiology, Central Ohio Primary Care Physicians, Columbus, OH, United States

Non-contrast angiography techniques are becoming increasingly important in the clinical setting. 3D SSFP Time-SLIP has been developed to produce bright blood angiograms for abdominal angiography, including renal MRA exams. The purpose of this study was to evaluate image quality and diagnostic confidence for Time-SLIP compared to contrast-enhanced MRA in the same group of patients. Image quality scores were 2.6±0.7 and 2.4±0.7 for Time-SLIP and CE-MRA, and Diagnostic quality scores were 2.8±0.4 and 2.4±0.8 for Time-SLIP and CE-MRA, respectively. This study indicates that Time-SLIP is a safe and effective alternative for CE-MRA and may replace CE-MRA in the clinical setting.

15:00 ***3768*. Non-Contrast-Enhanced Renal MRA Using Inflow-Enhanced, Inversion-Recovery at 3T**

Thorsten Alexander Bley[1,2], Scott Brian Reeder[2], Mark Schiebler[2], Naoyuki Takei[3], Jean H. Brittain[4], Thomas Grist[2], Christopher J. Francois[2]

[1]Diagnostic and Interventional Radiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany; [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [3]Japan Applied Science

Laboratory, GE Healthcare, Tokyo, Japan; [4]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States

This work presents validation of an inflow-enhanced, inversion-recovery (IR) balanced steady state free precession (bSSFP) based non-contrast-enhanced MRA (NCE-MRA) for assessment of renal arteries at 3T in patients with suspected renal artery stenosis or with a history of renal artery transplant. NCE-MRA with inflow-enhanced IR bSSFP produced consistent results and demonstrated moderate agreement with CE-MRA for both readers and strong inter-observer agreement for grading renal artery stenosis >50%.

Thursday 13:30-15:30 Computer 41

13:30 ***3769*. Time-SLIP Versus DSA in Patients with Renal Artery Stenosis**

Isabelle Parienty[1], Faiza Admiraal-Behloul[2], Francis Jouniaux[1], Michel Piotin[3], Guy Rostoker[3]

[1]Centre d'Imagerie du Bois de Verrière, Antony, France; [2]MRI, Toshiba Medical Systems Europe, Zoetermeer, Netherlands; [3]Nephrology, Centre Hospitalier Claude Galien, Paris, France

The purpose of this study was to compare the findings in non-contrast enhanced MRA using the Time Spatial Labeling Inversion Pulse (Time-SLIP) technique to those of Digital Subtraction Angiography (DSA) in patients with significant renal artery stenosis (>60%, or >50% with post stenotic dilation).

14:00 ***3770*. Respiratory Rate Regulation for Optimal Time-SLIP Imaging of Renal Arteries**

Francis Jouniaux[1], Isabelle Parienty[1], Faiza Admiraal-Behloul[2]

[1]Centre d'Imagerie du Bois de Verrière, Antony, France; [2]MRI, Toshiba Medical Systems Europe, Zoetermeer, Netherlands

Respiratory gated non contrast enhanced MR angiography using Time-Spatial inversion labeling pulse (Time-SLIP) is a well established technique at our institution for the exploration of renal arteries. Since 2007, we scanned more than 450 patients with age ranging for 18 to 92 year old. Patients with fast and/or irregular respiration rates (RR) can be very challenging to image. Most of the difficult patients are old (80+), or have a cardiac disease and/or a respiratory disease. A breath hold of more than 16s is intolerable for most of these patients. We describe how regulating the respiratory rate can significantly improve the image quality and the success rate of Time-SLIP.

14:30 ***3771*. Assessment of Non-Contrast Angiography in Diabetic Patients**

Erin Jane Kelly[1], JoEllyn L. L. Stolinski[2], James Jelinek[2]

[1]Magnetic Resonance, Toshiba America Medical Systems, Tustin, CA, United States; [2]Radiology, Washington Hospital Center, Washington, D.C., United States

Diabetes is highly associated with renal failure and peripheral artery disease. In light of the association between MRI contrast media and the onset of NSF/NSD, it is increasingly important to replace CE-MRA with non-contrast angiographic imaging techniques, such as Fresh Blood Imaging and Time-SLIP. In this study, diabetic patients referred for and MRA were imaged with FBI and Time-SLIP for peripheral run-offs and renal angiography. Image Quality and Diagnostic Confidence scores indicate that FBI and Time-SLIP are both safe and effective alternatives to CE-MRA in this patient group.

15:00 ***3772*. An MRI Examination for Evaluation of Aortic Dissection Using a Blood Pool Agent**

Rachel Clough[1], Tarique Hussain[1], Sergio Uribe[1], Peter Taylor[2], Reza Razavi[1], Tobias Schaeffter[1], Matthew Waltham[2]

[1]Division of Imaging Sciences, King's College London, London, United Kingdom; [2]Guy’s and St Thomas’ NHS Foundation Trust, St Thomas' Hospital, London, United Kingdom

An MRI examination for evaluation of aortic dissection using a blood-pool agent is presented. The aims of this study were to investigate the use of direct thrombus MRI and quantitative flow analysis for the determination of false lumen thrombus volumes in patients with Type B aortic dissection. It is shown that blood-pool imaging together with direct thrombus MRI allows assessment of aortic anatomy and more accurate quantification of false lumen thrombosis compared with CT. Current clinical trials using false lumen thrombosis as a primary endpoint should consider multi-parametric MRI as the preferred diagnostic tool.

MRA: Preclinical Technical Developments

Hall B Monday 14:00-16:00 Computer 42

14:00 ***3773*. Magnetic Resonance Venography with a Blood Pool Contrast Medium**

Teik Choon See[1], Andrew Winterbottom[1], Edmund Soh[2], Ilse Joubert[1], Martin Graves[1], David Lomas[1]

[1]Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom; [2]Singapore General Hospital, Singapore

Our prospective clinical trial authorised study aims to assess MR venography of the neck and thoracic central veinous system using Vasovist® (gadofosveset trisodium, Schering), a blood pool contrast agent, for first pass (FP) and steady state (SS) imaging. Images are assessed independently for image quality, artefacts, stenosis, and thrombosis. Sixteen participants recruited to date and 144 venous segments assessed. The result shows very favourable SS imaging quality compared to FP (although not quite statistically significant) with potential for improving diagnostic accuracy. Mild artefacts are seen in 50% of both techniques. No significant differences noted in detection of stenosis or thrombosis.

14:30 ***3774*. Group-Encoded Ungated Inversion Nulling for Non-Contrast Enhancement in the Steady State (GUINNESS): A Balanced SSFP-Dixon Technique for Breath-Held Non-Contrast MRA**

Manojkumar Saranathan[1], Ersin Bayram[2], James F. Glockner[3]
[1]Applied Science Lab, GE Healthcare, Rochester, MN, United States; [2]GE Healthcare, Waukesha, WI, United States; [3]Radiology, Mayo Clinic, Rochester, MN, United States

While contrast-enhanced MR Angiography (CEMRA) is widely used for evaluation of vascular pathology, recent nephrogenic systemic fibrosis (NSF) concerns following administration of Gadolinium based contrast agents have spurred interest in non-contrast MRA methods. Balanced steady state free precession (b-SSFP) imaging has shown great promise due to its high SNR and short scan times. We propose a balanced SSFP-Dixon technique with a novel group-encoded k-space segmentation scheme for breath-held non-contrast MRA.

15:00 ***3775*. Optimization of Gradient Moment Nulling for Hybrid of Opposite-Contrast MRA Sequence**

Tokunori Kimura[1], Masato Ikedo[2]
[1]MRI Systems Development Department, Toshiba Medical Systems , Otawara, Tochigi, Japan; [2]MRI Systems Development Department, Toshiba Medical Systems, Otawara, Tochigi, Japan

We have proposed a new MR angiography technique named Hybrid of Opposite-Contrast MRA (HOP-MRA) with 3D dual-echo gradient-echo sequence combining Time-of-Flight (TOF) with a Flow-Sensitive Black-Blood (FSBB) employing flow dephasing gradients. In this study, for the purpose of decreasing flow-void appeared in major arteries, two types of gradient moment nulling (GMN) for the TOF part were compared between 1st order full 3-axis GMN and partial 2-axis GMN. We demonstrated that flow-void artifacts were decreased by using the 2-axis GMN in the TOF part and vessel misregistration due to phase-encode displacement in the TOF part was minor. The HOP technique is suitable for decreasing both flow-void and PED artifacts in MRA compared to TOF alone.

15:30 ***3776*. Dynamically Changing Field-Of-View in the Comprehensive Neurovascular Exam**

Petrice M. Mostardi[1], Clifton R. Haider[1], Norbert G. Campeau[1], John Huston[1], Stephen J. Riederer[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

We define a comprehensive neurovascular exam (CNVE) as the high quality imaging of the aortic arch through the intracranial veins. The goal of this work is to image these territories by dynamically changing (scaling/shifting) the FOV during a contrast-enhanced acquisition. Volunteer studies were performed with an imaging protocol consisting of: (i) a large FOV, low dose (2 ml) time-resolved acquisition to provide overall diagnostic information and serve as a timing bolus and (ii) a high spatial resolution contrast-enhanced exam implementing dynamic change of the FOV to image the carotid arteries and the intracranial venous system.

Tuesday 13:30-15:30 Computer 42

13:30 ***3777*. Direct Imaging and Quantification of Carotid Plaque Calcification (CPC) Using Ultrashort TE Pulse Sequences**

Jiang Du[1], Jacqueline Corbeil[1], Richard Znamirowski[1], Michael Peterson[2], Niren Angle[3], Graeme Bydder[1], Andrew Kahn[4]
[1]Radiology, University of California, San Diego, CA, United States; [2]Pathology, University of California, San Diego, CA, United States; [3]Surgery, University of California, San Diego, CA, United States; [4]Medicine, University of California, San Diego, CA, United States

Carotid plaque vulnerability is dependent upon its tissue constituents, which may include fibrous tissue, lipid core, intra-plaque plaque hemorrhage as well as calcification. Clinical MR sequences have been employed to characterize the long T2 plaque components. Carotid plaque calcification (CPC) is undetectable with conventional clinical MR sequences. Here we describe the use of a 2D ultrashort TE (UTE) sequence combined with efficient long T2 suppression to image and characterize CPC (T2, T2* and water content) using a clinical 3T scanner. High spatial resolution micro-CT images were also acquired for comparison and validation.

14:00 ***3778*. A New PVA-Based Dynamic Cardiac Phantom for Evaluation of Functional MR Imaging Methods at 3T**

Robert Manzke[1], Anja Lutz[2], Marcel Schenderlein[3], Axel Bornstedt[2], Raymond C. Chan[4], Klaus Dietmeyer[3], Volker Rasche[5]
[1]Tomographic Imaging, Philips Research Europe, Hamburg, Germany; [2]Dept. of Internal Medicine II, University Hospital Ulm, Germany; [3]Inst. Measurement, Control, and Microtechnology, University Ulm, Germany; [4]Philips Research North America, Briarcliff Manor, NY, United States; [5]Dept. of Internal Medicine II, University Hospital Ulm, Germany

A new PVA-based dynamic cardiac MR phantom is introduced, aiming to enable cross validation of novel tagged and phase contrast MR methods specifically at 3T, aiding the development of clinically relevant functional MR techniques. Examples of phase contrast and tagged images using a 3T system with a 6 element cardiac coil are given.

14:30 ***3779*. Balanced SSFP Spin-Labeled Angiography Using Sparse Data: Optimization and Application to Supraaortic Vessels**

Ioannis Koktzoglou[1], Philip Hodnett, [1,2], Erik Offerman[1], Robert Edelman[1]
[1]Radiology, NorthShore University HealthSystem, Evanston, IL, United States; [2]Northwestern University, Chicago, IL, United States

Arterial spin-labeled MRA using a balanced steady-state free precession is limited by flow artifacts in the setting of luminal narrowing. In a stenotic flow phantom, we show that these artifacts can be minimized with the use of abbreviated echo trains made possible with the use of parallel imaging acceleration and partial Fourier acquisition, and subsequently apply the technique in volunteers and patients.

15:00 ***3780*. Magnetic Resonance Imaging Measurements Predict Need for Intervention in Patients Post Ross Procedure**

Anna Lakoma[1], James C. Carr[1]
[1]Department of Radiology, Northwestern University, Chicago, IL, United States

MRI derived pulmonary circulation parameters best predict need for future intervention in patients post Ross procedure.

Wednesday 13:30-15:30 Computer 42

13:30 ***3781*. Accelerated Time Resolved Inflow with 3D Multi-Echo Radial Trajectories**

Kevin M . Johnson[1], Oliver Wieben[1,2], Patrick Turski[2], Charles Mistretta[1]
[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States; [2]Radiology, University of Wisconsin - Madison, Madison, WI, United States

Arterial spin labeling (ASL) sequences which utilize tagging schemes to images the flow of blood have emerged as effective techniques for the non-contrast angiography; however, these techniques typically suffer from long acquisition times, sensitivity to tag delay parameters, and uncertain performance in cases of complex flow . To mitigate these errors, we investigate the utilization of highly accelerated, dynamic inflow imaging utilizing efficient, short TR 3D radial bSSFP sequences.

14:00 ***3782*. Non-Contrast Enhanced Pulmonary Vein MRA with Compressed Sensing**

Mehmet Akçakaya[1,2], Peng Hu[2], Vahid Tarokh[1], Warren J. Manning[2], Reza Nezafat[2]
[1]Harvard University, Cambridge, MA, United States; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States

Non-contrast pulmonary vein (PV) MR angiography (MRA) is an alternative to the clinical contrast-enhanced technique. We have recently developed a non-contrast PV MRA technique using a sagittal selective inversion pulse. However, the resulting acquisition time is significantly longer than breath-hold contrast-enhanced technique. In this study, we investigate the feasibility of using compressed sensing for accelerating data acquisition in non-contrast PV MRA. We use a distributed compressed sensing technique to reconstruct separate coil images simultaneously. We show that this reconstruction yields good results even at high rates (x10).

14:30 ***3783*. Non-Contrast Inversion Recovery Balanced Ssfp Mra of the Abdominal Aorta at 3T: Predicting Optimal Inversion Times by Blood Velocity Measurement**

Iliyana Plamenova Atanasova[1,2], Ruth P. Lim[1], Hua Guo[1], Daniel Kim[1], Pippa Storey[1], Kellyanne McGorty[1], Andrew Laine[2], Vivian S. Lee[1]
[1]Department of Radiology, New York University, New York, United States; [2]Columbia University, New York, United States

3D non-enhanced balanced steady-state free precession MRA with a slab-selective inversion (IR SSFP) has demonstrated promise for renal artery evaluation at 1.5T. With proper selection of inversion times (TI), the technique can be adopted for coronal imaging of the abdominal aorta with comprehensive superior-inferior coverage at 3T. We propose a method for subject-specific calculation of TI based on arterial blood velocities. Our results illustrate that visualization of the aortoiliac vessels using IR SSFP varies considerably across subjects depending on flow velocities. Thus, measuring aortic velocities prior to MRA enables an examination tailored to the patient's physiology for improved arterial visualization.

15:00 ***3784*. MRI Determined Carotid Artery Flow Velocities and Wall Shear Stress in a Mouse Model of Vulnerable and Stable Atherosclerotic Plaque**

Gustav Jacob Strijkers[1], Glenda S. van Bochove[1], Roel Straathof[1], Rob Krams[2], Klaas Nicolay[1]
[1]Biomedical NMR, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [2]Department of Bioengineering, London Imperial College, London, United Kingdom

We report here on the pre-clinical MRI characterization of an apoE-/- mouse model of stable and vulnerable carotid artery atherosclerotic plaques, which were induced by a tapered restriction (cast) around the artery. Specific focus was on the quantification of flow velocities and wall shear stress (WSS), which are considered key players in the development of the plaque phenotype.

Thursday 13:30-15:30 Computer 42

13:30 ***3785*. A Novel 3D Time-Of-Flight MRA with Optimized Partial Saturation Recovery 3D-FLASH**

Yutaka Natsuaki[1], Randall Kroeker[2], Gerhard Laub[3]
[1]Siemens Medical Solutions, Los Angeles, CA, United States; [2]Siemens Medical Solutions, Winnipeg, Manitoba, Canada; [3]Siemens Medical Solutions, San Francisco, CA, United States

One of the major drawbacks with 3DTOF is the inplane flow saturation, where the fresh inflow enters the imaging volume and gets saturated by the imaging RF pulses. This is particularly problematic when the inflow vessels are perpendicular to the slice direction (e.g. vertebral arteries), and this may result in signal loss of the blood vessels. The current work proposes a novel approach to the magnetization prepared 3D TOF MRA with the partial saturation recovery (SR) 3D-FLASH. The optimization strategies and initial results with improved visualization of vertebral arteries are presented.

14:00 ***3786*. 3D Non-Contrast MRA of Lower Extremities Using Balanced SSFP with Flow-Sensitive Dephasing (FSD) at 3T**

Hua Guo[1], Iliyana Atanasova[1,2], Ruth P. Lim[1], Pippa Storey[1], Jian Xu[3], Qun Chen[1], Henry Rusinek[1], Zhaoyang Fan[4], Debiao Li[4], Vivian S. Lee[1]
[1]Department of Radiology, New York University School of Medicine, New York, NY, United States; [2]Columbia University, New York, NY, United States; [3]Siemens Medical Solutions USA, Inc., MR R&D Collaboration, New York, United States; [4]Departments of Radiology and Biomedical Engineering, Northwestern University, Chicago, IL, United States

Flow-sensitive dephasing prepared balanced steady state free precession (FSD-bSSFP) has been proposed as a non-contrast MRA technique for the lower extremities at 1.5T. However, its application at higher magnetic fields is hindered by poor B0 and B1 homogeneities. As a result, the background signal cannot be completely suppressed. In this work, we investigated the performance of B1-insensitive adiabatic RF pulses for FSD preparation to improve non-contrast MRA with FSD-bSSFP at 3T. The results demonstrate that the approach is less B1-sensitive than with conventional hard RF pulses, thus providing better background signal suppression and more reliable MRA images at 3T.

14:30 ***3787*. MRI and Micro-CT Evaluate the Effect of VEGF in a Rabbit Femoral Artery Chronic Total Occlusion**

Xiuling Qi[1], Aaron Teitelbaum[1], Kevan Anderson[1], Nigel Munce[1], Beiping Qiang[1], Ronen Jaffe[1], Michelle Ladouceur-Wodzak[1], Bradley H. Strauss[1], Graham A. Wright[1]
[1]Sunnybrook Health Sciences Center, Toronto, Ontario, Canada

Synopsis: Revascularization in an arterial chronic total occlusion (CTO) could improve the prognosis. We evaluated the effect of injecting vascular endothelial growth factor (VEGF) into a CTO in a femoral artery of rabbit using in vivo MRI and ex-vivo micro-CT. Thirteen rabbit were divided randomly into control and VEGF groups. The blood volume changes in CTO pre and post interventions were determined. Results indicated by both MRI and micro-CT that the VEGF significantly increased the formation of microvessels within CTO. Our study also demonstrated that MRI is a feasible method to assess the new blood vessel growth in CTO tissue.

15:00 ***3788*. Noncontrast MRA Using Spiral Refocused Turbo Spin Echo**

Samuel W. Fielden[1], Hao Tan[1], John P. Mugler III[1,2], Christopher M. Kramer[2,3], 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

rTSE hybridizes the increased signal provided by the 180° refocusing RF pulses of RARE and the better flow performance of the fully-refocused gradients and phase alternation of balanced SSFP. Here, we apply the principles of rTSE with spiral readout gradients in order to improve the data acquisition efficiency of the sequence while increasing the echo spacing to provide improved artery-vein contrast.

Antennas & Waves

Hall B Monday 14:00-16:00 Computer 43

14:00 ***3789*. Traveling Wave MRI for the Acquisition of Reference Images for Parallel Imaging at the Carotid Artery at 7T - Proof of Concept**

Wouter Koning[1], Hugo Kroeze, [2], Bart Leo van de Bank, Vincent O. Boer, Cornelis A. van den Berg, Jaco J. Zwanenburg, Peter R. Luijten, Dennis W. Klomp
[1]Radiology, UMC Utrecht, Utrecht, Netherlands; [2]MTKF

In high field MRI, acceleration with parallel imaging in MRI can be a challenge as homogeneous reference scans are difficult to obtain. Traveling wave MRI can be applied for the acquisition of reference images. This enables acceleration with parallel imaging

even with RF coil setups that are optimized for sensitivity only. Here, a proof of principle is given at 7T using a quadrature antenna for acquisition of the reference images, together with an array of dedicated surface coils for carotid artery imaging.

14:30 ***3790*. A Novel Matching Strategy to Increase Power Efficiency of the Travelling Wave MR Imaging**

Anna Andreychenko[1], Hugo Kroeze[2], Dennis W. Klomp[2], Jan J. Lagendijk[1], Peter Luijten[2], Cornelius A.T. van den Berg[1]
[1]Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands; [2]Radiology, University Medical Center Utrecht, Utrecht, Netherlands

Travelling wave MR imaging exploits the RF shield of the scanner as a waveguide. When a patient is placed in the bore a strong impedance mismatch occurs between the hollow (where antenna is located) and loaded parts of the bore. It causes wave reflection and inefficient power is transferred to the target region. To avoid this impedance mismatch we propose to insert a quarter-wavelength coaxial waveguide between the antenna and load which gradually transforms impedance of the antenna to the load impedance. The effectiveness of this inset has been demonstrated both in the simulations and in-vivo experiments.

15:00 ***3791*. Shortened Quarter Lambda Antenna for Traveling Wave Excitation in High Field MRI**

Hugo Kroeze[1,2], Anna Andreychenko[3], Cornelis A.T. van den Berg[3], Dennis W.J. Klomp[1], Peter R. Luijten[1]
[1]Radiology, UMC Utrecht, Utrecht, Netherlands; [2]Medical Technology, UMC Utrecht, Utrecht, Netherlands; [3]Radiotherapy, UMC Utrecht, Utrecht, Netherlands

A patch antenna can be used for travelling wave excitation in high field MRI. Due to its size, this antenna has to be placed at the far end of the bore, reducing it efficiency when imaging in the abdominal area. A Shortened Quarter Lambda antenna is proposed to overcome this problem. By placing the SQL antenna between the lags of the patient, an 8 fold improved efficiency can be demonstrated in the abdomen, compared to a patch antenna. Images of the prostate and the head of a healthy volunteer are presented.

15:30 ***3792*. Waveguide Magnetic Resonance Imaging at 3 Tesla**

F Vazquez[1], R Martin[1], O Marrufo[1], Alfredo O. Rodriguez[1]
[1]Departament of Electrical Engineering, Universidad Autonoma Metropolitana Iztapalapa, Mexico, DF, Mexico

Waveguides have been successfully used to generate magnetic resonance images at 7 Tesla for whole-body systems. From these results, it has been established that waveguides are only suitable for 7T systems with wide bores of al least 60 cm. This is mainly due to the cut-off frequency of the cylindrical waveguides used. To overcome this limitation a parallel-plate waveguide was employed since its cut-off frequency depends on the separation of the plates. A parallel-plate waveguide was built and used to acquire images of a healthy volunteer's leg at 3 Tesla on a clinical MR imager.

Tuesday 13:30-15:30 Computer 43

13:30 ***3793*. A Traveling-Wave Setup for Parallel RF Transmission**

Jan Paska[1], David Otto Brunner[2], Klaas P. Pruessmann[2], Ingmar Graesslin[3], Juerg Froehlich[1], Ruediger Vahldieck[1]
[1]Laboratory for Electromagnetic Fields and Microwave Electronics, ETH Zurich, Zurich, Switzerland; [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [3]Philips Research Europe, Hamburg, Germany

The traveling wave concept for ultra high field MRI offers a large FOV and patient space. Only the two TE11 modes can propagate in an empty bore at 7T. To extend the traveling wave concept for parallel transmission also the higher order modes are needed, increasing the degrees of freedom.
This is done by lowering the cut-off frequencies of the higher order modes with dielectric inserts. Selective coupling into the orthogonal waveguide modes is desirable. This is however a demanding task in a multimodal waveguide, as known from optics.

14:00 ***3794*. Parallel Traveling-Wave MRI: Antenna Array Approach to Traveling-Wave MRI for Parallel Transmission and Acquisition**

Yong Pang[1], Chunsheng Wang[2], Daniel Vigneron[2,3], Xiaoliang Zhang[2,3]
[1]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA , United States; [2]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA, United States; [3]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco & Berkeley, CA, United States

Traveling-wave MRI utilizes the far field of a single piece patch antenna to generate homogeneous RF field covering large size imaging samples. In this work, we demonstrate a method to applying the "traveling wave" technology to parallel excitation and reception by using a multi-element patch antenna array. Each array element is a CP patch antenna which generates quadrature RF fields. FDTD simulation results demonstrate the excellent decoupling among elements, great g-factors at various reduction factors for 1D SENSE, demonstrating the feasibility of parallel imaging using traveling-wave.

14:30 ***3795*****. Targeted Travelling Wave MRI Using a Coaxial Waveguide**

Stefan Alt[1], Marco Müller[1], Reiner Umathum[1], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

In high field MRI with volume resonators, image quality suffers from the appearance of standing wave patterns. We propose the use of a coaxial waveguide with interrupted inner conductor to guide the RF energy to the designated imaging region. These targeted travelling waves can achieve a more homogenous excitation and reduce SAR outside the FOV. Feasibility of the method is assessed with RF field simulations using a detailed anatomical model as well as with a hardware prototype. Transverse magnetic field and SAR distributions are shown and evaluated on the simulated data and an image from the hardware prototype is shown.

15:00 ***3796*****. Optimization of Radiative Surface Antenna for High Field Mri**

Özlem Ipek[1], Alexander J.R. Raaijmakers[1], Jan J. Lagendijk[1], Cornelis A.T van den Berg[1]
[1]Radiotherapy and Radiology, UMC Utrecht, Utrecht, Netherlands

A novel radiative surface antenna consists of two copper strips placed on a dielectric rectangular substrate. It is investigated by means of electromagnetic modeling of the substrate material and the conductor dimensions in terms of impedance matching, effective B1+ delivery at depth and low local SAR. Such antenna design requires that its Poynting vector is directed into the target location and a dielectric substrate that ensures impedance matching at the antenna-body interface. When the dielectric constant of substrate is matched to that of the phantom, the radiative antenna is matched to 50 Ohm, thus its radiation efficiency is the highest.

Wednesday 13:30-15:30 Computer 43

13:30 ***3797*****. Simulation and Construction of a Modified Turnstile Dipole Tx Antenna for Whole Body 7T MRI with an Extended Gradient Coil RF-Shield of 1.58 M Length**

Tim Herrmann[1], Johannes Mallow[1], Jörg Stadler[2], Oliver Speck[3], Matthias Kladeck[3], Johannes Bernarding[1]
[1]Department of Biometry and Medical Informatics, OvG University, Magdeburg, Saxony-Anhalt, Germany; [2]Leibniz-Institute for Neurobiology, Magdeburg, Germany; [3]Biomedical Magnetic Resonance, OvG University, Magdeburg, Saxony-Anhalt, Germany

Goal of this study was to expand the abilities of the Travelling Wave concept in Ultra-Highfield MRI, to get an efficient body coil replacement in the future, by using the advantage of a bigger diameter and an extended length of the RF-shield. Promising results are shown by using the turnstile dipole antenna as Tx and a phased array RF-coil for Rx. The highest SNR can be achieved under Travelling Wave conditions because the B1-filling factor for phased array RF-coil is much better.

14:00 ***3798*****. MRI of the Human Torso at 7 Tesla Using Dual Quadrature Patch Antennas.**

Andrew Webb[1], Nadine Smith[1]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands

Whole-body imaging at high magnetic fields presents a variety of engineering challenges arising mainly from the short wavelength of electromagnetic radiation in the human body. One successful solution has been to use multi-transmit arrays with the magnitude and phase of the driving signal to each array element under operator control. In this work we present an alternative and simple approach which uses two large patch antennas, both driven in quadrature, which essentially form a large distributed microstrip. Using this hardware configuration, homogenous low-tip angle gradient echo images can be acquired through the abdomen and cardiac regions of the body.

14:30 ***3799*****. A Novel Radiative Surface Antenna for High Field Mri**

Özlem Ipek[1], Alexander J.R. Raaijmakers[1], Dennis W.J. Klomp[1], Jan J. Lagendijk[1], Cornelis A.T van den Berg[1]
[1]Radiotherapy and Radiology, UMC Utrecht, Utrecht, Netherlands

A radiative surface antenna is compared to a stripline element in terms of measured and simulated B1+ field and simulated SAR. The radiative antenna is suitable for high field imaging of deeply situated organs and designed to effectively couple an electromagnetic wave into the body. It consists of a dielectric substrate with two copper strips fed by a coaxial cable. Due to the radiative principle, the radiative antenna shows two times higher B1+ field at depth of the phantom as well as six times lower maximum SAR at the surface of the phantom in comparison to a conventional stripline element.

15:00 ***3800*****. Near- And Far-Field Measurements of Strip Conductor-Type Coils for 7-Tesla MRI**

Klaus Solbach[1], Stephan Orzada[2], Pedram Yazdanbakhsh[1]
[1]Radio Frequency Technology, University Duisburg-Essen, Duisburg, Germany; [2]University Duisburg-Essen, Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

Measurements of the electric and magnetic near-fields of our 7 Tesla strip conductor-type coils are presented using probes travelling on a linear scanning mechanism in our antenna test chamber. In addition, the far-field patterns and gain were measured and it is found that the coils behave much like stripline antennas with strong radiation fields. The measurements of the near-fields of a dipole- and loop-type coil shows important differences in the field levels and distributions with higher B1- flux levels and more concentrated spatial distribution as well as lower E-field levels in the dipole-type.

Thursday 13:30-15:30 Computer 43

13:30 ***3801*. New High Dielectric Materials for Tailoring the B1-Distribution at High Magnetic Field**

Kristina Haines[1], Nadine Smith[2], Andrew Webb[2]
[1]Penn State University; [2]Radiology, Leiden University Medical Center, Leiden, Netherlands

The distribution of magnetic fields can be tailored using high dielectric materials. Here, we introduce a new material with high and tunable dielectric constant, and also low background MRI signal. The material is based upon metal titanates, which can be made into a geometrically-formable slurry by combining with deionized water. Results obtained at 7 Tesla show a significant increase in image intensity in areas such as the temporal lobe and base of the brain.

14:00 ***3802*. Capacitively Tunable Patch Antenna for Human Head Imaging at 9.4 Tesla**

Jens Hoffmann[1], Gunamony Shajan[1], Rolf Pohmann[1]
[1]High Field Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tuebingen, Baden-Wuerttemberg, Germany

Microstrip patch antennas, recently used for "traveling-wave" excitation at high field strengths, provide a fairly homogeneous excitation pattern in the human head but have high power demands especially when the Larmor frequency is near or below the cutoff frequency of the waveguide. In this work, we present a capacitively tunable patch antenna that can be brought in close proximity to the subject in order to improve efficiency. We demonstrate the image homogeneity in the human head at 9.4 Tesla as well as a simulation-based evaluation of the antenna's efficiency and SAR depending on the distance to the subject.

14:30 ***3803*. A 700MHz Receive Array Using Patch Antenna for Spin Excitation**

Gunamony Shajan[1], Jens Hoffmann[2], Dávid Zsolt Balla[2], Rolf Pohmann[2]
[1]High Field Magnetic Resonance Center , Max Planck Institute for Biological Cybernetics, Tuebingen, Baden Wuttenberg, Germany; [2]High Field Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tuebingen, Baden Wuttenberg, Germany

The availability of receive array coils at high field, small bore animal scanners is limited by the lack of space for classical transmit volume resonators coupled with its inability to generate homogenous transmit B1 field due to wavelength effects. We explore the possibility of the traveling wave concept for spin excitation along with the phased array technique for signal reception at 16.4T. To this effect, a 3-channel phased array coil and a patch antenna were designed and combined. Signal to noise ratio and parallel imaging techniques were studied and achieved SNR equivalent to that of a quadrature surface coil.

15:00 ***3804*. Design and Numerical Evaluation of an 8-Element Quadrature Transceiver Array Using Single-Feed CP Patch Antenna for Parallel Reception and Excitation**

Yong Pang[1], Chunsheng Wang[2], Xiaoliang Zhang[2,3]
[1]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA , United States;
[2]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA, United States;
[3] UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco & Berkeley, CA, United States

An 8-element single-feed quadrature array is designed for 298 MHz using patch antenna technique. Each element is built as a nearly square ring microstrip antenna and is fed along the diagonal to generate a circularly polarized (CP) magnetic field. Compared with linear coils, the SNR can be improved by 40% or the transmission power can be reduced by half. Compared with conventional quadrature coil, this structure is simple and easily built as array. FDTD simulations demonstrate that the decoupling between elements are all better than -35dB and the RF field is homogeneous with deep penetration and quadrature behavior.

High Field Coils & Methods

Hall B Monday 14:00-16:00 Computer 44

14:00 ***3805*. Open Design 8-Channel Tx/Rx Ankle Coil for High-Resolution and Real-Time Imaging at 7 Tesla**

Stephan Orzada[1,2], Lena C. Schäfer[1,2], Andreas K. Bitz[1,2], Susanne C. Ladd[1,2], Mark E. Ladd[1,2], Stefan Maderwald[1,2]
[1]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, NRW, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany

Since the introduction of parallel transmission techniques like transmit SENSE or RF shimming, arbitrarily shaped arrays can potentially be used for excitation. Here we present an open U-shaped 8-channel transmit/receive strip line coil for 7 Tesla MRI designed for simultaneous high-resolution and real-time joint imaging of the human ankle. The coil produced high quality, high resolution images of the moving ankle during real-time imaging using an acceleration factor of four in the phase-encoding direction.

14:30 ***3806*. A 8 Channel TX/RX Decoupled Loop Array for Cardiac/body Imaging at 7T**

Wolfgang Renz[1,2], Tomasz Lindel, [23], Matthias Dieringer[2,4], Frank Seifert, [23], Jeanette Schulz-Menger, [2,5], Thoralf Niendorf[2,4], Bernd Ittermann, [23]

[1]Siemens AG, Erlangen, Germany; [2]Berlin Ultrahigh Field Facility, Max-Delbrueck-Center for Molecular Medicine, Berlin, Germany; [3]Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany; [4]Experimental and Clinical Research Center, Charite Campus Buch, Berlin, Germany; [5]CMR-Unit, Charite Campus Buch, Berlin, Germany

The first steps in cardiac/body imaging at 7T have been reported. One of the challenges is a suitable TX coil concept, which adresses the RF problems (B1 homogeneity, SAR) of body imaging at 300MHz. Traditional bodycoils seem not to be the right way, a coil array enabling TX SENSE and B1 shimming seems to be more promising. We describe a 8-element TX/RX loop coil array with adjustable capacitive decoupling. A prototype has been realised and tested. First imaging results in cardiac imaging are shown.

15:00 ***3807*. Investigation of Element Designs and Construction of a Reconfigurable 8 Channel Tx, 16 Channel Rx Torso Array for 7T**

Ryan Brown[1], Bernd Stoeckel[2], Daniel K. Sodickson[1], Graham C. Wiggins[1]

[1]Radiology, Center for Biomedical Imaging, NYU School of Medicine, New York, NY, United States; [2]Siemens Medical Solutions USA Inc., New York, NY, United States

7T torso imaging has been hindered by non-uniform B1+ distribution and inadequate B1+ in the center of the torso. Stripline coils are the preferred method for RF excitation at 7T and have shown promise for torso imaging. Nevertheless, loop coils have not been compared to striplines in the context of torso imaging. In this study, B1+ was measured using several single element prototype coils and an array of stripline/loop combination coils. Results showed that the stripline array offers improved transmit efficiency near the surface while loop coils may provide a marginal advantage at depth.

15:30 ***3808*. Uniform Prostate Imaging and Spectroscopy at 7T: Comparison Between a Stripline Array and an Endorectal Coil**

Alexander Raaijmakers[1], Bob van den Bergen[1], Dennis Klomp[2], Catalina Arteaga de Castro[2], Vincent Boer[2], Hugo Kroeze[2], Peter Luijten[2], Jan Lagendijk[1], Nico van den Berg[1]

[1]Radiotherapy, UMC Utrecht, Utrecht, Netherlands; [2]Radiology, UMC Utrecht, Netherlands

In this study, we compare a 8-stripline coil array with a endorectal coil. FDTD simulations are performed to evaluate the SAR deposition of both coils. Given the power restrictions due to these SAR levels, the suitability of the coils is tested for three common imaging protocols for prostate cancer: a T1w image, a T2w image and MR spectroscopy. Results show that a surface coil array is needed for T1w and T2w images, while the endorectal coil is needed for spectroscopy.

Tuesday 13:30-15:30 Computer 44

13:30 ***3809*. B1 Shimming Using Passive Surface Coils in the Abdomen**

Laura Sacolick[1], Pekka T. Sipilae[1], Mika W. Vogel[1], Ileana Hancu[2]

[1]GE Global Research, Garching b. Munchen, Germany; [2]GE Global Research, Niskayuna, NY, United States

Here we present a simple approach for improving B1 homogeneity in the abdomen at 3 Tesla. 3D B1 maps were acquired from 6 subjects in the lower abdomen from the GE HDx whole body transmit coil. The B1 in the abdomen had very similar distributions in all subjects studied. The average B1 distribution among these subjects was used to design and place two tuned passive loop coils to couple to the transmit field and increase the B1 field in regions of low B1. One loop was tuned to 136.5 MHz and placed on the anterior, and one tuned to 141.0 MHz was placed on the posterior abdomen. Significant improvement was found in the transmit B1 field homogeneity in subjects with the corrective coils.

14:00 ***3810*. Reduction of B_1 Inhomogeneity Using B_1 Rectifying Fin at High Fields**

Yukio Kaneko[1], Hideta Habara[1], Yoshihisa Soutome[1], Yoshitaka Bito[1]

[1]Central Research Laboratory, Hitachi, Ltd., Kokubunji-shi, Tokyo, Japan

B_1 inhomogeneity in a human body increases as static magnetic field strength becomes higher, and various RF control methods have been developed to reduce B_1 inhomogeneity. However, B_1 inhomogeneity still remains in some cases of abdominal imaging, and a more effective method is necessary. We have proposed a new method using a B_1 rectifying finish combined with B_1 shimming. Both electromagnetic simulation with phantom and experiments with a human abdomen were conducted, and we confirmed that the B_1 rectifying fin, used with B_1 shimming, was more effective in reducing B_1 inhomogeneity than B_1 shimming alone.

14:30 **_3811_. An Eight-Channel Tx/Rx Multi-Purpose Coil for MSK MR Imaging at 7 Tesla**

Oliver Kraff[1,2], Andreas K. Bitz[1,2], Philipp Dammann[1,3], Lena C. Schaefer[1,2], Mark E. Ladd[1,2], Susanne C. Ladd[1,2], Harald H. Quick[1,4]

[1]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Germany; [3]Clinic for Neurosurgery, University Hospital Essen, Essen, Germany; [4]Institute for Medical Physics, Friedrich-Alexander-University Erlangen-Nuernberg, Erlangen, Germany

An eight-channel transmit/receive RF array was built for imaging peripheral regions of the musculoskeletal system that have not been addressed at 7T so far. The array consists of two coil clusters, made of four overlapping loop coils each, to enable flexible positioning on the human body. Numerical simulations were performed for safety validation. We show in vivo results of the human wrist, shoulder, elbow and ankle revealing good excitation over a 180mm field-of-view. Not only GRE but also typical clinical sequences like STIR and TSE performed very well. Imaging of small pathologies (cartilage, ligaments, nerves) could benefit from this technique.

15:00 **_3812_. Development of Quadrature Transmit Elements for Breast MRI/MRSI at 7T**

Ananda Kumar[1], LeRoy Blawat[1], Michael Schär[2], Peter Barker[3]

[1]Resonant Research LLC., Baltimore, MD, United States; [2]Philips Healthcare, Cleveland, OH, United States; [3]Radiology, Johns Hopkins University, Baltimore, MD, United States

Two critical challenges encountered in the development of MR transmit elements at very high field strengths are RF power deposition and excitation field homogeneity. A quadrature transmit loop elements pair was developed for 7T breast MRI/MRSI using full-wave numerical EM methods. Field homogeneity and SAR values are accurately predicted by the EM methods employed and facilitates in the development of transmit elements for breast MR with improved field homogeneity with appropriate RF safety limits. The performance of the coil was successfully evaluated on an agar gel phantom and on a healthy volunteer.

Wednesday 13:30-15:30 Computer 44

13:30 **_3813_. Simulations of Tx-SENSE Performance of a 4 Channel Decoupled Loop Array for Cardiac Imaging at 7T**

Frank Seifert[1,2], Tomasz Dawid Lindel[1,2], André Kuehne[1,2], Helmar Waiczies[1,2], Wolfgang Renz, [23], Bernd Ittermann[1,2]

[1]Physikalisch-Technische Bundesanstalt (PTB), Abbestr. 2-12, D-10587 Berlin, Germany; [2]Berlin Ultrahigh Field Facility, Max-Delbrück-Center for Molecular Medicine, D-13125 Berlin, Germany; [3]Siemens Healthcare, D-91052 Erlangen, Germany

Tx-SENSE performance depends crucially on the reliable knowledge of the transmit sensitivity maps of the coil elements. For 7T body imaging the virtual reference approach fails to get reliable maps. This was shown for a simulated Tx-SENSE based zoomed cardiac imaging experiment at 7T. FDTD simulations were performed for a experimental 4-channel TX/RX coil array. Using either the virtual reference approach or the true sensitivity maps two sets of RF pulse shapes were calculated for a box like excitation pattern covering the heart. For both RF pulse sets the flip angle distribution was calculated from a full Bloch Equation simulation.

14:00 **_3814_. Optimization of Conductor Geometries of Small RF Loop Coils for Ultra High Field Applications**

David Otto Brunner[1], Clemens Grassberger[1], Klaas Paul Pruessmann[1]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Small receiver loop coils offer high SNR gain and are therefore common practice in MRI and MRS. In this work it was tried to optimize the conductor geometry and size of such loop coils comparing a series of conical coils with varying shell angles, diameters and placements. Furthermore the dependence of these parameters on the dielectric properties of the sample has been studied, which turned out to have a major impact at these frequencies.

14:30 **_3815_. Reducing SAR and Enhancing SNR with High Permittivity Dielectrics (ε) at 3T**

Qing X. Yang[1,2], Jianli Wang[1], Jinghua Wang[3], Chunsheng Wang[1], Christopher M. Collins[1], Michael B. Smith[4]

[1]Radiology, Penn State University College of Medcine, Hershey, PA, United States; [2]Neurosurgery, Penn State University College of Medicine, Hershey, PA, United States; [3]Magnetic Resonance Research Center, Yale University School of Medicine, New Haven, CT, United States; [4]Novartis Institutes for BioMedical Research, Inc.

Experimental results of human head imaging at 3T showed that padding around the human head containing appropriate amount of high dielectric material (~ 70) such as water reduced the input RF power for an 180° excitation pulse by 50% while enhancing image SNR by as much as 40%. Our experimental results demonstrated that placement of high ε pad enhanced B1 in the head and, thus, offers an effective approach for RF engineering.

15:00 *3816*. **A 7T 'Capless' Transceive Breast Coil**

Bing Keong Li[1], Hua Wang[1], Ewald Weber[1], Yu Li[1], Adnan Trakic[1], Daniel James Lee[2], Sedig Farhat[2], Paul Glover[2], Richard Bowtell[2], Stuart Crozier[1]
[1]School of ITEE, The University of Queensland, Brisbane, Qld, Australia; [2]School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom

A new method for designing a ultra high field bilateral transceive breast coil is presented. The design method does not require any discrete capacitors (hence the name "Capless Transceive Breast Coil") and can be driven by a single RF port for simultaneous bilateral breast imaging. A prototype breast coil using this design method was constructed and tested in a 7T Philips whole-body MRI system. Phantom images acquired using the prototype show high homogeneity and excellent RF penetration.

Thursday 13:30-15:30 Computer 44

13:30 *3817*. **A Distributed Impedance Model for the Shielded 7T Inductive Head Coil**

Joseph Murphy-Boesch[1]
[1]NINDS/LFMI, National Institutes of Health, Bethesda, MD, United States

The isolated meshes of the Inductive Resonator couple via strong mutual inductance to develop a "high-pass" distribution of modes for the coil. While simple mutual inductive coupling of neighboring meshes can accurately fit the modes of low frequency resonators, this model does not work for the shielded 7T head coil. Here, a transmission line and distributed impedance model is developed for the shielded 7T inductive resonator that accurately describes its modes and provides a model for high-frequency design.

14:00 *3818*. **31P Spectroscopy in Human Calf Muscle at 7 Tesla Using a Balanced Double-Quadrature Proton-Phosphorus RF Coil**

Andrew Webb[1], Nadine Smith[1]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands

In order to obtain high quality 31P data from human calf muscle, we have designed a closely-fitting double-tuned half-volume coil with quadrature on both 1H and 31P channels. Balanced, second order trap circuits are inserted into the heteronuclear coil to prevent counter-currents from being set up at the proton frequency, thus improving the efficiency of the proton channel. 2D 31P CSI data sets have been obtained at 7 tesla using this coil, with high signal-to-noise.

14:30 *3819*. **Loop T/R Coil for 7T MRI/MRS with Two Transmit/Receive Channels**

Zhiyong Zhai[1], Michael Morich[1], William Braum[1]
[1]Philips Healthcare, Cleveland, OH, United States

We propose a coil structure topologically similar to the single loop coil but with distinctly different operational characteristics. It has two concentric flat rings which can be tuned to two orthogonal resonant modes at the same frequency. Combining with two independent transmit/receive (T/R) channels for B1 shimming, a more uniform B1-field coverage in the sensitive region of the coil is achieved. The proposed coil can easily be used for various imaging purposes at different anatomies such as head, torso and extremities at 7T.

15:00 *3820*. **Quadrature Surface Coils for in Vivo Imaging in 900-MHz Vertical Bore Spectrometer**

Barbara L. Beck[1,2], Jose A. Muniz, [23], Ihssan S. Masad, [23], Samuel C. Grant, [23]
[1]McKnight Brain Institute, University of Florida, Gainesville, FL, United States; [2]National High Magnetic Field Lab, Tallahassee, FL, United States; [3]Chemical & Biomedical Engineering, Florida State University, Tallahassee, FL, United States

As MRI continues to evolve to higher static fields, radio frequency coil design must keep pace. Clockwise and counter clockwise field components must be considered when predicting signal intensity distributions. The magnetic fields of quadrature coils at 500 MHz and 900 MHz were simulated for the calculation of rotating components and simulated images. In addition, coils were constructed and tested in vertical bore magnets at 11.7 and 21.1 T. SNR of acquired images indicated 30% gain of quad coils over linear and approximately linear increase of SNR from 500 to 900 MHz.

Transieve Arrays

Hall B Monday 14:00-16:00 Computer 45

14:00 *3821*. **5 Decoupled Sets of Coupled Coils: An 8-20 Channel Subject-Insensitive Array for 7T Applications.**

Tamer S. Ibrahim[1], Tiejun Zhao[2], Eric Jefferies[3], Hai Zheng[3], Fernando E. Boada[4]
[1]Departments of Bioengineering and Radiology, Univeristy of Pittsburgh, Pittsburgh, PA, United States; [2]Siemens Medical Solutions; [3]Department of Bioengineering, University of Pittsburgh; [4]Department of Radiology, University of Pittsburgh

Several major obstacles have dampened the enthusiasm for widespread implementation of parallel transmission methods for ultrahigh field imaging including: 1) the need for accurate B1+ field mapping, 2) coil and subject dependent increases in local/global SAR, and

3) concerns regarding the unclear RF safety assurance of the PTX experiment due to inappropriate electromagnetic models for the estimation of the SAR at ultra-high. The work aims at alleviating these issues through the extension of the 4-port Tic Tac Toe coil to a more elaborate (covers the whole head volume,) 8-20 Tx channel, subject insensitive array for imaging at ultra high fields.

14:30 ***3822***. **Separated Volume Transmit / Volume Receive Arrays for Use in a 7T Head Gradient**

Lance J. DelaBarre[1], Scott Schillak[1], Brandon Tramm[1], Carl J. Snyder[1], J. Thomas Vaughan[1]
[1]CMRR - Radiology, University of Minnesota, Minneapolis, MN, United States

Head gradients constrain the dimensions of RF coils. Two 7T transmit TEM volume coils, one inductively coupled, one decoupled for parallel transmit, were designed to fit the head gradients. Each coil was equipped with an actively detuned, pre-amplifier decoupled, volume receiver array in close proximity to the transmitter. The performance of each is evaluated. Efficient independent transmit and receive volume arrays can be constructed in this tight configuration.

15:00 ***3823***. **Simulation and Construction of a CP Dual Helmholtz Saddle Tx / 8–ch.-Rx Head-Coil for 7T Whole Body System**

Tim Herrmann[1], Johannes Mallow[1], Jörg Stadler[2], Zang-Hee Cho[3], Kyoung-Nam Kim[3], Johannes Bernarding[1]
[1]Department of Biometry and Medical Informatics, OvG University, Magdeburg, Saxony-Anhalt, Germany; [2]Leibniz-Institute for Neurobiology, Magdeburg, Germany; [3]Neuroscience Research Institute, Gachon University of Medicine and Science, Incheon, Korea, Republic of

Goal of this study was to expand the abilities in fMRI experiments. To reach this goal a CP Dual Helmholtz saddle Tx / 8–ch.-Rx head-coil for 7T whole body system was simulated and constructed. This RF-coil has even more potential for visual stimulation and acoustic fMRI. The field simulation software allowed us to optimize the positioning of the capacitors and the extension of the frontal space between the phased array coils to allow visual fMRI experiments.

15:30 ***3824***. **Eight-Channel Tx/Rx Helmet Coil for Human Brain Imaging with Improved RF Homogeneity**

Wolfgang Driesel[1], Toralf Mildner[1], André Pampel[1], Harald E. Möller[1]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Two versions of an anatomically shaped microstrip transmission-line (MTL) helmet coil were built: (A) a circularly polarized (CP) transmit/receive (Tx/Rx) coil and (B) a CP-Tx/eight-channel-Rx array. Curved MTL elements of different lengths were used to provide sufficient space for audiovisual stimulation and the electrical length was adjusted by proper termination. Both helmet coils generated an almost perfect circular polarization in a large portion of the human head extending into regions near the coil elements. Initial experiments verify that the designs permit imaging of the brain with good tissue contrast and potential for parallel imaging.

Tuesday 13:30-15:30 Computer 45

13:30 ***3825***. **Tilted Transceiver Array for Ultra-High Field MRI**

Bing Wu[1], Yong Pang[1], Chunsheng Wang[1], Daniel Vigneron[1,2], Xiaoliang Zhang[1,2]
[1]Radiology&Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]UCSF/UC Berkeley Joint Group Program in Bioengineering, CA, United States

Element-tilted transceiver array was proposed for ultra-high field human studies. An 8-channel microstrip and an 8-ch loop array were fabricated for human knee at 7T. In those arrays, each element was tilted with a certain angle for achieving sufficient decoupling without using dedicated decoupling networks. Our result showed that decoupling was significantly improved (better than –18dB) for both arrays, and the B1 field is also increased (better than 20%) in the imaging region for the microstrip array compared with non-tilted case.

14:00 ***3826***. **RF Transparent Array for Testing Multi-Channel Transmit Systems**

Katherine Lynn Moody[1], Neal Anthony Hollingsworth[2], Jon-Fredrik Nielsen[3], Doug Noll[3], Steven M. Wright, [1,2], Mary Preston McDougall[1,2]
[1]Biomedical Engineering, Texas A&M University, College Station, TX, United States; [2]Electrical and Computer Engineering, Texas A&M University, College Station, TX, United States; [3]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

The use of high channel count transmit arrays in the clinical setting has yet to become widespread, and the integration of prototype hardware with a clinical scanner for testing adds complexity. A simple 8-channel transmit array capable of operating in series or parallel resonance was implemented to facilitate testing of multiple parallel transmit platforms, in particular comparing voltage and current source excitations schemes. The transmit array has been successfully implemented on a 3T GE clinical scanner and can simply be inserted into the body coil (used as the receive coil) without the need for a decoupling network.

14:30 ***3827*. A Mechanically Tuned 8-Channel Microstrip Array for Parallel Transmission at 7T (297MHz)**

Benoit Schaller[1], Arthur W. Magill[1,2], Rolf Gruetter[1,3]
[1]Laboratory of Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Department of Radiology, University of Lausanne; [3]Department of Radiology, Universities of Lausanne and Geneva, Switzerland

We present a new 8-channel microstrip array desiged for RF shimming and parallel transmission. Strips, mechanically tuned by adjusting the height over the ground plane, are symmetrically fed via a lattice balun, making the probe tune and match invariant under different loading conditions (different subject). Tuning and matching capacitors are fixed, the array gives a match of better than -23dB with Q=37 (loaded). Coupling between nearest neighbors was -22dB (loaded), and -17dB for the next neighbors, obtained without decoupling capacitors between elements. MR scans showed a penetration of 65mm inside a cylindrical saline phantom (Ø160mm, L=360mm).

15:00 ***3828*. Slot-Line Antenna Array for High Field Parallel Transmit MRI**

Christoph Leussler[1], Daniel Wirtz[1], Peter Vernickel[1]
[1]Philips Research Europe, Hamburg, Germany

We demonstrate initial results on the development of slot-line Tx/Rx array antennas for MRI. While the coil elements of a conventional antenna array typically are of TEM- or loop-type, the slot-antenna is fundamentally different: it can be understood as the complementary structure to an electric dipole. According to Babinet's principle, E- and B-fields are exchanged for both types of antennas. Slot antennas provide new degrees of freedom in antenna design: the operating frequency can be tuned geometrically (by adjusting the slot-size) or electrically by using (very few) resonance capacitors.

Wednesday 13:30-15:30 Computer 45

13:30 ***3829*. An 8 Element Inductively Decoupled Transceiver Array for 1H MR of the Brain at 7T: Performance Characteristics Across 82 Subjects**

Hoby Patrick Hetherington[1], Nikolai I. Avdievich[1], Jullie W. Pan[1]
[1]Neurosurgery, Yale University, New Haven, CT, United States

Transceiver arrays using multiple RF coils and RF shimming have demonstrated improved performance in comparison to conventional volume coils at 7T in the human brain. However, the variability in performance of these arrays across a large group of subjects and brain locations has been questioned due to their strong interactions with the sample. In this work we describe an 8 element transceiver array with selectable geometry and inductive decoupling which simplifies tuning and matching and provides consistent performance with regards to power requirements and overall homogeneity. We report results from 82 subjects at 7T characterizing the performance of the coil.

14:00 ***3830*. Implementation of a Novel 8-Ch Phase-Array Transmit/Receive Head Coil with RF Interface for Parallel Transmission on 3T**

Rong Xue[1], Huabin Zhu[2], Haoli Ma[1], Yanxia Li[1], Yan Zhuo[1]
[1]State Key Lab. of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China; [2]RF Department, Siemens Mindit Magnetic Resonance Ltd, Shen Zhen, China

We have successfully constructed a novel 8-channel phase-array transmit/receive head coil on Siemens 3T Tim Trio system for research on parallel transmission techniques including multiple-channel phase-array RF coil design and homogenous B1 shimming. The coil was better suited for Asian people fMRI studies, with an unblocked visual field as well as high image SNR and signal stability. The whole setup including the Tx/Rx coil, the related RF interface and parallel transmission techniques would further be applied to a Siemens 7T system and is expected to achieve good anatomical and functional images in ultra high field.

14:30 ***3831*. Experimental Verification of Enhanced B1 Shim Performance with a Z-Encoding RF Coil Array at 7 Tesla.**

Gregor Adriany[1], Johannes Ritter[1], Tommy Vaughan[1], Kamil Ugurbil[1], Pierre-Francois Van de Moortele[1]
[1]Center for Magnetic Resonance Research, University of Minnesota Medical School, Minneapolis, MN, United States

Efficient and homogeneous spin excitation in areas of the lower temporal lobe and the cerebellum is difficult to achieve at 7 tesla and above. We experimentally evaluated the performance of a 7 tesla transceiver head array with z encoding capability and compared this coil to a similar sized coil without the additional coil elements along the z direction. Capability to RF shim the whole head is demonstrated.

15:00 ***3832*. 7 Tesla 16-Element TEM Tx Coil with Dedicated 14-Channel Receive-Only Array**

Tamer S. Ibrahim[1], Tiejun Zhao[2], Fernando E. Boada[3]
[1]Departments of Bioengineering and Radiology, Univeristy of Pittsburgh, Pittsburgh, PA, United States; [2]Siemens Medical Solutions; [3]Department of Radiology, University of Pittsburgh

In this work we present a design for homogenous and efficient Tx head coil combined with receive-only array. The coil exhibits excellent homogeneity throughout the brain volume. In addition, the coil is also highly efficient and is capable of achieving 180o flip angle without SAR violation.

Thursday 13:30-15:30 Computer 45

13:30 ***3833*. A Stripline-Like Coil Element Structure for High Field Phased Array Coils and Its Application for a 8-Channel 9.4T Small Animal Transceive Array**

Yu Li[1], Ewald Weber[1], BingKeong Li[1], Feng Liu[1], Johannes Schneider[2], Stéphanie Ohrel[2], Sven Junge[2], Peter Ullmann[2], Markus Wick[2], Stuart Crozier[1]
[1]School of ITEE, The University of Queensland, Brisbane, Queensland, Australia; [2]Bruker BioSpin MRI GmbH, Ettlingen, Germany

In this work, the development of an optimized, shielded 8-element transceive volume-array for small animal MRI applications at 9.4T is discussed. A novel stripline-like sandwiched conductor structure for the coil element has been proposed. A prototype was constructed and tested in a Bruker 9.4T Biospec MRI system. Simulated and experimental results presented herein demonstrate the potential of the design.

14:00 ***3834*. A Novel TxRx Head Coil for Visual Stimulation FMRI with High Signal Stability**

Huabin Zhu[1,2], Yanxia Li[2], Bida Zhang[3], Jianmin Wang[1], Yan Zhuo[2], Rong Xue[2]
[1]Radio Frequency Department, Siemens Mindit Magnetic Resonance Ltd., Shenzhen, Guangdong, China; [2]State Key Lab. of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China; [3]Siemens Mindit Magnetic Resonance, Siemens Healthcare MR Collaboration NE Asia, Shenzhen, Guangdong, China

A large portion of fMRI experiments include visual stimulation. An unblocked vision window can improve subject's coziness, and hence improve the reliability of visual stimulation experiment. Normally fMRI experiments demand high stability of MRI scanners including coil and other components, to ensure stable signal magnitude for temporal measurements. Using Siemens Trio Tim system and its 12-ch head coil, the signal fluctuation with a signal shot EPI sequence without stimulation can be about 0.4-0.5 percent on water phantom. In this project, we developed an 8-ch TxRx phase-array head coil , which has two obvious advantages in fMRI. First, a rectangular window of size 116mmx74mm is opened in the upper part of the coil to provide a comfortable vision view for subjects. Second, there is significant improvement in signal stability, which helps to detect the small signal change during fMRI scanning.

14:30 ***3835*. Design and Comparison of Two 8-Channel Transmit/Receive Radiofrequency Arrays for in Vivo Rodent Imaging on a 7T Human Whole-Body MRI System**

Stephan Orzada[1,2], Stefan Maderwald[1,2], Sophia L. Göricke[2], Nina Parohl[2], Susanne C. Ladd[1,2], Mark E. Ladd[1,2], Harald H. Quick[1,3]
[1]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, NRW, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; [3]Institute of Medical Physics, Friedrich-Alexander-University Erlangen-Nurnberg, Erlangen, Germany

MRI of rodents is an ever growing application when translatory imaging research “from mouse to man” is envisioned. In this study, two different multi-channel transmit/receive radiofrequency coil arrays have been designed for high-resolution rodent imaging on a 7T whole-body human MRI system. Both arrays have been evaluated in comparative phantom experiments and in vivo high-resolution MRI in rats. Both coil setups provided high signal-to-noise-ratio in rodents. While the 8-channel loop radiofrequency array with its larger inner diameter provided better overall signal homogeneity, the 8-channel novel stripline radiofrequency array design provided overall higher signal-to-noise-ratio and better parallel imaging acceleration performance.

15:00 ***3836*. A 3.0-Tesla Transmit and 32-Channel Receive Head Array Coil**

Tsinghua Zheng[1], Craig Lawrie[1], Xiaoyu Yang[1], Joseph Herczak[1], Paul Taylor[1], Hiroyuki Fujita[1,2], Takahiro Ishihara[3], Kazuya Okamoto[3], Sadanori Tomiha[3], Kaori Togashi[4], Tomohisa Okada[4]
[1]Quality Electrodynamics, LLC, Mayfield Village, OH, United States; [2]Departments of Physics and Radiology, Case Western Reserve University, Cleveland, OH, United States; [3]Toshiba Medical Systems Corporation, Otawara, Tochigi, Japan; [4]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan

We have developed a 3-Tesla head array with an integrated local birdcage transmit coil and 32-receive surface coils for much higher spatial and temporal resolution head imaging. The coil was tested on a Toshiba 3T Atlas 32-Channel MRI System. Benchmarking with a commercially-available 1.5-Tesla 14-channel receive-only head array coil, the proposed Tx-and-32Rx head coil showed a significant improvement in image quality with respect to the SNR enhancement and much improved temporal resolution that are well expected from a higher channel count array coil.

Receive Arrays

Hall B Monday 14:00-16:00 Computer 46

14:00 ***3837*. 1H/23Na Dual-Tuned RF Unicoil for Human Body MR Imaging at 3T**

Jung-Hwan Kim[1], Kyung-Nam Kim[2], Chan Hong Moon[1], Suk-Min Hong[2], Bum-Woo Park[1], Haekyun Joshua Park[2], Kyongtae Ty Bae[1]
[1]University of Pittsburgh, Pittsburgh, PA, United States; [2]Gachon University of Medicine and Science, Incheon, Korea, Republic of

We have developed a dual-tuned 1H and 23Na coil at 3T by utilizing the Unicoil concept and coil geometry to improve the SNR and RF penetration depth. The coil allowed us to acquire 1H and 23Na images of the spine and kidney with excellent image quality. Future studies include development and generalization of Unicoil concept for imaging other body parts and comparative evaluation of the performance of Unicoil with other coil designs.

14:30 ***3838*. A Flexible 32-Channel Array for ^{3}He Human Lung Imaging at 1.5T**

Martin H. Deppe[1], Juan Parra-Robles[1], Titus Lanz[2], Jim M. Wild[1]
[1]Academic Radiology, University of Sheffield, Sheffield, Yorkshire, United Kingdom; [2]Rapid Biomedical GmbH, Rimpar, Germany

This work presents a flexible 32-channel array coil for imaging of hyperpolarized ^{3}He at 1.5 T, designed as an insert into an existing birdcage transmit coil of excellent B_1 homogeneity. The array consists of an anterior and a posterior half, containing 16 channels each. Nearest neighbours are decoupled by concentric shields. Functionality of the array is demonstrated by human lung images at different acceleration factors. Residual coupling to the transmit coil, which is currently not detuned during the reception phase, remains, and will be addressed in future by detuning the birdcage.

15:00 ***3839*. 28-Channel Receive-Only Array for Body Imaging at 7T**

Carl J. Snyder[1], Lance DelaBarre[1], Jinfeng Tian[1], Can Akgun[1], Gregory John Metzger[1], Kamil Ugurbil[1], J. Thomas Vaughan[1]
[1]University of Minnesota, Minneapolis, MN, United States

Currently most 7T body imaging is limited to surface transeive arrays. However, dedicated transmit coils used in combination with local receive-only arrays have shown benefits at lower field strengths. Here we have constructed a 28-channel receiver array to be used with a dedicated transmit array at 7T.

15:30 ***3840*. ASK-Asymmetric Saddle K-Topology for Spinal Cord Imaging**

Modhurin Banerjee Snyder[1], Pei H. Chan[1], Fraser Robb[1]
[1]GE Healthcare, Aurora, OH, United States

A coil system based exclusively on the Double Asymmetric Saddle Pair motif was conceived as an extension of the work done with the DLAS (Double Loop Asymmetric Saddle) system. This coil system, dubbed the ASK (Asymmetric Saddle K-topology) was evaluated for SNR and uniformity-of-response performance against loop-based, quadrature loop/saddle-based, and DLAS based designs via phantom imaging. The relative SNR gain provided by the ASK array compared to the DLAS ranges from 40 % at the periphery to 15% at the center; furthermore, the ASK system demonstrated a peak SNR (at center) 20% better than the standard Quadrature Coil(QD).

Tuesday 13:30-15:30 Computer 46

13:30 ***3841*. A 16 Channel Radio Frequency Anterior Neck Coil for Imaging of the Cervical Carotid Bifurcation**

Quinn Tate[1], Laura C. Bell[2], Seong-Eun Kim[2], Emilee Minalga[2], Dennis L. Parker[2], J. Rock Hadley[2]
[1]Radiology-UCAIR, University of Utah, Salt Lake City, UT, United States; [2]Radiology - UCAIR, University of Utah, Salt Lake City, UT, United States

A 16 channel recieve only coil was constructed in order to meet the need for greater relative signal to noise ratio (rSNR) at the carotid bifurcation as well as increased coverage of the anatomy, and improved parallel imaging performance. Current 4 channel coils provide acceptable rSNR. However, the 4 channel coil has a limited field of view which can require repositioning. The 16 channel coil increases the S/I FOV while significantly increasing the rSNR along the vessel compared to the 4 channel coil. This coil also enables Reduction factors of R=2 and 3, reducing possible image artifacts from motion

14:00 ***3842*. QASCI-Quadruple Asymmetric Saddles for Cardiac Imaging**

Modhurin Banerjee Snyder[1], Pei H. Chan[1], Fraser Robb[1]
[1]GE Healthcare, Aurora, OH, United States

In this work we have created a flexible, modular 32-channel array for cardio-thoracic imaging that is based on traditional loop elements and Double Asymmetric Saddle (DAS) pairs. This unique design, dubbed the QASCI (Quad Asymmetric Saddle for Cardiac Imaging), is an extension of the work done with the DLAS (Double Loop Asymmetric Saddle) to a cardiothoracic application. The

QASCI system was evaluated via phantom imaging, and demonstrated a nominal 50% improvement in SNR over a larger FOV (34cm by 34 cm) than the 8 channel cardiac coil, even when evaluated on an element-by-element/channel-by-channel basis.

14:30 ***3843*. An Optimized "QD-Like" 6-Channel Flexible and Ergonomic Shoulder Array Coil at 1.5T**

Xiaoyu Yang[1], Steven Walk[1], Paul Taylor[1], Tsinghua Zheng[1], Hiroyuki Fujita[1,2]
[1]Quality Electrodynamics, Mayfield Village, OH, United States; [2]Physics and Radiology, Case Western Reserve University, Cleveland, OH, United States

The MRI trend sees the increasing availability of wider-bore scanners at 1.5T and 3T to accommodate much broader coverage of the patient population. Addressing the need, an optimized 6-channel ergonomically-designed shoulder coil is proposed at 1.5T. The coil consists of 3 rows of loop and saddle pairs with flexible flaps for better fitting of different size shoulder sizes and thereby increasing SNR. Comparison tests were performed between the proposed flexible coil and a commercially available 4-channel rigid shoulder coil. The testing and evaluation also included the performance comparison among various shoulder sizes. The results show that the proposed "one-fits-all" coil provides good SNR, depth coverage and uniformity for the broad range patient population.

15:00 ***3844*. A 8+4-Channel Receive Phased Array for Imaging Newborns and Premature Infants at 1.5T**

Stefan Fischer[1], Florian M. Meise[2], Jörn Ewald[2], Torsten Hertz[2], Torsten Lönneker-Lammers[3], Laura M. Schreiber[1]
[1]Department of Diagnostic and Interventional Radiology, Section of Medical Physics, University Medical Center of the Johannes Gutenberg-University, Mainz, RLP, Germany; [2]LMT Medical Systems GmbH, Lübeck, SH, Germany; [3]Lammers Medical Technology GmbH, Lübeck, SH, Germany

In this study a 8+4-channel receive phased array for optimized MRI of newborns and premature infants at 1.5T was developed. State of the art MRI coils are mostly designed for adults and suitable to only a limited extent for pediatric and newborn imaging. Several challenges like imaging of small objects with high resolution and accelerated imaging to prevent motion artifacts can be met by using an adapted phased array. It provides high signal-to-noise-ratio and the possibility for accelerated imaging. The very compact design allows using the 8+4-channel array system in a MR safe incubator to minimize environmental stress.

Wednesday 13:30-15:30 Computer 46

13:30 ***3845*. Multi-Coil MR Imaging with a Receive Array of Eight Microcoils**

Kai Kratt[1], Elmar Fischer[2], Vlad Badilita[1], Mohammad Mohammadzadeh[2], Jürgen Hennig[2], Jan G. Korvink[1,3], Ulrike Wallrabe[1,3]
[1]Dept. of Microsystems Engineering - IMTEK, University of Freiburg, Freiburg, Germany; [2]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [3]Freiburg Institute of Advanced Studies (FRIAS), University of Freiburg, Freiburg, Germany

We present the development of an eight-channel microcoil array as a prototype for the simultaneous detection of signal from samples at predefined spatial positions. The manufacturing process is fully MEMS compatible, therefore being cost-effective and making the array suitable for one-time usage. Eight microcoils have been selected for this study, but the number of coils (i.e. positions) could be extended to the maximum number of receive channels provided by the MRI spectrometer. By varying size, number and mutual distance of the microcoils, such a multi-coil array can be used for testing detection schemes of parallel imaging techniques.

14:00 ***3846*. Modular, Decoupled Yet Bendable Coil Array System at 3T**

Stefan Schonhardt[1], Andreas Peter[2], Jan G. Korvink[2,3]
[1]Department of Microsystems Engineering, University of Freiburg - IMTEK, Freiburg, Germany; [2]Department of Microsystems Engineering, University of Freiburg - IMTEK, Germany; [3]Freiburg Institute of Advanced Studies (FRIAS), University of Freiburg - IMTEK, Freiburg, Germany

A hexagonal surface filling coil tiling has been designed and manufactured in a flexible Polyimide foil, featuring additional overlap loops on all six tips of a hexagon. The loops serve the purpose of decoupling the next neighboring coils. The immediate neighbor coils are decoupled by overlaps along their edges. The single identical coils are staggered with respect to each other to form an almost arbitrary large phased array. The respective coupling between the single coils is -20 dB or better, even if bent at a radius of 15 cm along an arbitrary in-plane direction.

14:30 ***3847*. Development of a Receive-Only Inductively-Coupled RF Coil System to Enhance ^{1}H NMR Localized Spectroscopy to Monitor an Implantable Bioartificial Construct at 11.1T**

Nelly A. Volland[1], Thomas H. Mareci[2,3], Nicholas E. Simpson[4]
[1]Radiology, University of Utah, Salt Lake City, UT, United States; [2]Biochemistry and Molecular Biology, University of Florida, Gainesville, FL, United States; [3]McKnight Brain Institute, University of Florida, Gainesville, FL, United States; [4]Medicine, University of Florida, Gainesville, FL, United States

Introduction: Uniform excitation and highly sensitive signal detection is necessary for optimal MRS of bioartificial constructs, particularly when determining function. Methods: Receive-only implantable coils were constructed, coated, and integrated with the macroconstruct. This assembly was inductively-coupled to an external coil and tested in vitro in combination with a transmit-only volume coil at 11.1T. Results: Studies showed small overall gains in SNR with this system under loaded conditions over a transmit-receive system, and greater signal uniformity. Conclusion: A receive-only implantable coil system was successfully built and tested. This system will allow for superior quantitative monitoring of implanted bioartificial organs.

15:00 ***3848*. A Combined Solenoid-Surface RF Coil for High-Resolution Whole-Brain Rat Imaging on a 3.0 Tesla Clinical MR Scanner**

Hunter R. Underhill[1,2], Chun Yuan[1], Cecil E. Hayes[1]
[1]Radiology, University of Washington, Seattle, WA, United States; [2]Bioengineering, University of Washington, Seattle, WA, United States

In this study, a novel coil design, subsequently referred to as the rat brain coil, is described which exploits and combines the strengths of both solenoids and surface coils into a simple, multi-channel, receive-only coil dedicated to whole-brain rat imaging on a 3.0 T clinical MR scanner. Compared to other coils, the rat brain coil improved SNR by a minimum of 60%. Improvement in SNR afforded by the rat brain coil may broaden applications and experiments that utilize clinical MR scanners for in vivo image acquisition.

Thursday 13:30-15:30 Computer 46

13:30 ***3849*. Enhancing FMRI Sensitivity at 7T with a Modular 16-Channel Small Element Surface Coil**

Natalia Petridou[1], M Italiaander[1], B.L. van de Bank[1], J.C.W. Siero[1], J.M. Hoogduin[1], P.R. Luijten[1], D.W.J. Klomp[1]
[1]UMC Utrecht, Utrecht, Netherlands

Even though the BOLD contrast is enhanced at 7T, the finer scale of neurovascular coupling remains difficult to detect because the high spatial and temporal resolution required to explore these properties remain limited by SNR. To improve SNR we developed a 16channel surface coil comprised of 1x2cm elements arranged in 4 flexible modules that can be positioned within 1mm from the human head; we show that a surface array consisting of the theoretical smallest useful element dimension enhances SNR at 7T. This surface array can be used with high resolution fMRI to improve sensitivity as compared to conventional receiver arrays.

14:00 ***3850*. A 7-Channel Receive Array Insert for Enhancement of SNR and Acquisition Speed in the Cerebellum and Visual Cortex at 7T**

Stephan Orzada[1,2], Oliver Kraff[1,2], Kasja Rabe[3], Dagmar Timman-Braun[3], Mark E. Ladd[1,2]
[1]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, NRW, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; [3]Department of Neurology, University Hospital Essen, Essen, NRW, Germany

In this work we present a 7-channel receive coil which can be inserted into a non-detunable commercially available 8 channel head coil for 7 T. The insert is used to enhance image quality and imaging speed in the cerebellum and in the visual cortex. Image comparisons show that image quality is improved even at higher parallel imaging acceleration factors.

14:30 ***3851*. Improved Optic Nerve Imaging Using a Collapsible Head Coil Design**

Robb Merrill[1], Dennis Parker[1], Emilee Minalga[1], Laura Bell[1], John Rose[2,3], Rock Hadley[1]
[1]Dept. of Radiology (UCAIR), Salt Lake City, UT, United States; [2]Neurovirology Laboratory VASLCHCS; [3]Brain Institute

Existing head coils are typically built using one-piece rigid cylindrical formers. The performance of advanced imaging techniques of the optic nerve is limited by reduced SNR when smaller-sized heads are imaged in these coils. Phantom studies in a rigid 12-channel Siemens coil indicate an SNR difference of over 60% when the coil-to-sample distance from the top coil elements is decreased by 4cm. This study shows results from an improved collapsible-design head coil specifically built for optic nerve imaging. Volunteer studies show an SNR improvement of nearly 30% in the orbits when the collapsible optic nerve coil is used.

15:00 ***3852*. A Multi-Element Receive Coil Array for MRI/FMRI of Awake Behaving Marmosets**

Hellmut Merkle[1], Julie B. Mackel[1], Junjie V. Liu[1], Yoshiyuki Hirano[1], Afonso C. Silva[1]
[1]NINDS, NIH, Bethesda, MD, United States

Significant effort has been placed on the development of awake behaving animals that allow longitudinal studies to be carried out without the confounds of anesthesia. Here we describe a 7-element receive coil array for MRI/FMRI scanning of awake behaving marmosets at 7 Tesla incorporated into individualized noninvasive helmet restraints and integrated to low input impedance RF preamplifiers. Excellent isolation between the coils and spatial coverage of the whole brain were achieved. The SNR was optimized to the somatosensory and motor cortices. Further refinements of the helmet restraint will lead to additional geometries optimized for different brain regions.

Measuring & Modeling RF Performance

Hall B Monday 14:00-16:00 Computer 47

14:00 ***3853*. Accurate Measurement of RF Power Deposition During 3T MRI**

AbdElMonem M. El-Sharkawy[1], Di Qian, [1,2], Paul A. Bottomley[1,2], William A. Edelstein[1]
[1]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States; [2]Electrical and Computer Enginnering, Johns Hopkins University, Baltimore, MD, United States

Accurate measurements of RF power deposition are central to safe MRI operation, especially at higher fields. We have characterized the losses in the body coil, cables, filter box, transmit-switch and quadrature hybrid. We find that transmit chain and body coil losses are such that the power reaching the patient is < 50% of the power supplied by the transmitter. Measured power deposition in four subjects of different body mass indices varied from 46-83% of the scanner estimated power deposition. This indicates that scanner estimates are not accurate indicators of MRI RF exposure.

14:30 ***3854*. Subject-Specific Evaluation of Multi-Channel Receive Coil Arrays by Fast Integral-Equation Method**

Shumin Wang[1], Jacco A. de Zwart, Jeff H. Duyn[1]
[1]LFMI/NINDS/NIH, Bethesda, Center Dr. , United States

The performance of high-field receive coil arrays depends on the geometry of coil elements, the shape of subjects, and their relative position. Knowing the actual performance, such as the combined sensitivity and the g-Factor maps, is valuable in post-processing images. Conventionally, subject-specific coil performance was evaluated via measurements. In this work, we present an alternative approach by numerical simulations based on fast integral-equation method and subject models obtained from MRI pre-scans. Results demonstrate the feasibly of performing subject-specific coil evaluations based on pure numerical approaches.

15:00 ***3855*. RF-Invisible Inductors**

Victor Taracila[1], Vijayanand Alagappan[1], Aleksey Zemskov[1], Fraser Robb[1]
[1]GE Healthcare, Aurora, OH, United States

Ideal inductors must have lump circuit characteristics only, without exhibiting any radiative properties. These goals might appear to be contradictory since inductors with higher inductances must be bigger and have a certain surrounding volume for magnetic field confinement. In this work we address the question of the “invisible” inductors – inductors with highly confined magnetic field, which still have satisfactory inductive characteristics.

15:30 ***3856*. Detailed Investigations of a Metamaterial Transmit/receive Coil Element for 7 T MRI**

Jochen Mosig[1], Achim Bahr[1], Thomas Bolz[1], Andreas Bitz[2], Stephan Orzada[2]
[1]RF&Dosimetry, IMST GmbH, Kamp-Lintfort, Nordrhein-Westfalen, Germany; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Nordrhein-Westfalen, Germany

In a previous work the design and numerical results for a composite right/left-handed metamaterial coil element were presented. This work shows dosimetric measurement and first imaging results together with further numerical results. A good agreement between the simulations and the measurements was observed. In contrast to the homogeneous B1 field, the circular polarized B1+ field shows some discontinuities. This has lead to the investigation of different designs for the metamaterial element. As a result, an extended layout is presented, that eliminates the local minima in the field distribution of the original element, and shows a significant different field distribution.

Tuesday 13:30-15:30 Computer 47

13:30 ***3857*. A Modelling Study of a Hybrid Loop-Strip Coil Structure for Multichannel Transceive Breast Array Coil**

Yu Li[1], Feng Liu[1], Jin Jin[1], Ewald Weber[1], BingKeong Li[1], Hua Wang[1], Stuart Crozier[1]
[1]The University of Queensland, Brisbane, Queensland, Australia

Because of the specific position of a patients’ breast related to the B0 field of a horizontal clinical MRI scanner, it is challenging to use conventional equal structured loop coils to induce a desired homogenous B1 field. More importantly, in the anterior-posterior area of the breast, little or no signal can be received by a loop coil. This work presented a loop-strip hybrid transceive phased array breast coil design. The new design can offer improvement to the B1 field in the anterior-posterior area of the breast, which is difficult to achieve by using a loop-only breast coil.

14:00 ***3858*. A Comprehensive Coil Resistance Composition Model for High Field**

Qi Duan[1], Daniel K. Sodickson[1], Bei Zhang[1], Graham C. Wiggins[1]
[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States

This abstract provides a detailed understanding for loop coil resistance, a crucial component of SNR in the MR experiment. In comparison to existing models, the new model presented in this abstract includes more components which were often overlooked in

the past and thus yields more realistic prediction of coil resistance at high field. The ability to characterize coil losses is the key for optimizing loop-based coil and array designs, and providing an accurate coil noise model in full-wave simulations.

14:30 ***3859***. **Statistical Noise Model in GRAPPA-Reconstructed Images**

Santiago Aja-Fernandez[1], Antonio Tristan-Vega[1], Scott Hoge[2]
[1]Universidad de Valladolid, Valladolid, VA, Spain; [2]Brigham and Women's Hospital, Boston, MA, United States

A statistical noise model is derived for multiple-coil MR signals when using subsampling and GRAPPA reconstruction methods. The reconstructed data in each coil is shown to follow a non-stationary Gaussian distribution. Under some assumptions the signal may be considered as nearly stationary. For each pixel, if the coefficient of variation of the noise variance across coils is low enough, a non-central Chi model may be considered. This is the same model used for non-subsampled multiple-coil acquisitions. However, the non-central Chi model is not always assured in GRAPPA reconstructed data.

15:00 ***3860***. **Channel Reduction with Multiple Receptions**

Bing Wu[1], Chunsheng Wang[1], Yong Pang[1], Xiaoliang Zhang[1,2]
[1]Radiology&Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]UCSF/UC Berkeley Joint Group Program in Bioengineering, CA, United States

The need for high signal-to-noise ratio and fast imaging acquisitions have driven the development of MRI systems with more receive channels. However, such multi-channel systems are not always available. Array compression techniques with the use of hybrids, Butler matrix or mode-mixing hardware, allow the optimal use of existing channels. In this work, a straight-forward method by applying multiple receptions is proposed for channel reduction.

Wednesday 13:30-15:30 Computer 47

13:30 ***3861***. **MR Simulation System for MR Guided Radiation Therapy at 3.0T**

Haoqin Zhu[1], Mehran Fallah-Rad[1], Alexander Shvartsberg[1], Victoria Hornblower[1], Labros Petropoulos[1]
[1]IMRIS Inc, Winnipeg, MB, Canada

Until recently, MRI has only been used as a guidance tool during Radiation Therapy's planning stage, due to CT's inability to image oblique planes and large FOVs. Presently, there are no MR compatible simulation systems incorporating the head-neck mask and obtaining MR images for Radiation Therapy planning. We propose, a novel MR simulation system for RT planning of head-neck tumors that includes an MR compatible board combined with a dedicated set of three phased array coils, providing superior uniform coverage of the head-neck region with minimum 40% SNR increase when compared to a commercially available coil system.

14:00 ***3862***. **Analysis of Equivalent Noise Resistance of Surface and Small Volume Coils by the Finite Element Method**

Ye Li[1], Yan Guo[1], Xiaohua Jiang[1]
[1]Department of Electrical Engineering, Tsinghua University, Beijing, China

This work proposes an approach to analysis the equivalent noise resistance, including coil self-resistance, of surface coils of low field MRI and small volume coils of extra high field MRI using the finite element method. The simulation and imaging results suggest that the finite element method is feasible to analyze surface coils of low field MRI and small volume coils of extra high field MRI. The coil self-resistance accounts higher percentages of the equivalent noise resistance of surface coil whereas it is comparable with the sample resistance of animal coils which are integrated with animal holder.

14:30 ***3863***. **Improvement in High Field Pulsed Arterial Spin Labelling Using Dielectric Pads: A Simulation and Experimental Study**

Wouter Teeuwisse[1], Christopher Collins[2], Ching Wang[2], Qing Yang[2], William Ma[2], Nadine Smith[1], Matthias van Osch[1], Andrew Webb[1]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Radiology, Hershey Medical School, Hershey, PA, United States

Although pulsed arterial spin labelling should benefit from high fields in terms of sensitivity and longer blood T1 values, there are significant challenges to its successful implementation. One of the major difficulties is in using commercial volume transmit coils for efficient arterial labelling due to the inherent B1 inhomogeneities produced by a human subject at high field. This work presents a simulation study, and confirmatory experimental results, which show that the use of appropriately-positioned water-based dielectric pads can be used to increase the labelling efficiency and improve the quality of ASL scans at 7 Tesla.

15:00 ***3864***. **Quantitative Calculation of the Proton Radiation Damping Constant at 14.1 Tesla**

James Tropp[1], Kayvan Keshari[2], Mark Van Criekinge
[1]Global Applied Science Lab, GE Healthcare Technologies, Fremont, CA, United States; [2]Radiology, University of California San Francisco, San Francisco, CA, United States

We have calculated the radiation damping constant for protons in neat H2O at 14.1 tesla, and confirmed the accuracy of our prediction by measurement. The calculation contains no adjustable parameters, and replaces the coil filling factor and Q with the coil efficiency, i.e. B1 per absorbed power. The calculated and measured linewidths are, respectively 46.6 Hz and 44.0 Hz.

Thursday 13:30-15:30 Computer 47

13:30 ***3865*****.** **Simulation of a Novel Radio Frequency Ablation Device Within a MR Scanner**

Yik-Kiong Hue[1], Jerome L. Ackerman[1]
[1]Martinos Center, Department of Radiology, Massachusetts General Hospital, Boston, MA, United States

An electromagnetic modeling of a novel radiofrequency ablation device within the MR scanner was done to study the safety and performance issue. It provides quantitative and understandable model of the physics in rough agreement with the experiment.

14:00 ***3866*****.** **Numerical Investigation of Nonlinear, Spatially-Varying Pulsed Magnetic Fields**

Tony Stöcker[1], Kaveh Vahedipour[1], N. Jon Shah[1,2]
[1]Institute of Neuroscience and Medicine - 4, Forschungszentrum Juelich, Juelich, Germany; [2]Faculty of Medicine, RWTH Aachen, Aachen, Germany

Curved spatially-varying magnetic fields have a strong impact on MRI, especially in the context of correcting magnetic field inhomogeneities (shimming). New progress from hardware and sequence development intends to overcome certain limitations, e.g. by the use of higher-order shim coils or the application of spatially-selective dynamic shimming. Beyond field corrections, curved field gradients are also under discussion for region-specific zoomed spatial encoding with reduced peripheral nerve stimulations. However, the gains from such strategies are hardly predictable without simulations. Here, a framework for exact numerical MRI simulations of nonlinear spatially-varying pulsed magnetic fields is presented.

14:30 ***3867*****.** **Modelling the Sources of the Pulse Artefact in Simultaneous EEG/fMRI**

Winston X. Yan[1], Karen Julia Mullinger[1], Gerda B. Geirsdottir[1], Richard W. Bowtell[1]
[1]Sir Peter Mansfield Magnetic Resonance Center, School of Physics and Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Simultaneous EEG/fMRI is hindered by large artefacts in EEG recordings. The pulse artefact (PA) is particularly troublesome because of its variability and persistence after artefact correction. We investigate two potential causes of the PA (cardiac-pulse-induced head rotation and Hall voltages generated by blood flow), through physical modelling and experimental measurements on an agar phantom and human head. Our results show head rotation is the most plausible artefact source, generating artefact patterns and magnitudes similar to the measured PA for realistic motional parameters. The models derived here can facilitate development of improved artefact correction algorithms based on simulated spatial templates.

15:00 ***3868*****.** **Measurement of Q-Factors Including Radiation Loading of Strip-Type Coils for 7-Tesla MRI**

Klaus Solbach[1], Stephan Orzada[2], Pedram Yazdanbakhsh[1]
[1]Radio Frequency Technology, University Duisburg-Essen, Duisburg, Germany; [2]University Duisburg-Essen, Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, Germany

Our strip conductor-type coil for 7-Tesla MRI exhibits strong radiation loading due to its length of a quarter-wave. The loading by a phantom is seen to be superimposed by mutual coupling effects in a similar way as known from antennas. When using the conventional figure of merit based on the “unloaded” to “loaded” Q-factors we have to perform the “unloaded” measurement with the coil under a conducting shield (”Wheeler cap”) in order to exclude the radiation loading.

SAR: Simulations & Safety

Hall B Monday 14:00-16:00 Computer 48

14:00 ***3869*****.** **Local SAR Calibration and Prediction Model in Parallel Transmit MRI**

Leeor Alon[1], Cem Murat Deniz[1], Riccardo Lattanzi[1], Graham Wiggins[1], Ryan Brown[1], Daniel K. Sodickson[1,2], Yudong Zhu[1]
[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, NYU School of Medicine, New York, NY, United States; [2]Sackler Institute of Graduate Biomedical Sciences, NYU School of Medicine, New York, NY

Current SAR monitoring methods offer no capability for a-priori prediction of local SAR under actual experimental conditions. In this study, we present a model implementation for the calibration and prediction of local SAR distribution in parallel transmit MR systems. Calibration based on a modest number of targeted MR thermometry experiments suffices to enable accurate prediction of local SAR maps for any pulse shape in situ as long as the temperature change is within linear regime and heating occurs rapidly. This method is a potential candidate for ex-vivo local SAR prediction, which would be useful to evaluate the performance of parallel transmit coil setups on various tissues with different electrical properties. In vivo applications will also be explored.

14:30 ***3870*. SAR Sensitivity to Phase AndSAR Sensitivity to Phase and Amplitude Perturbations When Utilizing Parallel Transmission**

Martijn Anton Cloos[1], Michel Luong[2], Guillaume Ferrand[2], Alexis Amadon[1], Dennis Le Bihan[1], Nicolas Boulant[1]

[1]CEA, DSV, I2BM, NeuroSpin, LRMN, Gif-sur-Yvette, France; [2]CEA, DSM, IRFU, SACM, Gif-sur-Yvette, France

When using parallel transmission at high field, it is well established that high local specific absorption rate (SAR) values can occur. So far, no reports have been made regarding the behavior of transmit-SENSE pulses with regard to amplitude and phase perturbations. In this work, we investigated the behavior of the local SAR regarding perturbed spoke k-space trajectory-based excitation pulses designed using simulated B1-maps. Results indicate that although substantial variations can occur the local SAR may be considered relatively robust and remains far below the local SAR obtained with the worst-case scenario.

15:00 ***3871*. Specific Absorption Rate Monitor for In-Vivo Parallel Transmission at 7 Tesla**

Martijn Anton Cloos[1], Nicolas Boulant[1], Michel Luong[2], Guillaume Ferrand[2], Dennis Le Bihan[1], Alexis Amadon[1]

[1]CEA, DSV, I2BM, NeuroSpin, LRMN, Gif-sur-Yvette, France; [2]CEA, DSM, IRFU, SACM, Gif-sur-Yvette, France

It is well established that high local specific absorption rate (SAR) values can occur when using a transmit array at high field. In order to guarantee patient safety without harsh limitations to in-vivo transmit-SENSE applications, subtle SAR monitoring is necessary. In this work we present a SAR monitor at 7 Tesla based on real-time measurement of power going out of each RF amplifier in combination with pre-calculated simulations over a variety of human head models and positions.

15:30 ***3872*. SAR Monitoring and Pulse Design Workflow in Parallel Transmission at 7 Tesla**

Khaldoun Makhoul[1], Yik-Kiong Hue[1], Lohith Kini[2], Kawin Setsompop[1], Joonsung Lee[2], Kyoko Fujimoto[1], Elfar Adalsteinsson[2,3], Lawrence Leroy Wald[1,3]

[1]A. A. Martinos Center for Biomedical Imaging, Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Charlestown, MA, United States; [2]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States; [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

The use of parallel transmission requires additional care to avoid exceeding local SAR limits. SAR calculation must be done for each RF pulse designed while the subject is in the scanner. An integrated software tool for SAR monitoring provides a means of performing B_1^+ mapping, RF pulse design and SAR checking in a simple workflow, emphasizing patient safety. Using pre-calculated E_1 fields, and performing the SAR calculation on a consumer-level graphics processor, computation times on the order of minutes are achieved.

Tuesday 13:30-15:30 Computer 48

13:30 ***3873*. Towards Patient-Specific SAR Calculation for Parallel Transmission Systems**

Ingmar Graesslin[1], Shumin Wang[2], Sven Biederer[3], Giel Mens[4], Bjoern Annighoefer[5], Hanno Homann[1], Jeff Duyn[2], Paul Harvey[4]

[1]Philips Research Europe, Hamburg, Germany; [2]NINDS, National Institutes of Health, Bethesda, MD, United States; [3]Institute of Medical Engineering, University of Lübeck, Lübeck, Germany; [4]Philips Healthcare, Best, Netherlands; [5]TU Hamburg-Harburg, Hamburg, Germany

In parallel transmission, safety assessment via the specific absorption rate (SAR) is non-trivial, since local SAR distributions depend on the individual patient anatomy and on the multi-channel excitation. In general, patient safety can be achieved by carrying out simulation-based SAR calculations and by monitoring the deviation from the desired waveform. Typically, SAR calculations rely on generic patient models and on evaluation of worst-case scenarios. Patient-specific SAR calculations allow a more efficient exploitation of the respective limits and can improve imaging performance. This paper presents the general concept of patient-specific SAR calculations and describes the implementation of the real-time SAR computation.

14:00 ***3874*. Patient-Specific SAR Models and in Vivo Validation**

Hanno Homann[1], Ingmar Graesslin[2], Holger Eggers[2], Kay Nehrke[2], Peter Börnert[2], Olaf Dössel[1]

[1]Karlsruhe University, Karlsruhe, Germany; [2]Philips Research, Hamburg, Germany

Dielectric body models are increasingly used for safety assessment of the local specific absorption rate (SAR). In this work, a new method for the generation of dielectric body models from MR images was developed. The method is based on a water-fat-separation of MR images and an expectation-maximization (EM) segmentation of the 2D histogram. Models of five subjects in different body poses were generated and simulated using the finite-differences time-domain (FDTD) method. Validation of the simulated fields against measured B1 field maps was performed.

14:30 ***3875*.** **Effects of Head Size and Position on SAR**

Mikhail Kozlov[1], Robert Turner
[1]Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Sachsen, Germany

We investigated effects of head size and position on SAR for a commercially available Rapid BioMed 7 T 8-element head coil. For this coil axial rotation of the head can be considered safe, if the distance to lumped capacitors is more than 20 mm. It is more dangerous to use this coil with the head only partly inserted. The total head SAR should be considered as the important safety limit, because the 3.2 W/kg whole head SAR limit is reached sooner than the 10W/kg local SAR limit.

15:00 ***3876*.** **Patient-Specific *in Vivo* Local SAR Estimation and Validation**

Tobias Voigt[1], Hanno Homann[1], Ulrich Katscher[2], Olaf Doessel[1]
[1]Institute of Biomedical Engineering, University of Karlsruhe, Karlsruhe, Germany; [2]Philips Research Europe, Hamburg, Germany

Local Specific Absorption Rate (SAR) is a major problem for high field MRI, particularly when using multiple transmit channels. In this study, a patient-specific estimation of local SAR based on B1 mapping is presented. Experimental results imaging healthy volunteers are validated using subject-specific FDTD simulations. It is found, that the presented approach yields a sufficiently accurate and patient-specific local SAR measurement.

Wednesday 13:30-15:30 Computer 48

13:30 ***3877*.** **RF Exposure and Resulting Temperature in the Fetus During MRI**

Jeff W. Hand[1], Yan Li[1], Jo V. Hajnal[1]
[1]Imaging Sciences Dept, Clinical Sciences Centre, Imperial College London, London W12 0NN, United Kingdom

SAR and temperature in a 26 week pregnant woman within a 64 MHz birdcage coil are predicted numerically. Heat transfer from fetus to placenta via the umbilical vein and arteries as well as that across the fetal skin/amniotic fluid /uterine wall boundaries is modelled. Fetal SAR and average temperature comply with international limits when maternal whole body SAR $\leq$2 W kg^{-1}, although maximum fetal temperature > 38^{o}C may result from continuous exposure over periods $\geq$7.5 minutes. However, assessment of risk posed by the maximum temperature predicted in a static model is difficult in view of frequent fetal movement.

14:00 ***3878*.** **SAR Evaluation of Whole-Body Pregnant Woman Models at Different Gestational Stage and Position in MRI Birdcage Coil**

Zhangwei Wang[1], Desmond Yeo[2], George Xu[3], Jason Jin[1], Fraser J. Robb[1]
[1]GE Heathcare Coils, Aurora, OH, United States; [2]GE Global Research, Niskayuna, NY, United States; [3]Rensselaer Polytechnic Institute, Troy, NY, United States

A set of high-resolution whole body pregnant woman models at three gestational stages(3, 6 and 9 months) was adopted to investigate the SAR distribution at different position and field strength. The highest SAR is occurred in the mother's peripheral tissues in all pregnancy phase. And the maximum local SAR of the fetus is over IEC limitation in some cases. The results show that the local maximum SAR1g and SAR10g can be better indications as limitation factor other than the whole body average SAR

14:30 ***3879*.** **Numerical Simulation of SAR for 3T Whole Body Coil: Effect of Patient Loading Positions on Local SAR Hotspot**

Xin Chen[1], Yoshinori Hamamura[1], Michael Steckner[1]
[1]Toshiba Medical Research Institute USA, Inc., Mayfield Village, OH, United States

Previous studies have shown that local SAR levels (hotspots) are much higher than whole body average SAR with a whole body transmit coil. Local SAR hotspots depend on many factors such as tissue heterogeneity, body habitus, and patient imaging position. This abstract extends previous 3T whole body SAR simulations with chest and abdomen imaging positions to five other common positions. Results show that 1) the SAR distribution varies significantly between imaging positions, and 2) the ratios of local SAR hotspot to whole body average SAR can be over 4x higher than previously reported. While temperature increase is the key safety concern, understanding SAR distribution is an important factor in patient safety.

15:00 ***3880*.** **SAR Comparison for Multiple Human Body Models at 1.5T and 3.0T**

Zhangwei Wang[1], Desmond Yeo[2], Christopher M. Collins[3], Jason Jin[1], Fraser J. Robb[1]
[1]GE Heathcare Coils, Aurora, OH, United States; [2]GE Global Research, Niskayuna, NY, United States; [3]The Pennsylvania State University, Hershey, PA, United States

High-resolution heterogeneous human body models are used increasingly in field calculations for MRI engineering and safety assurance. In this study, we modified six currently available male and female models and adapt to commercial finite-difference time-domain software. Calculations show that the human body shape and position have big effect on SAR distribution.

Thursday 13:30-15:30 Computer 48

13:30 ***3881***. **MRI-Based Temperature and SAR Mapping with a New Dual-Coil Solenoid/Birdcage Heating/Measurement System**

Sukhoon Oh[1], Colin A. Roopnariane[2], Mohammad-Reza Tofighi[2], Christopher M. Collins[1]
[1]PSU College of Medicine, Hershey, PA, United States; [2]Engineering and Technology, Penn State University, Middletown, PA, United States

For evaluation of techniques for measuring heating related to specific absorption rate (SAR) in MRI, these can be advantageous to having independent control of heating and measurement coils. We describe an MRI-based method for mapping temperature and SAR using a solenoid coil and a birdcage coil for heating and imaging, respectively. The accuracy and quality of SAR/temperature mapping are enhanced by separating the heating and imaging coils. The MR-based temperature measurements were in good agreement with fiber-optic measurements. The dual-coil heating system was simulated using the finite-difference time-domain method. The distribution of numerically-calculated and experimentally-acquired SAR were in good agreement.

14:00 ***3882***. **Influence of Non-Conductive Probes on Specific Absorption Rate**

Sukhoon Oh[1], Christopher M. Collins[1]
[1]PSU College of Medicine, Hershey, PA, United States

Recently, there are an increasing number of interventional studies in which minimally invasive procedures are performed using MRI guidance using thin and precisely controlled devices and sensors. The influence of non-conductive devices on the specific absorption rate (SAR) in surrounding tissues are rarely investigated compared to studies investigating safety issues of metallic probes and devices. Here, we show that even non-conductive probes, in our case fiber optic thermal sensors, can have notable effects on SAR. Numerical calculations, based on the finite-difference time-domain (FDTD) method at 3 T, clearly show increased SAR around the non-conductive probes in a conductive phantom.

14:30 ***3883***. **Reduction of RF Heating of Metallic Devices Using Transmit Arrays**

Yigitcan Eryaman[1], Taner Demir[1], Ergin Atalar[1]
[1]UMRAM,National Research Center for Magnetic Resonance,Department of Electrical Engineering, Bilkent Univesity, Ankara, Turkey

In this work shown it is shown that RF heating due to metallic devices in MRI can be reduced with Transmit Arrays. Additionally whole body average SAR can be reduced without sacrificing homogeneity.

15:00 ***3884***. **On the SAR Averaging Nature of Parallel Excitation Pulses and Its Impact on Conservative Worst-Case Analysis**

Stefanie Buchenau[1], Martin Haas[1], Jürgen Hennig[1], Maxim Zaitsev[1]
[1]Department of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

To assure patient safety during parallel excitation experiments, monitoring of the RF pulses is necessary. If no additional hardware is available that measures RF phases a common approach is a conservative worst-case analysis that assumes absolutely constructive interference of the electric fields. This work shows that due to the varying phase settings during a parallel excitation pulse, worst-case SAR that may occur for single time steps is averaged over the pulse duration. This still holds true if the designed RF pulse is erroneously executed. Therefore conservative worst-case analysis overestimates SAR and it is possible to relax RF power limits that are based on this worst-case analysis.

Safety: Implants & Devices

Hall B Monday 14:00-16:00 Computer 49

14:00 ***3885***. **Prediction of Implant Tip Heating Using Modified Transmission Line Method (MoTLiM) Under MRI**

Volkan Acikel[1,2], Burak Akin[2], Ibrahim Mahcicek[2], Ergin Atalar[1,2]
[1]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey; [2]UMRAM, Ankara, Turkey

MRI examination of patients with medical implants has risks due to RF field. RF heating of implant lead tips can cause tissue burns. Although this problem has been examined several times both by experimentally and computer simulations there is not an analytical solution exists. In our study we used MoTLiM, which solves induced currents on leads analytically, to calculate implant tip heating. Then we compare it with experimental methods. According to these calculations we saw that MoTLiM is accurate enough to calculate implant tip heating. As MoTLiM gives analytical results for problem a deeper understanding of problem can be achieved.

14:30 *3886*. **Safety in Simultaneous EEG-FMRI: Temperature Changes of the Electrodes in a Phantom and a Volunteer Study**

Linda Kuusela[1,2], Sampsa Turunen[1,3], Outi Sipilä[1]
[1]HUS Helsinki Medical Imaging Center, Helsinki (HUS), Finland; [2]Department of Physics, Univeristy of Helsinki, Helsinki, Finland; [3]Department of Physics, University of Helsinki, Helsinki, Finland

An EEG-fMRI protocol is being developed at the Helsinki Medical Imaging Center to aid in the pre-surgical evaluation of patients with epilepsy. The purpose of this study was to study the heating of the electrodes with our protocol. Phantom and volunteer studies were performed, by measuring the temperatures of the EEG-electrodes in a 3T MRI scanner. A maximum temperature increase of 4.1 and 1.0º C was observed for a T2-TSE sequence in the phantom and the volunteer study, respectively. The temperature increase was found to be within safe limits to perform simultaneous EEG-fMRI patient studies with our protocol.

15:00 *3887*. **Magnetic and RF Characterization of Stents Using Magnetic Resonance Imaging**

Karl-Heinz Herrmann[1], Anne Rösler[2,3], Andreas Hansch[4], Stefan OR Pfleiderer[5], Jürgen R. Reichenbach[2]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital , Jena, Thüringen, Germany; [2]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Thüringen, Germany; [3]Department of Medical Engineering and Biotechnology, University of Applied Sciences, Jena, Germany; [4]Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany; [5]Central Institute for Diagnostics and Nuclear Medicine, Clinical Center Bremerhaven-Reinkenheide, Germany

While some manufacturers provide MR compatibility certifications for stents, the actual imaging artifacts after implantation may still vary widely. To assess and predict imaging artifacts produced by implanted stents, characterization of both, magnetic and rf properties, is necessary. In this study effective susceptibilities and maps of the flip angle distribution were determined from MR imaging data for different stent types.

15:30 *3888*. **A FMRI Compatible Thumb Actuator for Stroke Patients**

Ewa Piatkowska-Janko[1], Grzegorz Goworek[1], Artur Handke[2], Tomasz Wolak[3], Maciej Krawczyk[4], Piotr Bogorodzki[1]
[1]Institute of Radioelectronics, Warsaw University of Technology, Warsaw, Poland; [2]Wroclaw University of Technology, Poland; [3]Institute of Physiology and Pathology of Hearing, Poland; [4]Institute of Psychiatry and Neurology, Poland

In order to overcome limitations of fMRI for disabled patients we propose a pneumatical mechanical system helping them in fMRI motor stimulation paradigms. Results for group of healthy volunteers right and left handed were preset. Preliminary results for patient monitoring during rehabilitation time were also presented.

Tuesday 13:30-15:30 Computer 49

13:30 *3889*. **Safety in EEG-MRI: Heating Beneath EEG Scalp Electrodes for Different RF Transmit Coils**

Ulrike Nöth[1], Helmut Laufs, [1,2], Robert Stoermer[3], Ralf Deichmann[1]
[1]Brain Imaging Center (BIC), Goethe University Frankfurt am Main, Frankfurt am Main, Germany; [2]Department of Neurology, Goethe University Frankfurt am Main, Frankfurt am Main, Germany; [3]Brain Products GmbH, Gilching, Germany

The heating beneath eight EEG scalp electrodes during simultaneous EEG-MRI acquisition was measured in vivo, using various MR sequences covering a wide range of SAR values. RF transmission was performed with a head and a body coil in comparison. Temperature increases beneath the electrodes were stronger and more frequent for the body coil, and fitted equilibrium temperatures reached the critical level of 41°C for high SAR sequences. This is of special interest as many scanners are not routinely equipped with a head transmit coil.

14:00 *3890*. **The Compatibility of Temporary Pacemaker Leads with Magnetic Resonance Imaging – an Ex Vivo Tissue Study**

Reinhard Rzanny[1], Andreas Hansch[2], Alexander Pfeil[3], Alexander Gussew[1], Stefanie Drobnik[4], Jürgen R. Reichenbach[5]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany; [2]Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany; [3]Department of Internal Medicine III, Jena University Hospital, Jena, Germany; [4]Department of Cardiothoracic Surgery, Jena University Hospital, Jena, Germany; [5]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany

The presence of pacemaker leads is considered to be a safety contraindication for MRI. To measure heating effects at the tip of temporary pacemaker leads, the frequency shift of water was estimated by single voxel 1H-MRS. The temperature dependence of the water frequency in the myocardial tissue was estimated in prior preliminary experiments during 3 warming and cooling cycles of a heart between 20 and 40°C. As a result of applying several MR imaging sequences on 12 pig hearts with implanted temporary pacemaker leads in a whole body MRI (1.5 T), no substantial heating was observed.

14:30 ***3891***. **Impact of Imaging Landmark on RF-Induced Heating of Cardiac Pacemakers and Other Medical Devices in MRI**

Peter Nordbeck[1,2], Oliver Ritter[1], Ingo Weiss[3], Daniel Gensler[2], Marcus Warmuth[2], Volker Herold[2], Peter M. Jakob[2], Mark E. Ladd[4], Harald H. Quick[5], Wolfgang R. Bauer[1]
[1]Internal Medicine I, University of Würzburg, Würzburg, Germany; [2]Experimental Physics V, University of Würzburg, Würzburg, Germany; [3]Biotronik GmbH & Co. KG, Berlin, Germany; [4]Diagnostic and Interventional Radiology, University of Duisburg-Essen, Essen, Germany; [5]Medical Physics, University Erlangen-Nürnberg, Erlangen, Germany

The purpose of this study was to further assess the impact of the imaging landmark on the risk for unintended MRI-induced implant heating by measuring the RF-induced electric fields in a body phantom under several imaging conditions at 1.5 T in 3 different scanners. The results show that global RF coupling is highest with the torso centered along the superior-inferior direction of the transmit coil. The induced E-fields inside the body shift when changing body positioning. Potential hazards can be reduced by adequate selection of MR imaging landmark in patients with implanted medical devices.

15:00 ***3892***. **Thermal and Electrical Characterization of PAA and HEC Gel Used in MRI Testing of Active and Passive Medical Implants**

Holly Moschiano[1], Warren Dabney[1], Robert S. Johnson[1], Lana Placek[1]
[1]Greatbatch Medical, Clarence, NY, United States

Polyacrylic acid (PAA) gel has been used historically as the phantom material in MRI testing of passive and active medical implants. However, PAA exhibits undesirable variability in bulk electrical and thermal properties due to the presence of crystallites. Hydroxyethyl Cellulose (HEC) gel has been referenced in the most recent version of ASTM F 2182-02a as an acceptable substitute for PAA gel. HEC gel has similar electrical, thermal, and materials properties as PAA gel. Variations in electrical conductivity and specific heat capacity can greatly affect the amount of temperature rise seen in a test phantom in an MRI environment.

Wednesday 13:30-15:30 Computer 49

13:30 ***3893***. **Insulation, Lead-Length, and Sample-Size Affect the MRI-Safety of Implanted Leads**

Ananda Kumar[1], Perry Karmarkar[1], William A. Edelstein[1], Paul A. Bottomley[1]
[1]Suite B307, 1101 E 33rd Street, SurgiVision Inc, Baltimore, MD, United States

Concerns about RF heating of implanted devices precludes MRI for many patients who could otherwise benefit. Implanted leads are insulated and vary in length, depending on function and patient size. We investigated experimentally and theoretically the local specific absorption rate (SAR) and heating of leads as a function of sample size, lead length, and insulation thickness in gel phantoms exposed to 4W/kg at 1.5T. Heating and SAR are maximum at the bare electrode, increasing with lead insulation thickness and sample size. SAR is highly nonuniform so sensor sampling volume is critical for matching local theoretical SAR with measured temperature changes.

14:00 ***3894***. **Effect of Linear Phase Electric Field Variation on Implant Lead Heating**

Yigitcan Eryaman[1], Volkan Acikel[1], Esra Abaci Turk[1], Nikolay Vladimirovic Viskusenko[1], Ergin Atalar[1]
[1]UMRAM,National Magnetic Resonance Research Center,Department of Electrical Engineering, Bilkent Univesity, Ankara, Turkey

In this work it is shown that a helical lead experiences a linear phase electric field variation in a typical quadrature birdcage coil. It is demonstrated that the effect of linear phase excitation maximizes heating at one tip and minimizes the heating at the other one.

14:30 ***3895***. **Changing Boundary Conditions: Effects on Catheter Heating**

Samuel O. Oduneye[1], Sudip Ghate[2], Kevan JT Anderson[1], Graham A. Wright[1]
[1]Medical Biophysics, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada;
[2]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

During an MRI examination induced radio frequency (RF) currents on electric conductors, such as electrode lines within catheters, may cause heating in surrounding regions .The objective of this study was to investigate the effects of RF induced heating as a result of changing boundary conditions at the point of connection of a catheter to the MR-guided clinical system. In our setup, the termination represents a sudden change of impedance, an additional reflection point, where heating occurs; both simulation and experimental results show that this point alters significantly the current along the wire, the overall reflection coefficient and heating properties.

15:00 ***3896*. On the Heating of Small Inductively Coupled RF Coils Mounted on an Intravascular Model Catheter During MR Imaging**

Harald Busse[1], Gregor Thörmer[1], Nikita Garnov[1], Jürgen Haase[2], Thomas Kahn[1], Michael Moche[1]
[1]Diagnostic and Interventional Radiology, Leipzig University Hospital, Leipzig, Germany; [2]Physics and Geosciences Department, Leipzig University, Leipzig, Germany

Applications in interventional MR angiography would potentially benefit from a safe and reliable localization of guidewires and catheters. Small inductively coupled RF coils have already been suggested or used as MR-visible markers for various purposes. When using such markers inside the body, however, inductively coupling during RF-intense MRI may pose a safety hazard. We have therefore investigated RF-exposed markers mounted on an intravascular model catheter and submerged in a vessel phantom under different flow conditions. While a considerable but small heating (<1°C) was observed under extreme conditions without flow, a negligible heating (<0.1°) was observed under a small volume flow.

Thursday 13:30-15:30 Computer 49

13:30 ***3897*. Safe Deep Brain Stimulator MR Imaging Experiments Using Fiber Optic Current Monitoring Feedback System**

Haydar Celik[1,2], Namik Sengezer[3], Burak Akin[2], Dogac Mehmet Gulnerman[3], Burcu Cingoz Insal[4], Can Kerse, [23], Ergin Atalar, [23]
[1]Electrical and Electronics Engineering, Bilkent University , Ankara, Turkey; [2]National Magnetic Resonance Research Center (UMRAM), Ankara, Turkey; [3]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey; [4]Moleculer Biology and Genetics, Bilkent University, Ankara, Turkey

MRI has been used to image deep brain stimulator (DBS) lead and fMRI studies have been conducted in order to understand stimulation profiles of the electrodes. Both placement and functionality of the lead are vital. However, DBS leads may cause severe results because of the RF and gradient fields. Previously, a fiber optic signal transmission system was presented by authors. In this study, an important extension is proposed in order to maximize safety profile of the system. Proposed feedback mechanism enables monitoring of the induced current to the brain. Any rise or fall of the current is a possible reason of changing conductivity due to RF heating. Therefore, monitoring this quantity provides opportunity for better safety profile. In this study, in-vivo and in-vitro safety experiments have been conducted.

14:00 ***3898*. Skin Injury Experienced During MRI Scans: Measurements of Body Coil Electric Field**

Sunder S. Rajan[1], Marta Zanchi[2], Howard Bassen[3], Paul Hardy[4], Joshua Gaug[3]
[1]Div of physics, fda/cdrh/osel, Silver Spring, MD, United States; [2]Stanford University; [3]FDA/CDRH/OSEL; [4]FDA/CDRH/ODE

The aim of this study is to evaluate the incidence of skin-injuries caused by contact with the magnet-bore and to explore whether the electric-fields are responsible. The FDA database was searched for events. Skin-injuries increased from 5-67 cases /yr between 1998-2009. A significant fraction was from contact with magnet-bore. The E-field at the wall of a stand-alone body-coil was measured using three devices. The E fields in air showed peaks in the vicinity of the capacitors. The field values decreased with distance from the capacitors. The maximum values with 20W CW in air were 3.0, 2.04 at wall and 0.95KV/m at 2 cm.

14:30 ***3899*. Brain Tissue Response to Chronically Implanted NMR Microcoils**

Aziz Kadjo[1], Jean-christophe Brisset[1], Minh-Dung Hoang[1,2], Patrick Poulichet[3], Colette Rousset[4], Abdennasser Fakri[3], Youssef Z. Wadghiri, Marlène Wiart[1], Lionel Rousseau[3], Raymond Cespuglio[4], Andre Briguet[1], Danielle Graveron-Demilly[1], Latifa Fakri-Bouchet[1]
[1]Université Lyon1, CREATIS-LRMN CNRS UMR 5220, INSERM U630, Villeurbanne, France; [2] NYU, New York University, School of Medicine, Center for Biomedical Imaging, 10016 NY, United States; [3]ESIEE Paris, Lab. de Technologie avancée en microélectronique ESYCOM,EA 2552, Noisy Le Grand, France; [4]Université Lyon1, Lab. «Radicaux libres/substrats énergie et physiopathologie cérébrale.» EA 4170, Lyon, France

New generation of implantable microcoils proposed for localized spectroscopic studies of NMR observable cerebral metabolites into 2mm3 region of interest Latero Dorsal Tegumentum (LDT), aims at pushing limits of in vivo detection. However microantenna active part introduction into the brain can generate irreversible damage and inflammation that can distort spectroscopic measurements. This longitudinal study was performed on two healthy cohorts of implanted and control rat via MRI and confirmed by histopathology. The results show brain tissue response against implantable NMR microcoil and demonstrate the limited brain tissue reaction associated to the chronic microcoils implantion.

15:00 ***3900*. Technical and Safety Aspects in Concurrent TMS/fMRI**

Paolo Ferrari[1], Luigi Cattaneo[1], Jens Volkmar Schwarzbach[1], Marco Sandrini[1], Jorge Jovicich[1]
[1]Center for Mind/Brain Sciences, University of Trento, Mattarello, Trento, Italy

Transcranial magnetic stimulation (TMS) is an important method for cognitive neuroscience research in noninvasive stimulation of the human cortex combined with fMRI. The high magnetic field strength of modern MRI scanners imposes several limitations and

challenges for its simultaneous combination with TMS. Our goal was to investigate technical and safety aspects in concurrent TMS/fMRI: 1) temperature characterization of the TMS coil, 2) synchronization procedure for TMS stimulation in concurrent TMS/fMRI. The implementation of the thermal curve help the planning of the TMS/fMRI protocols. With the external control system is possible to minimize the risk for patient and the scanner.

Intraluminal, Micro & Cryo Coils

Hall B Monday 14:00-16:00 Computer 50

14:00 ***3901*. Inductively Coupled Birdcage Coil**

Haydar Celik[1,2], Dogac Mehmet Gulnerman[3], Burak Akin[2], Ergin Atalar, [23]

[1]Electrical and Electronics Engineering, Bilkent University , Ankara, Turkey; [2]National Magnetic Resonance Research Center (UMRAM), Ankara, Turkey; [3]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey

Although birdcage coils are essential elements of modern MRI scanners, they have never been miniaturized for placement inside body orifices such as the rectum and used as inductively coupled coil elements. In this study, inductively coupled birdcage coil (ICBC) and receive coupled birdcage coil (RCBC) are introduced as internal coil. These coils can be used without modifying the scanner hardware and do not affect tuning of external coils. ICBC coils are not connected to the scanner by wires; rather the MR signal picked up by these coils is transferred to a receiving coil by induction. Therefore, they are system independent.

14:30 ***3902*. SNR and B1 Homogeneity Analysis of Intra-Vascular/Cavity RF Coil Designs**

Scott B. King[1], Jesse Bellec[2], Vyacheslav Volotovskyy[1], Hung-Yu Lin[1], Christopher P. Bidinosti[2], Krzysztof Jasinski[3], Mike J. Smith[1], Boguslaw Tomanek[4]

[1]Institute for Biodiagnostics, National Research Council of Canada, Winnipeg, Manitoba, Canada; [2]Department of Physics, University of Winnipeg, Winnipeg, Manitoba, Canada; [3]Department of Magnetic Resonance Imaging, Polish Academy of Sciences, H. Niewodniczanski Institute of Nuclear Physics, Krakow, Poland; [4]Institute for Biodiagnostics (West), National Research Council of Canada, Calgary, Alberta, Canada

High spatial resolution vessel/cavity wall MRI requires a signal-to-noise ratio much higher than can be achieved using external phased array coils, so intravascular RF coils are used directly adjacent to the vessel of interest. Concentric birdcage designs are interesting in that they maintain the longitudinal SNR coverage, but also demonstrate some radial homogeneity albeit with azimuthal asymmetries that may not be ideal. Multi-turn crossed loops are another good design retaining the forward looking capability and orientation independence previously reported, but now with good longitudinal SNR coverage. These designs may offer alternatives to the low SNR opposed solenoid design.

15:00 ***3903*. Coil Design for Imaging the Uterine Cervix at 3T. Control of R.f. Eddy Currents.**

David John Gilderdale[1,2], Maria Angelica Schmidt[1], Nandita Maria deSouza[1]

[1]Cancer Research UK & EPSRC Cancer Imaging Centre, Institute of Cancer Research & Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [2]Pulseteq Ltd, Wotton-under-Edge, Gloucestershire, United Kingdom

A single-turn enveloping solenoid receive-only coil can produce significant shielding of the excitation field. This effect is independent of currents circulating around a resonant loop, which are normally removed with a suitable blocking circuit. The B1 distortion resulting from these extraneous r.f. eddy currents is demonstrated by EM simulation and also by MR imaging. A simple multi-turn modification to the structure is investigated and shown virtually to eliminate the field distortion.

15:30 ***3904*. Design of a Double Tuned TxRx ^{1}H/ ^{31}P Endorectal Prostate Coil for 7T**

Mark J. van Uden[1], Andor Veltien[1], Tom W.J. Scheenen[1], Arend Heerschap[1]

[1]Radiology, Radboud University Nijmegen Medical Center, Nijmegen, Gelderland, Netherlands

The use of an endorectal 31P coil at high magnetic field strength might provide opportunities to sample signals from energy and phospholipid compounds with a clinically relevant spatial resolution in the prostates of patients with prostate cancer. We present a double tuned coil concept that can be fit inside the housing of an endorectal balloon coil design so that it can be positioned close to the organ for optimum receive performance. The double tuned coil design was built and tested for SNR in comparison with two single resonant coils (1H and 31P).

Tuesday 13:30-15:30 Computer 50

13:30 ***3905*. Inductive and Dielectric Tuning Techniques for High-Sensitivity Miniature Monolithic Surface Coils.**

Jean-Clément Guisiano[1,2], Simon Lambert[1], Souhil Megherbi[2], Jean-Christophe Ginefri[1]

[1]U2R2M, Orsay, France; [2]IEF, Orsay, France

Dedicated tuning techniques for high-sensitivity miniature monolithic coils are needed. Inductive and dielectric tuning techniques were investigated using experimental measurements, analytical model or numerical simulations. Maximum frequency shifts of 15.3% for the inductive tuning and 9.9% for the dielectric tuning were reported. A mean deviation of 1% between experiments and the proposed inductive model and 2% between experiments and simulations for the dielectric tuning were achieved. The influence of both

technique on the quality factor was discussed. A piezoelectric-based displacement device was proposed to perform a precise positioning of a tuning element and a fine resonance frequency control.

14:00 ***3906*.** **Development of Multilayer Coil Using Non-Planar MEMS Process for Intraluminal MRI Probe**

Shizuo Ichimura[1], Wei Quan[2], Tadao Matsunaga[2], Yuichiro Matsuoka[3], Kagayaki Kuroda[4], Yoichi Haga[2]
[1]KANEKA Corporation, Settsu, Osaka, Japan; [2]Graduate School of Biomedical Engineering, Tohoku University, Sendai, Miyagi, Japan; [3]Graduate School of Medicine, Kobe University, Japan; [4]Dept. of Human & Information Science, Tokai University, Japan

Intraluminal MRI probe holds promise to achieve high resolution image of small pathological lesion such as the vessel plaque comparing to the conventional MRI scanner. The MR signal receive coil is expected to be characterized by high signal-noise-ratio (SNR), good signal homogeneity and small size. By employing the developed photolithography technology on cylinder substrates, the MRI receive coil for the intraluminal application can be fabricated arbitrarily with the accurate and optimized shape. Comparing to previous single layer coil, this study presents the design of the multilayer receive coil for improving the imaging performance.

14:30 ***3907*.** **B1 and B0 Mapping of a Micro Helix Coil at 9.4T**

Mohammad Mohammadzadeh[1], Hans Weber[1], Nicoleta Baxan[1], Vlad Badilita[2], Julian Maclaren[1], Jurgen Hennig[1], Dominik v. Elverfeldt[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Dept. of Microsystems Engineering-IMTEK, University of Freiburg, Freiburg, Germany

In this study the performance of a five turns micro helix coil wound on an SU8 cylinder, was evaluated by mapping its 2D B1 and B0 fieldâ€™s distribution. These tests are done inside doped water phantom, on a 9.4T using 3D GE sequences. B1 maps are acquired using multi flip angle MFA method and B0 mapping are performed by measuring frequency deviation inside a doped water phantom. In General, Results show that coil has enough SNR and provides minimum frequency deviation and maximum B1 uniformity across the sample and particularly at the coil center.

15:00 ***3908*.** **Systematic Characterization of Small Inductively Coupled Radiofrequency Coils as MR-Visible Markers at 1.5T**

Nikita Garnov[1], Gregor Thörmer[1], Wilfried Gründer[2], Robert Trampel[3], Michael Moche[1], Thomas Kahn[1], Harald Busse[1]
[1]Diagnostic and Interventional Radiology, Leipzig University Hospital, Leipzig, Germany; [2]Institute of Medical Physics and Biophysics, University of Leipzig, Leipzig, Germany; [3]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Small inductively coupled RF coils in solenoid design were systematically evaluated as MR-visible markers at 1.5T. Coil performance was assessed for different flip angles, ±240 mm translations from the isocenter, and tilting of the coil axis with respect to the transverse plane using a balanced SSFP sequence. Marker contrast was highest at very low FAs (0.2°-0.6°) and was also sufficiently high for automatic marker detection throughout the entire FOV and for tilt angles up to 55°. Coil heating was measured during 10-minute RF expositions using different clinical pulse sequences (SAR<2 W/kg) and found to be tolerable (<5°C) for extracorporal application.

Wednesday 13:30-15:00 Computer 50

13:30 ***3909*.** **A Novel Nanomaterial Coil for High Resolution Prostate Imaging**

Raju Viswanathan[1], Bradley Goldstein[1], Kevan Anderson[2], Axel Krieger[3]
[1]Tursiop Technologies, LLC, Cleveland, OH, United States; [2]Sunnybrook Health Sciences Center, University of Toronto, Toronto, Ontario, Canada; [3]Sentinelle Medical Inc., Toronto, Ontario, Canada

An emerging RF coil technology based on a new nanostructured material was recently introduced. This material can be macroscopically configured in a mechanically robust ribbon or string form comprised of carbon nanotubes. The material can provide a combination of increased inductance and reduced resistance that permits building MR receive coils with enhanced SNR. Here this is explicitly demonstrated in a prototype prostate imaging "nanocoil" that was built to fit into a commercial endorectal prostate imaging probe. It is shown that with a single channel nanocoil, SNR profiles similar to those from a standard but advanced dual-channel array can be generated.

14:00 ***3910*.** **Investigation of Decoupling Techniques for Two-Element Cryogenic Arrays**

Jarek Wosik[1,2], Leiming Xie[1], Lian Xue[3], Krzysztof Nesteruk[4], Kurt H. Bockhorst[3], Ponnada A. Narayana[3]
[1]Electrical and Computer Engineering, University of Houston, Houston, TX, United States; [2]Texas Center for Superconductivity, Houston, TX, United States; [3]Diagnostic and Interventional Imaging, University of Texas, Health Science Center-Houston Medical School, Houston, TX, United States; [4]Institute of Physics Polish Academy of Sciences, Warsaw, Poland

In order to address constrains regarding low loss decoupling techniques for application in high-Q cryogenic arrays, we evaluated and compared SNR gain from cooling to liquid nitrogen temperatures of 2x1 array at 7 Tesla for three different decoupling methods. Beside standard overlapping approach we have also used "eight shape" loop and capacitive decoupling techniques. Calculations and

experimental results showed the best performance (two fold SNR gain) of the array with capacitive decoupling. The “eight shape” loop decoupled array showed only a few percent lower SNR gain, whereas the geometrical decoupling technique had reduced SNR gain by close to 20%.

14:30 ***3911*. High Resolution Mouse Imaging Using a Liquid Nitrogen Cooled Receive Only Coil on a 3T Clinical Scanner**

Bobo Hu[1], Gopal Varma[2], Stephen Keevil[2], Chris Randell[3], Paul Glover[4]
[1]Sir Peter Mansfield Magnetic Resonance Centre , University of Nottingham, Nottingham, United Kingdom; [2]St Thomas¡¯s Hospital, Kings College, London, United Kingdom; [3]Pulseteq Ltd., Wotton-under-Edge, Gloucestershire, United Kingdom; [4]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, United Kingdom

The performance of a liquid nitrogen cooled receive-only copper coil to acquire micron scale high resolution mouse imaging on a 3T whole body scanner is investigated. In this work a novel cryostat design, which provides easy access for small animal samples, is described. The receive coil is a 2 cm diameter copper coil with active decoupling during transmission. The Q factor of the coil has been enhanced by 60% after cooling down for 1 hour to reach 120 K, and the SNR performance has increased by 2 fold compared with the room temperature version of the same coil.

Thursday 13:30-15:30 Computer 50

13:30 ***3912*. Experimental MRI Evidence of the Lift-Off Effect in the Case of a Small High Temperature Superconducting Coil.**

Jean-Christophe Ginefri[1], Marie Poirier-Quinot[1], Luc Darrasse[1]
[1]Unité de Recherche en Résonance Mgnétique Médicale, CNRS-Université Paris-Sud, Orsay, France

The optimization of the SNR achievable with a small High Temperature Superconducting (HTS) surface coil is investigated as a function of the sample size and position using theoretical analysis, inductive measurements, and MRI experiments at 1.5 T. This study was conducted with a 6mm HTS coil operating at 77 K and small conductive saline phantoms. SNR measured on phantom images are in good agreement with theoretical data and inductive measurements and demonstrate the existence of an optimal distance between the sample and the HTS coil for which the SNR is maximum and that depends on the loading configuration.

14:00 ***3913*. Whole Body Screening Using High-Temperature Superconducting MR Volume Coils:**

In-Tsang Lin[1], Hong-Chang Yang[2], Jyh-Horng Chen[1]
[1]Interdisciplinary MRI/MRS Lab, Department of Electrical Engineering, Graduate Institute of Biomedical Electronics and Bioinformatics, Taiper, 106, Taiwan; [2]Department of Physics, National Taiwan University, Taipei 106, Taiwan

Previous studies on HTS coils can be put into two categories: tape surface coils and thin-film surface coils[1-4]. In this study, we built a whole new Bi2Sr2Ca2Cu2O3 (Bi-2223) superconducting volume coil (length of 8 cm) designed for magnetic resonance image of the mice whole body at Bruker 3T MRI system. The HTS volume coil has 2.3 folds higher than of the HTS volume coil at 300K for a mice body screen.

14:30 ***3914*. Development of Stable Cryo Probe and HTS Helmholtz Coil for Clinical Application**

Jack Liu[1], C. W. Hu[1], Q. Y. Ma[1]
[1]Time Medical Inc., Shanghai, China

Development of HTS surface and Helmholtz coils for orthopedic imaging with improvement of both SNR and penetration depth.

15:00 ***3915*. A Long Duration High-Temperature Superconducting RF Platform**

In-Tsang Lin[1], Hong-Chang Yang[2], Jyh-Horng Chen[1]
[1]Interdisciplinary MRI/MRS Lab, Department of Electrical Engineering, Graduate Institute of Biomedical Electronics and Bioinformatics, Taiper, 106, Taiwan; [2]Department of Physics, National Taiwan University, Taipei 106, Taiwan

High-temperature superconducting (HTS) radio-frequency (RF) coil has been proposed as a promising tool for MR microscopy due to its zero-resistance characteristic for the MR probe design. However, the cryogenic system is very difficult to design due to its thermal insulation demands. In this study, we have succeeded to design a longitudinal dewar that can keep animal body temperature for more than three hours. A 40 mm in diameter Bi2Sr2Ca2Cu3Ox (Bi-2223) tape HTS RF coil with this dewar was demonstrated. The signal to noise gain is 3.79 compared to the copper coil with the same geometry at room temperature.

Coil Interfacing: LNA's, Baluns & Decoupling

Hall B Monday 14:00-16:00 Computer 51

14:00 ***3916*. Variation of Preamplifier Noise Figure with B_0 Field Strength**

Nicola De Zanche[1,2], Brodi Roberts, [1,2], B. Gino Fallone[1,2]
[1]Department of Medical Physics, Cross Cancer Institute, Edmonton, Alberta, Canada; [2]Department of Oncology, University of Alberta, Edmonton, Alberta, Canada

Preamplifier S parameters are known to vary with B_0 field strength and orientation. Variations in noise figure are also expected, but such data has not been reported until now. Here we present the variation of noise figure of a commercially available amplifier (MAR 8A+, Mini-Circuits, USA) at field strengths up to 9.4 T. The method allows arbitrary noise source impedances for complete noise parameter measurement, if desired. Variations in noise source power (ENR) with applied field are prevented by locating the noise source outside the field.

14:30 ***3917*. Automated Preamplifier Noise Parameter Measurement System Using a Combination Analyzer**

Brodi Roberts[1,2], B. Gino Fallone, [1,2], Nicola De Zanche, [1,2]
[1]Department of Oncology, University of Alberta, Edmonton, Alberta, Canada; [2]Department of Medical Physics, Cross Cancer Institute, Edmonton, Alberta, Canada

Optimal matching between each coil in an array and its respective amplifier requires knowledge of its noise parameters, which are rarely available from manufacturers at MRI frequencies. Measuring noise parameters is also needed to identify inter-device variability. The system we describe is based on a common combination spectrum / network analyzer, which, unlike noise figure analyzers, allows the measurement of S parameters. Corrections can thus be readily implemented for noise reflections at various stages of the system. The LabVIEW instrument control environment is used to automate calibration, measurement, and data processing.

15:00 ***3918*. High Input Impedance LNA with Passive Negative Feedback for High Field Imaging**

Cecilia Possanzini[1], Marco Boutelje[1], Rudolf Kunnen[1]
[1]MR Development, Philips Healthcare, Best, Netherlands

In this paper, we show the design of a high impedance amplifier using a passive negative feedback in order to improve manufacturability and reproducibility. The noise figure, gain, and stability of the preamplifier has been simulated with a non linear model and measured on different samples at 3T.

15:30 ***3919*. MRI Coil Stability**

Selaka Bandara Bulumulla[1], Wolfgang Loew[2], Christopher J. Hardy[1]
[1]GE Global Research, Niskayuna, NY, United States; [2]GE Global Research, Munich, Germany

MRI receiver chains that are carefully tuned and matched to operate at the Larmor frequency are often prone to oscillations at other, nearby frequencies. These oscillations degrade image quality, yet isolating and eliminating oscillations is a challenge in large arrays, and significantly add to development cycle. In this work, we develop methods to analyze and predict the stability of coil arrays given preamp data, coil/balun/feedboard circuits and geometry. The method is used to predict the stability of a coil array at the Larmor and nearby frequencies, for varying conditions of coil loading and preamp termination, and compared with experimental results.

Tuesday 13:30-15:30 Computer 51

13:30 ***3920*. An Automatic Impedance Matching System for Multiple Frequency Coils**

Sien Wu[1], Barbara L. Beck[2], Walker J. Turner[1], Rizwan Bashirullah[1], Thomas Mareci[3]
[1]Electrical and Computer Engineering, University of Florida, Gainesville, FL, United States; [2]McKnight Brain Institute, University of Florida, Gainesville, FL, United States; [3]Biochemistry and Molecular Biology, University of Florida, Gainesville, FL, United States

This Automatic Impedance Matching system is designed to tune and match multiple frequency coils in order to monitor multiple nuclei of an artificial pancreas for Type I diabetes. This system uses an impedance sensing circuit to measure the reflected signal of the coil at the frequency of interest and a microcontroller to tune and match the coil. A prototype of the Automatic Impedance Matching system described in this report successfully demonstrates the capability to tune and match a simplified double frequency coil, and the system design can be extended to multiple frequency coils.

14:00 ***3921*. Quarter Wave Multi Layer Cable Balun**

Victor Taracila[1], Vijayanand Alagappan[1], Aleksey Zemskov[1], Fraser Robb[1]
[1]GE Healthcare, Aurora, OH, United States

One of the critical problems coil designer confront is the parasitic current induced on the cables during transmit phase of the MRI sequence. During receive phase cables must not couple to the multiple coil elements, otherwise shading, oscillations and heating could occur. Typical method of reducing the current on cables is by utilizing cable baluns. In this work we try to accommodate the well-known quarter wave balun to the low frequencies without adding length to the signal transmission line and without adding any lumped circuit components.

14:30 **_3922_. Six Layers Stripline RF-Invisible Balun**

Victor Taracila[1], Aleksey Zemskov[1], Vijayanand Alagappan[1], Fraser Robb[1]
[1]GE Healthcare, Aurora, OH, United States

In the well-known preamplifier decoupling technique, a low input impedance preamplifier in series with an inductor attached to the matching capacitor is utilized. One of the problem of this design is the inductor's stray field and preamplifier's ground disturbance. When using a balun in front of the preamplifier, the transmission line from which the balun is composed creates the needed inductance. Also, providing high impedance on the outer shield of the balun, amplifier ground is kept unperturbed. In this work we present the RF-invisible balun based on double spiral inductor shape and its PCB implementation.

15:00 **_3923_. Design and Construction of an Actively Frequency-Switchable RF Coil for Fast Field-Cycling Magnetisation Transfer Contrast MRI**

Chang-Hoon Choi[1], Ioannis Lavdas[1], James M. S. Hutchison[1], David J. Lurie[1]
[1]Aberdeen Biomedical Imaging Centre, University of Aberdeen, Aberdeen, Scotland, United Kingdom

An off-resonance RF pre-saturation pulse is typically employed for magnetisation transfer contrast MRI. Measuring the magnetisation transfer (MT) effect as a function of magnetic field (B_0) may provide valuable. In order to conduct field-dependent MT experiments, two techniques are required. Firstly, B_0 should be switched between levels by fast field-cycling during irradiation of the saturation pulse, and secondly the resonance frequency of the resonator (f_0) should also be shifted simultaneously. Here, we constructed the frequency-switchable RF coil using PIN diodes. (f_0) is actively switched between five different values, with excellent impendent matching (about -40dB) and the Q-factor (approximately 80).

Wednesday 13:30-15:30 Computer 51

13:30 **_3924_. Optimizing Pin Diode Performance in Transceiver Coils**

Feng Zhou[1], Mirko I. Hrovat[2]
[1]Dept. of Physics, University of Massachusetts Lowell, Lowell, MA, United States; [2]Mirtech, Inc., Brockton, MA, United States

A simple parallel pin-diode configuration is demonstrated to provide better performance than traditional pin diode circuits in transceiver coils. With this configuration, there are no special requirements such as high power ratings or high break down voltages for selecting the pin-diode.

14:00 **_3925_. A High Dynamic Range Receiver for Improved Diffusion Tensor Imaging**

Wolfgang Gaggl[1], Andrzej Jesmanowicz[1], Robert W. Prost[1]
[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

Diffusion Tensor Imaging experiments require wide dynamic signal ranges, as they necessitate collecting an unweighted spin-echo image with a high intensity and a series of diffusion-weighted images with low intensities. Dynamic range increases with increasing the diffusion-weighting. Analog-digital converters with typical RF receivers have 16-bit resolution, while our system reaches over 20-bit. This is possible by direct-sampling the RF signal and downsampling it. Data from our receiver demonstrate superior signal-to-noise and diffusion-to-noise ratios and a dynamic range that is at least 4 bits wider than typical 16-bit receivers, shortening scanning durations and making it ideal for experiments with high diffusion-weighting.

14:30 **_3926_. An Orthogonality Based RF Decoupling Method**

Hua Wang[1], Bing Keong Joe Li[1], Adnan Trakic[1], Ewald Weber[1], Craig Engstrom[1], Yu Li[1], Stuart Crozier[1]
[1]School of ITEE, The University of Queensland, Brisbane, QLD, Australia

A conformal RF coil array design for use in a MRI system is proposed. In particular, the coil array is designed without the use of any cumbersome mutual decoupling schemes. Coil elements are designed based on orthogonality, which will naturally minimise the problematic mutual coupling effects inherently existed in most phased-array systems. A prototype of a knee coil constructed with this scheme is testified to be pertinent to Magic Angle applications. In addition, consistent imaging quality invariant to coil orientation with respect to B0, like B1 homogeneity, SNR and coil efficiency, can be obtained with the proposed orthogonality design.

15:00 **_3927_. Tunable Geometric Decoupling Mechanisms for Phased Array Coils**

Sahil P. Bhatia[1], Fraser J. Robb[2], Yiping Guan[2], Mary P. McDougall[1]
[1]Magnetic Resonance Systems Lab, Texas A & M University, College Station, TX, United States; [2]G.E. Healthcare, Aurora, OH, United States

Effective geometric decoupling between array elements becomes increasingly important when isolation preamplifiers are not available or employable, as is the case for certain field strengths and in the case of transmit array design. We present two methods of tunable geometric decoupling that allow the coil-to-coil decoupling to be adjustable and provide a straightforward mechanism for optimizing the overlap area. Bench measurements demonstrate the ability of both mechanisms to optimize decoupling between adjacent elements under a range of loading conditions, and imaging confirms that the addition of the mechanisms does not alter the field patterns or SNR of the coil elements.

Thursday 13:30-15:30 Computer 51

13:30 ***3928***. **Minimal Acceptable Blocking Impedance for RF Receive Coils**

Victor Taracila[1], Pei Chan[1], Fraser Robb[1]
[1]GE Healthcare, Aurora, OH, United States

During the transmit phase of the MR sequence the receiving coils are usually detuned to minimize body coil disturbance. This is typically achieved with passive or active decoupling parallel tank circuits which, when active, create very high impedance in coil elements so that the current induced into them is very small and does not affect the process of magnetization tipping. When planning the build of a coil, the magnitude and the number of decoupling boards required for every receive element needs to be considered. In this work we deduce a simple rule for quick evaluation of the required blocking impedance.

14:00 ***3929***. **Dynamic Modeling of Low Magnetic Moment PIN Diodes for MR Scanner Applications**

Robert Caverly[1], Ronald Watkins[2], William Doherty[3]
[1]Electrical and Computer Engineering, Villanova University, Villanova, PA, United States; [2]Radiology, Stanford University, Stanford, CA, United States; [3]Lowell Division, Microsemi Corp., Lowell, MA, United States

A SPICE-compatible PIN diode model suitable for time domain dynamic modeling is presented, with information for both fast rectifier and higher power devices design shown.

14:30 ***3930***. **Overlap Decoupling in Hole-Slotted Arrays**

Marcos Alonso Lopez[1,2], Felix Breuer[2], Daniel Gareis[1,3], Peter Michael Jakob[1,2]
[1]Experimental Physics 5, University of Wuerzburg, Wuerzburg, Bavaria, Germany; [2]Research Center Magnetic Resonance Bavaria, Wuerzburg, Bavaria, Germany; [3]Noras MRI Products GmbH, Hoechberg, Bavaria, Germany

The hole-slotted coil design provides a deeper RF penetration into the sample compared to standard loop designs and has already been shown to operate as an array with capacitive decoupling at 7 T. In this work, the applicability of overlap decoupling in a hole-slotted loop-geometry array is investigated at 1.5 and 7 T. The overlap ratio for an optimal decoupling has been experimentally found. The hole-slotted geometry is a well-suited design in an array setup using overlap decoupling. At 7 T has been shown to have approximately the same RF penetration than the hole-slotted array with capacitive decoupling.

15:00 ***3931***. **MRI Compatible (2.4GHz) Bluetooth Communication System: Isolating and Eliminating Electromagnetic Noise**

Jacob Bender[1,2], Mihaela Jekic[1,2], Orlando P. Simonetti[1,3]
[1]The Dorothy M. Davis Heart and Lung Research Institute, Ohio State University, Columbus, OH, United States; [2]Biomedical Engineering, Ohio State University, Columbus, OH, United States; [3]Radiology, Internal Medicine, Biomedical Engineering, Ohio State University, Columbus, OH, United States

A 2.4 GHz MRI compatible Bluetooth transceiver was constructed for use with a mouse and keyboard inside of a MRI room. Shielding and filtering prevented noise from Bluetooth electronics from entering the room. Only a few required small ferromagnetic parts were incorporated into the design. No noise was generated from the system. This was verified visually with phantom scan, a frequency spectrum obtained with a network analyzer, quantitatively with RF noise checks, and through technical specification from the manufacturer, FCC, and ETSI.

Gradient Coil Design

Hall B Monday 14:00-16:00 Computer 52

14:00 ***3932***. **Can We Re-Design the Gradient Coil to Make the Eddy Current Field Match the Primary Gradient Field?**

Hector Sanchez[1], Michael Poole[1], Adnan Trakic[1], Stuart Crozier[1]
[1]Research Group/Affiliation: EMI, School of Information Technology & electrical Engineering, Brisbane, QLD, Australia

MRI requires rapidly switched magnetic field gradients. This time-dependent magnetic fields induce eddy currents in nearby conducting structures. These currents generate detrimental transient magnetic fields in the region of interest (ROI) and hence, current compensation is required to minimize the consequential image distortion. In order to apply successfully current compensation techniques, it is required that the primary and the secondary magnetic fields possess a similar spatial form in the ROI. In this work we present two approaches for gradient coil design that produces gradient fields with characteristics similar to those produced by the eddy currents.

14:30 ***3933*.** **Eigenmode Analysis of Eddy Currents and Eigenmode Coil Design**

Michael Stephen Poole[1], Hector Sanchez Lopez[1], Stuart Crozier[1]
[1]School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, QLD, Australia

Modelling gradient-induced eddy currents using eigenmode analysis reveals a set of non-interacting modes with characteristic exponential decays. These combine in conventional gradient coils to produce an eddy current that changes its magnitude and spatial form in time. This causes gradient pre-emphasis techniques to be ineffective over the whole imaging region. We propose, and demonstrate by simulation, that the eddy currents can be made more amenable to pre-emphasis by suppressing all but one mode. At the same time the primary field must match the field generated by this mode.

15:00 ***3934*.** **Curved Gradient Coil Designs for Anatomically Specific Imaging Applications**

Chad Tyler Harris[1], William B. Handler[1], Blaine Alexander Chronik[1]
[1]Department of Physics and Astronomy, University of Western Ontario, London, Ontario, Canada

We have implemented a boundary element method to design and analyze the performance of curved gradient coil geometries as a function of the degree of curvature over all three axes, varying continuously from planar to full cylindrical. A form of curved gradient coil could serve as anatomically-specific gradient channels to be used in conjunction with whole-body coils to comprise a 4- to 6-channel hybrid system. The function of the anatomically-specific channels could include the ability to provide very high performance diffusion weighted imaging in a specified volume of tissue such as the breast, prostate, or posterior regions of the brain.

15:30 ***3935*.** **Using Shape Optimization to Linearise the Eddy Current Field**

Hector Sanchez[1], Michael Poole[1], Stuart Crozier[1]
[1]Research Group/Affiliation: EMI, School of Information Technology & electrical Engineering, Brisbane, QLD, Australia

MRI requires rapidly switched magnetic field gradients. This time-dependent magnetic fields induce eddy currents in nearby conducting structures. These currents generate detrimental transient magnetic fields in the region of interest (ROI) and hence current compensation (CC) is required to minimize the consequential image distortion. In order to apply successfully CC techniques, it is required that the primary and the secondary magnetic fields possess a similar spatial form in the ROI. We investigated by simulation, the effect of re-shaping a highly conducting passive shield surrounding a gradient coil (and the gradient coil surface) over the matching field for optimal current compensation.

Tuesday 13:30-15:30 Computer 52

13:30 ***3936*.** **Development of a New High-Performance PatLoc Gradient System for Small-Animal Imaging**

Stéphanie Ohrel[1], Heinrich Lehr[1], Frédéric Jaspard[2], Peter Ullmann[1], Hans Post[1]
[1]Bruker BioSpin MRI GmbH, Ettlingen, Germany; [2]Bruker BioSpin SA, Wissembourg, France

The experimental feasibility of PatLoc imaging at small-animal scale has been demonstrated in several studies. However, the limited performance provided by the PatLoc gradient prototype involved led to experimental restrictions like long echo and repetition times. This has been addressed in this study by developing a more efficient PatLoc gradient coil which can be driven with higher currents. Initial measurements demonstrate a twofold-increased efficiency of the new design which leads, together with the extended current limits, to a roughly tenfold-enhanced gradient strength. Furthermore, gradient-echo imaging could be performed with high quality using the new PatLoc gradient for in-plane spatial encoding.

14:00 ***3937*.** **A 50-Channel Matrix Gradient System: A Feasibility Study**

Stefan Wintzheimer[1], Toni Driessle[2], Michael Ledwig[1], Peter M. Jakob[1,2], Florian Fidler[1]
[1]MRB, Research Center Magnetic-Resonance-Bavaria, Wuerzburg, BY, Germany; [2]Experimental Physics 5, University of Wuerzburg, Wuerzburg, BY, Germany

Shimming a magnetic field usually requires an additional set of complex coils which act independently from the linear gradient system used for MRI. In this study a novel matrix gradient design is presented, which is capable of generating both linear gradient fields for imaging and at the same time high order shim fields to compensate inhomogeneities in the main magnetic field. They provide the possibility to create a large variety of field profiles. Furthermore the new design is able to switch every field order very fast due to low inductivity of the coils.

14:30 ***3938*.** **Designing 3D Gradient Coils for Open MRI Systems**

Peter T. While[1], Larry K. Forbes[1], Stuart Crozier[2]
[1]School of Maths and Physics, University of Tasmania, Hobart, TAS, Australia; [2]School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, QLD, Australia

An analytic method is described for the theoretical design of 3D gradient coils for open MRI systems. Rather than restricting coil windings to planar surfaces, the precise 3D geometry is obtained as part of the optimisation. The inverse problem is solved using regularisation with a minimum power constraint. A priority streamline seeding technique is used to position the windings. Results for an unshielded coil display concentrated current near the DSV with looped return path windings. However, for a shielded coil the windings are confined to biplanar surfaces, suggesting this is the optimum geometry for a shielded minimum power open coil.

15:00 **3939**. **A Split Gradient Coil for High Speed Imaging with Application to MRI-RT**

Shmaryu Shvartsman[1], Gordon DeMeester[1], Timothy Eagan[1], Steve Bates[2], Mark Savill[2]
[1]ViewRay Incorporated, Oakwood Village, OH, United States; [2]Tesla Engineering Ltd, Storrington, West Sussex, United Kingdom

It is desirable to have a high speed whole body gradient coil with a central gap between coils of 200mm for applications in MRI guided Radiation Therapy. Multileaved Collimators (MLCs) near the coil gap have conducting and possible eddy current surfaces that indicate avoidance of 3D coil design in this region. Our gapped coil design is different from the approach described in [1]. A similar design for a whole body gradient was analyzed in [2]. Radiation treatment monitoring requires continuous fast imaging for time intervals of 20min, so gapped gradient inefficiency and duty cycle requirements combine to increase cooling requirements.

Wednesday 13:30-15:30 Computer 52

13:30 **3940**. **Superelliptical Insert Gradient Coil with Field Modifying Layers for Breast MRI**

Sung M. Moon[1], K. Craig Goodrich[1], J. Rock Hadley[1], Gengsheng Lawrence Zeng[1], Glen Morrell[1], Matthew A. McAlpine[2], Blaine A. Chronik[2], Dennis L. Parker[1]
[1]UCAIR (Utah Center for Advanced Imaging Research), Radiology, University of Utah, Salt Lake City, UT, United States; [2]Physics and Astronomy, University of Western Ontario, London, Ontario, Canada

With higher gradient strength and slew rate, planar insert gradients can attain higher spatial and temporal resolution than the body gradients. However, a homogeneous gradient volume of the planar gradient is relatively small due to its inherent geometry and exponential field fall-off with distance from the coil surface. Therefore, the HGV may be too small for breast imaging. In this work, to create wider HGV, the planar geometry was widened and the edges were bent vertically using superelliptical curvature on both sides, creating a so-called superellipse shape to fit in the magnet bore. These vertical edges increase the uniformity. Furthermore, an extra outer layer of current windings was added to increase its strength and homogeneity.

14:00 **3941**. **Segmented Insert Gradient Coil for Bilateral Knee Imaging**

Sung M. Moon[1], K. Craig Goodrich[1], J Rock Hadley[1], Dennis L. Parker[1]
[1]UCAIR (Utah Center for Advanced Imaging Research), Radiology, University of Utah, Salt Lake City, UT, United States

MRI of the knee can benefit from high spatial resolution and short echo times for both proton and sodium-23 imaging of cartilage. With higher gradient strength and slew rate, the insert gradient coils can attain shorter echo times and higher spatial and temporal resolution than the body gradients. Prior flat gradient system designs have relatively smaller HGVs, which are not quite wide enough for bilateral knee imaging. To image both knees simultaneously, we have developed a segmented two-region insert gradient system which has two wide HGVs, one for each knee, along the x-axis. This was achieved by adding an extra vertical winding in the middle of the x-gradient to create high gradient strength, and by using superelliptical geometry, which enlarges the HGV dramatically by spreading wire patterns around both knees.

14:30 **3942**. **Transversal Gradient Compensation in Three-Sided MRI Magnets**

Franco Bertora[1], Alice Borceto[1], Andrea Viale[1]
[1]Robotics, Brain and Cognitive Sciences, Italian Institute of Technology, GENOVA, GE, Italy

The design of a fMRI magnet for the study of the human motor cortex poses a number of challenges due to the necessity of maintaining the subject in a natural, erect position, with free access to the environment. One way of meeting the challenge is to center the design around a three-dimensional finite configuration containing a closed cavity where the field is homogeneous. When the cavity is open to allow patient access a strong gradient arises that needs to be compensated without compromising the structure efficiency.

15:00 **3943**. **Temperature Characteristics of Gradient Coils with Minimax Current Density**

Michael Stephen Poole[1], Pierre Weiss[2], Hector Sanchez Lopez[1], Michael Ng[3], Stuart Crozier[1]
[1]School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, QLD, Australia; [2]Institut de Mathematiques, Universite Paul Sabatier Toulouse 3, Toulouse, France; [3]Department of Mathematics, Hong Kong Baptist University, Kowloon Tong, Hong Kong

Gradient and shim coils designed with minimum power or stored energy can possess regions of high current density. A new method has been developed to spread out these areas of high current density, which should lead to lower peak temperatures. Here we test the heating properties of such minimax current density coils with and show that indeed the peak temperature is reduced in a model coil.

Thursday 13:30-15:30 Computer 52

13:30 **3944**. **Minimising Hot Spot Temperature in Gradient Coil Design**

Peter T. While[1], Larry K. Forbes[1], Stuart Crozier[2]
[1]School of Maths and Physics, University of Tasmania, Hobart, TAS, Australia; [2]School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, QLD, Australia

Gradient coil hot spots can lead to image distortion and coil failure. An analytic method is presented for redesigning gradient coils with improved spatial temperature distributions and reduced hot spot temperatures. Maximum temperature is a non-linear constraint and a relaxed fixed point iteration scheme is introduced to alter the coil windings iteratively and lower the hot spot temperature. The new coil windings display a considerable improvement in hot spot temperature, at no cost to coil performance, when compared to equivalent minimum power x-gradient coils. The model can be adapted easily for other geometries, thermal properties, cooling mechanisms and non-linear constraints.

14:00 ***3945*****.** **A Temperature Distribution Model for Gradient Coils**

Peter T. While[1], Larry K. Forbes[1], Stuart Crozier[2]
[1]School of Maths and Physics, University of Tasmania, Hobart, TAS, Australia; [2]School of Information Technology and Electrical Engineering, University of Queensland, Brisbane, QLD, Australia

Excessive heating of gradient coils is a considerable concern. An analytic model is presented for calculating theoretically the spatial temperature distribution for cylindrical gradient coils. The model includes Ohmic heating due to current density in resistive material, thermal conduction through a copper layer and an epoxy former, and radial heat loss to the environment. A great number of coil parameters can be varied, including geometry, electrical and thermal properties, and results are shown for a standard x-gradient coil under three different types of cooling. In addition, temperature rise-times are predicted using a time-dependent solution for hot spot temperature.

14:30 ***3946*****.** **Safety Considerations for a PatLoc Gradient Insert Coil for Human Head Imaging**

Chris A. Cocosco[1], Andrew J. Dewdney[2], P Dietz[2], M Semmler[2], Anna M. Welz[1], Daniel Gallichan[1], Hans Weber[1], Gerrit Schultz[1], Juergen Hennig[1], Maxim Zaitsev[1]
[1]Dept of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, B.W., Germany; [2]Siemens Healthcare, Erlangen, Germany

We present the design considerations and evaluation measurements for the safety of a PatLoc (Parallel Acquisition Technique using Localized Gradients) gradient insert coil designed for human head imaging on a 3T MRI system. This novel concept has the potential to allow higher gradient switching rates while not exceeding the Peripheral Nerve Stimulation (PNS) limits. Based on the presented experimental measurements and simulations, we consider imaging human volunteers with this system to be safe.

15:00 ***3947*****.** **First Results for Diffusion-Weighted Imaging with a 4th Channel Gradient Insert**

Rebecca E. Feldman[1], Jamu Alford[2], Timothy Scholl[2], Blaine A. Chronik[2]
[1]Medical Biophysics, University of Western Ontario, London, Ontario, Canada; [2]Physics and Astronomy, University of Western Ontario, London, Ontario, Canada

Gradients in diffusion-weighted imaging play two distinct roles. A gradient with a linear range sufficient to cover the sample is required for imaging. For the diffusion-weighting, the gradient is only required to be strong. A fourth gradient was inserted into the bore for the purposes of diffusion-weighting only. The inserted gradient was pulsed twice, before and after the 180 degree RF pulse, and the image acquisition was done using the whole body gradients. Using the insert b-values greater than 1000 s/mm2 were obtained a time frame that would permit only a b-value of 100 using the whole-body gradients.

Hybrid Systems: MR+

Hall B Monday 14:00-16:00 Computer 53

14:00 ***3948*****.** **A Depth-Encoding Detector Module for an MR-Compatible PET Insert**

Yibao Wu[1], Yongfeng Yang[1], Bo J. Peng[1], Simon R. Cherry[1]
[1]Department of Biomedical Engineering, University of California, Davis, Davis, CA, United States

The next generation of MR-compatible PET insert is under development for small-animal imaging providing greater than an order of magnitude increase in sensitivity by utilizing 20 mm thick scintillator crystal elements with excellent stopping power. A detector module based on avalanche photodiode read out with depth-of-interaction encoding was designed and evaluated to overcome the resolution-degrading parallax errors associated with such thick detectors. Detectors for the new PET insert were characterized in terms of crystal identification and energy spectra. Data were acquired outside a 7T MR scanner, inside the MR scanner, with and without sequences running. An MR phantom also was measured with the PET detector module inside the MR system. No significant interference between the PET detector module and the MR system were observed. The design of the new PET insert based on these detectors is presented.

14:30 ***3949*****.** **Design of a Dynamically-Controlled Resistive Shield for a Combined PET and Superconducting MRI System for Small Animal Imaging**

Geron Andre Bindseil[1], Timothy J. Scholl[1], William B. Handler[1], Chad T. Harris[1], Blaine A. Chronik[1]
[1]Department of Physics and Astronomy, University of Western Ontario, London, Ontario, Canada

Combining conventional PET and MRI faces numerous technical challenges, particularly the sensitivity of photomultiplier tube-based (PMT) PET detectors to magnetic fields. The authors describe an approach to PET/MRI in which a resistive electromagnet shield is used to null the field at the PMTs of a conventional PET system in the vicinity of a superconducting MRI system. The electromagnetic characteristics of the shield coil are presented. This approach benefits from allowing the use of commercially available PET systems, which include state-of-the-art timing & energy resolution, high sensitivity, and highly optimized event processing hardware.

15:00 ***3950*****.** **Minimum Stored Energy Split Superconducting Magnet for 3T Mri-Pet Animal Imaging System**

Quang M. Tieng[1], Viktor Vegh[2]
[1]Centre for Magnetic Resonance, University of Queensland, Brisbane, Queensland, Australia; [2]Centre for Advanced Imaging, University of Queensland, Brisbane, Queensland, Australia

There exists an ever increasing need to design and build medical imaging systems that are capable of obtaining PET-MRI images in conjunction. This work describes minimum stored energy superconducting magnet coil arrangements for the purpose of a combined PET-MRI scanner. Two symmetric magnet coil configurations are used, similarly to the double doughnut systems, with space between them allowing for the insertion of a PET camera. The final design is capable of delivering 3T, which is appropriate for animal MRI. The results show that the minimum stored energy approach yields a compact configuration with a small footprint.

15:30 ***3951*****.** **Investigation of PET Count Rate Reduction During EPI Scan on an MR-PET Hybrid System**

Joachim Bernhard Maria Kaffanke[1], Christoph Weirich[1], Lutz Tellmann[1], Karl-Joseph Langen[1], Hans Herzog[1], N. Jon Shah[1,2]
[1]Institute of Neurosciences and Medicine 4, Medical Imaging Physics, Forschungszentrum Jülich GmbH, 52425 Juelich, Germany; [2]Faculty of Medicine, Department of Neurology, RWTH Aachen University, 52074 Aachen, Germany

Hybrid MR-PET scanners offer great opportunities for the investigation of scientific questions and clinical diagnoses that are related to metabolism as well as function and structure of the brain. However, since the technology is new and still in development, it is of great importance to investigate how MR and PET systems influence each other in a combined scanner. Here, the effect of switched magnetic field gradients on the PET count rate is demonstrated and investigated.

Tuesday 13:30-15:30 Computer 53

13:30 ***3952*****.** **Solving RF Interference for a Simultaneous PET/MRI Scanner**

Bo Joseph Peng[1], Yibao Wu[1], Jeffrey Walton[2], Simon R. Cherry[1]
[1]Biomedical Engineering, University of California, Davis, Davis, CA, United States; [2]2NMR Facility, University of California, Davis, Davis, CA, United States

From single PET module data acquisitions, we further demonstrate the effectiveness of concentric carbon fiber tubing as an excellent shielding material against 300 MHz RF. We also present a solution to reduce the 81 kHz RF interference generated by the MR gradient power supply.

14:00 ***3953*****.** **MR-Based PET Attenuation Correction for Neurological Studies Using Dual-Echo UTE Sequences**

Ciprian Catana[1], Andre van der Kouwe[1], Thomas Benner[1], Michael Hamm[2], Christian J. Michel[2], Matthias Fenchel[2], Larry Byars[2], Matthias Schmand[2], Alma Gregory Sorensen[1]
[1]MGH, Radiology, A.A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]Siemens Healthcare

Attenuation correction is a required step not only for obtaining quantitative data, but also for performing meaningful qualitative image analysis. In order to achieve the necessary quantification for accurate quantitative neurological studies, three main components must be identified: water-based structures, bone tissue and air-filled cavities. DUTE sequences can potentially be used for bone/air segmentation. An MR-DUTE-based AC method could in principle provide accurate estimation of the radiotracer concentration in a particular voxel. Implementing an accurate MR-based AC will allow us take advantage of the improved quantitative capabilities of the combined MR-PET scanner.

14:30 ***3954*****.** **fMRI Investigations on an MR-PET System During Simultaneous PET Scanning: Technical Considerations**

Joachim Bernhard Maria Kaffanke[1], Irene Neuner[1,2], Tony Stöcker[1], Lutz Tellmann[1], Karl-Joseph Langen[1], Hans Herzog[1], N. Jon Shah[1,2]
[1]Institute of Neurosciences and Medicine 4, Medical Imaging Physics, Forschungszentrum Jülich GmbH, 52425 Juelich, Germany; [2]Faculty of Medicine, Department of Neurology, RWTH Aachen University, 52074 Aachen, Germany

The new technology of hybrid MR-PET scanners offers great opportunities for the investigation of scientific questions and clinical diagnosis that are related to metabolism as well as function and structure of the brain. Despite the fact that the implementation of a PET ring inside the bore of a modern whole body MR scanner is demanding the benefits in terms of scan time reduction as well as spatial and temporal co-registration speak for the combination of these complementary technologies. In this feasibility study we demonstrate the simultaneous acquisition of FET-PET and fMRI data in human subjects with brain tumours.

15:00 *3955*. **Improved PET Data Quantification in an Integrated Brain MR-PET Scanner**

Ciprian Catana[1], Thomas Benner[1], Andre van der Kouwe[1], Michael Hamm[2], Daniel B. Chonde[1], Christian J. Michel[2], Larry Byars[2], Georges El Fakhri[3], Nathaniel M. Alpert[3], Matthias Schmand[2], Alma Gregory Sorensen[1]

[1]MGH, Radiology, A.A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]Siemens Healthcare; [3]Radiology, MGH, Division of Nuclear Medicine & Molecular Imaging, United States

Simultaneous MR-PET data acquisition immediately brings to mind the possibility of improving the performance of one instrument by using the information obtained from the other modality. A number of aspects have to be considered in PET for obtaining a correct quantitative measure of the activity concentration in a specific voxel. Examples include the attenuation and motion correction and the arterial input function estimation. The accuracy of these methods, in principle, could be improved by including the MR information.

Wednesday 13:30-15:30 Computer 53

13:30 *3956*. **Low-Noise Broadband Receive Amplifier for Real-Time Magnetic Particle Imaging**

Ingo Schmale[1], Bernhard Gleich[1], Jürgen Rahmer[1], Claas Bontus[1], Jürgen Kanzenbach[1], Joachim Schmidt[1], Oliver Woywode[2], Juergen Weizenecker[3], Jörn Borgert[1]

[1]Philips Research Europe, Hamburg, Germany; [2]Philips Medical Systems, Hamburg, Germany; [3]University of Applied Sciences, Karlsruhe, Germany

Magnetic particle imaging (MPI) is a new tomographic imaging modality first presented in 2005. It directly and quantitatively images iron-oxide nano-particle concentrations. By means of a broadband data acquisition, MPI also is very fast imaging modality allowing real-time volumetric imaging. After a motivation for broadband reception, this abstract describes the inherent challenges of and a technical solution for a low-noise broadband receive amplifier. This new amplifier is part of the current pre-clinical MPI demonstrator with ~12cm bore size.

14:00 *3957*. **Narrowband MPI and Image Reconstruction for Small Animals**

Patrick Goodwill[1], Steven Conolly[2]

[1]UC Berkeley / UC SF Joint Graduate Group in Bioengineering, Berkeley, CA, United States; [2]Bioengineering, University of California, Berkeley, Berkeley, CA, United States

Magnetic Particle Imaging (MPI) is a new imaging modality that directly detects SPIO nano-particles. Here we describe the construction and use of a small animal MPI system and mathematical methods for image reconstruction.

14:30 *3958*. **Reducing Noise Artifacts in Intracranial EEG Within High Field MRI**

Giorgio Bonmassar[1], Alexandra Golby[2]

[1]AA Martinos Center, Massachusetts General Hospital, Charlestown, MA, United States; [2]Neurosurgery and Radiology, Brigham and Women's Hospital, Boston, MA, United States

A new type of MRI compatible intracranial electrode based on Polymer Thick Film (PTF) is presented and studied. When free electrons in the leads are exposed to Lorentz forces due to the motion of the leads in the static magnetic field (B0) results in induced current noise which makes the electroencephalogram impossible to interpret. The resistive leads were compared with metallic leads to estimate the Faradays induced current noise. In metallic materials the carrier density is very high (10^{22} electrons/cm^{-3}) compared to resistive leads. The results show that PTF resistive leads may reduce by four times the noise amplitude.

15:00 *3959*. **Radio Frequency Shielding for a Linac-MRI System**

Michael Lamey[1], Ben Burke[1], Satyapal Rathee[2,3], Nicola De Zanche[2,3], Gino Fallone[2,3]

[1]Physics, University of Alberta, Edmonton, Alberta, Canada; [2]Medical Physics, Cross Cancer Institute, Edmonton, Alberta, Canada; [3]Oncology, University of Alberta, Edmonton, Alberta, Canada

This work illustrates that through proper shielding techniques, noise-free MR images can be acquired while a linac or MLC operate.

Thursday 13:30-15:30 Computer 53

13:30 *3960*. **Development of a Novel 1 MT Planar B-Zero Coil for Patient Respiratory Motion Compensation in Magnetic Resonance Imaging**

Shakil Ahmed Awan[1], John McGinley[2], Robert Dickinson, Ian Young[3]

[1]Bioengineering, Imperial College London, South Kensington, London, United Kingdom; [2]Mechanical Engineering, Imperial College London; [3]Electrical & Electronic Engineering, Imperial College London

A technique has been developed, based on a planar B0-coil, to reduce artefacts in MRI caused by respiratory motion in patients. This should enable sub-millimetre resolution images to be detected using a MEMS microcoil. The microcoil, subject of a separate publication, was developed for catheter mounting and deployed in an endoscope for MR imaging of cholangiocarcinomas. The B0-coil has been designed to generate 1 mT, parallel to the main field of MRI scanner, with 80 Apk and to be homogenous to within ± 1% in a 150 mm DSV.

14:00 ***3961*. MRI Motion Compensation by Ultrasound Navigators**

Benjamin Matthew Schwartz[1], Nathan McDannold[2]
[1]Biophysics, Harvard University, Boston, MA, United States; [2]Radiology, Harvard Medical School, Boston, MA, United States

A well-known technique to reduce motion artifacts uses MR navigator echoes to track the position of the object being imaged, and compensates for the motion using this position information. We demonstrate an analogous technique, tracking motion using A-line images from a single ultrasound transducer. The ultrasound data can be analyzed in real time for prospective motion correction, or processed offline for retrospective correction. Ultrasound navigation allows the use of unmodified pulse sequences, with attendant advantages in acquisition speed, steady-state polarization, and reduced engineering requirements. Future development includes multidimensional tracking and supplying position data to non-MR equipment.

14:30 ***3962*. Characterising Gradient Non-Linearities of a Split Gradient Coil in a Hybrid MRI-Linear Accelerator**

Sjoerd Crijns[1], Johan Overweg[2], Bas Raaymakers[1], Jan Lagendijk[1]
[1]Department of Radiotherapy, UMC Utrecht, Utrecht, Netherlands; [2]Medical Imaging Systems, Philips Research Europe, Hamburg, Germany

The performance of a split gradient coil for MRI guided radiotherapy is evaluated in terms of geometrical accuracy.

15:00 ***3963*. Precise Co-Registration of SPECT and MRI for Small Animal Imaging Using a Common Animal Bed with External References:Visualization of Macrophage Distribution Within Inflammatory Lymph Nodes**

Masayuki Yamaguchi[1], Daisuke Suzuki[1,2], Ryosuke Shimizu[1,2], Ryutaro Nakagami[1,3], Keisuke Tsuda[1], Izumi Ogihara Umeda[1], Yasuo Okuyama[2], Kohki Yoshikawa[2], Hirofumi Fujii[1,4]
[1]Functional Imaging Division, National Cancer Center Hospital East, Kashiwa, Chiba, Japan; [2]Faculty of Health Sciences, Komazawa University, Setagaya, Tokyo, Japan; [3]Graduate School of Human Health Sciences, Tokyo Metropolitan University, Arakawa, Tokyo, Japan; [4]Institute for Bioinformatics Research and Development-Japan Science and Technology Agency, Chiyoda, Tokyo, Japan

We tested the SPECT-MRI fusion technique to visualize regional lymph nodes involved in subacute inflammation arising from the lymphatic basin using a mouse model. Two to three weeks after the administration of Freund complete adjuvant to the foot pad, ^{99m}Tc phytate high-resolution SPECT images of the hind limb were obtained using a small animal SPECT scanner equipped with 4 detectors with multi-pinhole collimators. These SPECT images were merged with MR images to provid precise anatomical information. SPECT-MRI fusion images showed swollen popliteal lymph nodes and the accumulation of ^{99m}Tc at the periphery, suggesting the inhomogeneous distribution of macrophages within the swollen lymph nodes.

Diffusion MRI

Hall B Monday 14:00-16:00 Computer 54

14:00 ***3964*. Validating Validators: An Analysis of DW-MRI Hardware and Software Phantoms**

Paulo Rodrigues[1], Vesna Prckovska[1], W. L.P.M. Pullens[2], Gustav J. Strijkers[3], Anna Vilanova[1], Bart M. ter Haar Romeny[1]
[1]Biomedical Image Analysis, Eindhoven University of Technology, Eindhoven, Noord Brabant, Netherlands; [2]Maatricht Brain Imaging Center, Maastricht University, Maastricht, Limburg, Netherlands; [3]Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Noord Brabant, Netherlands

Diffusion Weighted MRI techniques such as Diffusion Tensor Imaging (DTI) and High Angular Resolution Diffusion Imaging (HARDI) are emerging MRI techniques able to depict in-vivo brain's connectivity map. There is a wide range of uses of these techniques; however, their application in a clinical setting requires thorough validation. This work aims to validate DTI and HARDI software phantoms, in regions of single and complex fiber bundles, w.r.t to hardware phantom and in-vivo human brain data. Knowledge of the accuracy of synthetic data can improve the evaluation of such algorithms, and advance the employment of DTI and HARDI into clinical environment.

14:30 ***3965*. Diffusion Imaging and Tractography on a Hardware Model of the Human Optic Chiasm**

Wilhelmus LPM Pullens[1], Alard Roebroeck[1], Rainer Goebel[1]
[1]Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Limburg, Netherlands

The human optic chiasm is an interesting, complex fiber structure, hard to image in vivo. Based on the anatomy, a DW-MRI phantom was constructed, offering the possibility to quantify tractography results, with little limits on imaging time, and it does not suffer from motion or cardiac pulsation artifacts. A detailed analysis of Constrained Spherical Deconvolution and tensor reconstructions was done, as well as quantitative (probabilistic) fiber tracking. These phantoms form ideal test objects to improve and validate imaging and quantitative DW-MRI tractography on complex fiber structures such as the optic chiasm.

15:00 ***3966*.** **Diffusion Properties of Cortical Layers in Fixed Human Brain Tissue Investigated with High-Resolution STEAM**

Ana-Maria Oros-Peusquens[1], Arlad Roebroeck[2], Oleg Posnansky[1], N Jon Shah[1,2]
[1]Institute of Neuroscience and Medicine 4, Medical Imaging Physics, Forschungszentrum Juelich GmbH, Juelich, Germany; [2]Faculty of Medicine, JARA, RWTH Aachen University, Aachen, Germany

MRI of fixed tissue can be performed with very high resolution since measurement time is not a major constraint. Here, we use STEAM diffusion to overcome EPI-related problems (poor resolution, distortions, signal drop out) at 9.4T. We investigate fixed tissue samples from the occipital lobe (visual cortex) and temporal lobe (auditory cortex) with a voxel size of 80nl (resolution of 0.3x0.3x0.8mm). Cortical layer structure is observed in the ADC and FA maps. Fibre tracks from the stria of Gennari, from adjacent white matter and fibres emerging from the grey matter joining the regular tracts of the white matter are investigated.

15:30 ***3967*.** **Nanotubular Superparamagnetic Probes as Contrast Agents for Diffusion Tensor Magnetic Resonance Imaging**

Viviana Negri[1], Arisbel Cerpa[2], Laura Nieto[3], Pilar Lopez-Larrubia[3], Sebastian Cerdan[3], Paloma Ballesteros[4]
[1]Organic Synthesis and Molecular Imaging Laboratory, UNED-CSIC Unit, Madrid, Spain; [2]Universidad Europea de Madrid, Madrid, Spain; [3]Animal Models of Human Disease, IIBM-CSIC, Madrid, Spain; [4]Orghanic Synthesis and Molecular Imaging Laboratory, UNED-CSIC Unit, Madrid, Spain

Single Walled Carbon Nanotubes (SWNT´s) prepared by Chemical Vapor Deposition, oxidized with nitric acid during 48h, depicted 100-200 nm length and contained the paramagnetic metals (17% Ni, 4% Y). Orthogonal water ADC measurements performed in a suspension of SWNT´s in sodium dodecylbenzenesulfonate (2%), with the diffusion encoding gradient oriented in the H-F, L-R or A-P directions, showed significantly higher water ADC´s in the H-F direction than in the perpendicular plane. These results suggest that ADC values of tissue water may be modified anisotropically using these preparations, opening a new perspective for contrast agents active in ADC weighted MRI.

Tuesday 13:30-15:30 Computer 54

13:30 ***3968*.** **Non-Parametric Deformable Registration of High Angular Resolution Diffusion Data Using Diffusion Profile Statistics**

Pew-Thian Yap[1], Yasheng Chen[1], Hongyu An[1], John H. Gilmore[2], Weili Lin[1], Dinggang Shen[1]
[1]Department of Radiology, University of North Carolina, Chapel Hill, NC, United States; [2]Department of Psychiatry, University of North Carolina, Chapel Hill, NC, United States

We propose a full-brain multi-scale feature-based deformable registration algorithm based on the statistics of the diffusion profile of HARDI data. Besides the advantage of avoiding any predetermined models which may not necessarily fit the data, our method registers the diffusion weighted images (DWIs) and allows model fitting after the registration. This essentially means that our method can be utilized as a preprocessing step for a wide assortment of available diffusion models. Our method is also well suited for clinical applications due to its low computational cost – around 5 minutes on a 2.8GHz Linux machine (without algorithm optimization) to register a pair of images of typical size 128 x 128 x 80. The main idea involves extraction of statistical features directly from the diffusion profile, which includes mean diffusivity, diffusion anisotropy, regional diffusion statistics, and statistic-map-based edges.

14:00 ***3969*.** **Symmetric Diffeomorphic Normalisation of Fibre Orientation Distributions**

David A. Raffelt[1,2], J-Donald Tournier[3,4], Jurgen Fripp[1], Alan Connelly[3,4], Stuart Crozier[2], Olivier Salvado[1]
[1]The Australian E-Health Research Centre, CSIRO, Brisbane, QLD, Australia; [2]Department of Biomedical Engineering, University of Queensland, Brisbane, QLD, Australia; [3]Brain Research Institute, Florey Neuroscience Institutes (Austin), Melbourne, VIC, Australia; [4]Department of Medicine, University of Melbourne, Melbourne, VIC, Australia

Fibre Orientation Distributions (FODs) computed by Constrained Spherical Deconvolution can resolve multiple fibres within a single voxel. We have developed a symmetric diffeomorphic registration method to exploit crossing fibre information provided by FODs to spatially normalise high angular resolution diffusion weighted imaging data. We demonstrate the utility of the proposed method by generating a group average FOD template.

14:30 ***3970*.** **Diffeomorphic Image Registration of Diffusion MRI Using Spherical Harmonics**

Xiujuan Geng[1], Hong Gu[1], Wang Zhan[2], Wanyong Shin[1], Yi-Ping Chao[3], Norbert Schuff, Ching-Po Lin[4], Yihong Yang[1]
[1]Neuroimaging, National Institute on Drug Abuse, NIH, Baltimore, MD, United States; [2]Department of Radiology, University of California, San Francisco; [3]Department of Electrical Engineering, National Taiwan University, Taiwan; [4]Institute of Brain Science, National Yang-Ming University, Taiwan

We propose a novel diffeomorphic registration method for diffusion MRI data by mapping their orientation distribution functions (ODFs) represented with spherical harmonics (SHs). The registration is based on optimizing a diffeomorphic demons cost function. ODF reorientation is performed by rotating the SH coefficients to maintain the consistency with the local fiber orientations. Rotation on SH coefficients avoids the estimation of principle directions which has no analytical solution and is time consuming. The

performance was tested using different SH orders. Results show that registration with higher orders improves the registration accuracy in terms of smaller similarity error and higher directional consistency.

15:00 ***3971***. **Fast Feature-Based Multi-Scale Registration of HARDI Data Using Fourth Order Tensors**

Pew-Thian Yap[1], Yasheng Chen[2], Hongyu An[2], John Gilmore[3], Weili Lin[2], Dinggang Shen[2]
[1]Department of Radiology, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States; [2]Department of Radiology, University of North Carolina, Chapel Hill, NC, United States; [3]Department of Psychiatry, University of North Carolina, Chapel Hill, NC, United States

Fourth Order Tensors (FOTs) give elegant mathematical properties akin to that of the second order tensors. Recent formulation of FOT imposes positivity on the estimates to ensure soundness in a physical sense - a property not often found in more general higher order tensor approximations. Employing FOTs, we propose a fast feature-based multi-scale registration algorithm for whole brain HARDI data. Our registration algorithm requires a low computation cost – 5 minutes to register a pair of 128x128x80 images at 2mm isotropic resolution – making it practically feasible for clinical applications. Our methods involve three major components: 1) Generation of FOT-based features, 2) Hierarchical correspondence matching, 3) Dense deformation field estimation, and 4) Retransformation.

Wednesday 13:30-15:30 Computer 54

13:30 ***3972***. **Bias Free Estimates of the Diffusional Kurtosis in Two Minutes: Avoid Solving the Kurtosis Tensor**

Jimmy Lätt[1,2], Markus Nilsson[2], Sara Brockstedt[3], Ronnie Wirestam[2], Freddy Ståhlberg[2,4]
[1]Center for Medical Imaging and Physiology, Lund University Hospital, Lund, Sweden; [2]Department of Medical Radiation Physics, Lund University, Lund, Sweden; [3]Radiation Physics, Lund University Hospital, Lund, Sweden; [4]Department of Diagnostic Radiology, Lund University, Lund, Sweden

Diffusion kurtosis imaging provides additional information as compared to diffusion tensor imaging. Due to the long scan times, required to solve the kurtosis tensor, diffusion kurtosis measurements are not always clinical feasible. In this study, we show that a bias free kurtosis value can be estimated through an optimized encoding scheme within a clinically feasible time of two minutes.

14:00 ***3973***. **Influence of Maximal B-Value, Fit Polynomial and Number of Diffusion Directions on the Measured Kurtosis: A Phantom Study**

Tristan Anselm Kuder[1], Bram Stieltjes, Amir Moussavi[1], Frederik Bernd Laun[1]
[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

The diffusion kurtosis is obtained by fitting a polynomial to the logarithmic diffusion weighted signal acquired at different b-values. The aim of this study was to evaluate factors influencing the measured kurtosis. A strong dependence on the maximum b-value and the fitting polynomial was found. The cubic fit does not eliminate the dependence on the maximum b-value and causes a larger uncertainty in the measured kurtosis values compared to the quadratic fit. Thus, the quadratic fit is preferable. Fitting the Diffusion Kurtosis Tensor with 15 directions is unstable and at least 30 gradient directions should be used.

14:30 ***3974***. **Robust Estimation of Kurtosis and Diffusion Tensors in Diffusional Kurtosis Imaging**

Ali Tabesh[1], Jens H. Jensen[1], Babak A. Ardekani[2], Joseph A. Helpern[1,2]
[1]Radiology, New York University School of Medicine, New York, NY, United States; [2]Medical Physics, The Nathan S. Kline Institute for Psychiatric Research, Orangeburg, NY, United States

The diffusional kurtosis imaging model of non-Gaussian water diffusion is parameterized by the diffusion and kurtosis tensors, which are typically estimated via unconstrained least squares (LS) methods. Unfortunately, these methods do not necessarily produce physically and biologically plausible tensor estimates. We address this drawback by formulating the estimation problem as linearly constrained linear LS. Comparison of in vivo mean kurtosis maps obtained using the proposed formulation and unconstrained linear LS highlights the improved estimation quality. The proposed formulation achieves comparable map quality with fewer gradient images than the unconstrained LS approach, offering a savings of 38% in acquisition time.

15:00 ***3975***. **Improving the Fit of the Diffusion Kurtosis Tensor by Emphasizing the Directions of Restricted Water Motion**

Tristan Anselm Kuder[1], Bram Stieltjes, Amir Moussavi[1], Frederik Bernd Laun[1]
[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

The Diffusion Kurtosis Tensor (DKT) describes the directional dependence of the kurtosis which quantifies non-Gaussian diffusion. The aim of this study was to evaluate the quality of the tensor determination under well-defined conditions using diffusion phantoms. The DKT was determined using two methods. While the standard method using a pseudoinverse matrix fails, the new method emphasizing the high kurtosis values allows a reliable fit of the DKT. Comparison of the measurement using 30 directions to that with 256 directions shows the high quality of the tensor model when combined with the improved calculation method.

Thursday 13:30-15:30 Computer 54

13:30 ***3976*. High-Resolution DTI Tractography of the Spinal Cord with Reduced-FOV Single-Shot EPI at 3T**

Emine Ulku Saritas[1], Greg Zaharchuk[2], Ajit Shankaranarayanan[3], Murat Aksoy[2], Roland Bammer[2], Nancy J. Fischbein[2], Maxwell Boakye[4], Dwight G. Nishimura[1]
[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Department of Radiology, Stanford University, Stanford, CA, United States; [3]Global Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [4]Department of Neurosurgery, Stanford University, Stanford, CA, United States

There is much interest in extending diffusion tensor imaging (DTI) research to the spinal cord, whose connections are responsible for motor and sensory functions of the body. However, DTI of the spinal cord is limited by the need for high spatial-resolution, as well as the difficulties associated with susceptibility differences, field inhomogeneities (especially at 3T), and motion of the cord. A reduced field-of-view (FOV) method using a 2D echo-planar RF excitation has recently been shown to overcome these limitations and improve spinal cord diffusion-weighted imaging. This study addresses the application of this method to acquire high-resolution low-distortion DTI (including both fractional anisotropy (FA) maps and fiber tractography) of the spinal cord at 3T.

14:00 ***3977*. Differences Between Bipolar Disorder Patients and Control Subjects Using a New SPM Toolbox for Track-Based Spatial Statistics**

Jadwiga Rogowska[1], M Lopez-Larson[2], M Bielecki[3], Piotr Bogorodzki[3], D Yurgelun-Todd[2]
[1]Brain Imaging Center, McLean Hospital/Harvard Medical School, Belmont, MA, United States; [2]The Brain Institute, University of Utah, Salt Lake City, UT, United States; [3]Institute of Radioelectronics, Warsaw Technical University, Warsaw, Poland

Human imaging studies have implicated structural and functional abnormalities in patients with bipolar disorder. In this study we examined the differences in diffusion tensor imaging (DTI) data between bipolar patients and healthy control subjects using the methodology of Track-Based Spatial Statistics and our newly developed SPM's Toolbox. We found that bipolar disorder patients had significantly lower fractional anisotropy values within the cingulate gyrus when compared to control subjects. Our findings suggest that DTI techniques can highlight microstructural abnormalities in the brain, not evident on conventional MRI, which may be associated with the neuropathology of this disorder.

14:30 ***3978*. Functional Diffusion Map Evaluation of Perihematomal Edema as an Imaging Biomarker for the Early Prediction of Primary Intracerebral Hemorrhage Outcome**

Yuan-Hsiung Tsai[1,2], C-P Lin[2,3], L-M Hsu[2], H-H Weng[1]
[1]Diagnostic Radiology, Chang Gung Memorial Hospital, Chiayi, Taiwan, Taiwan; [2]Biomedical Imaging and Radiological Sciences, National Yang Ming University, Taipei, Taiwan, Taiwan; [3]Neuroscience, National Yang Ming University , Taipei, Taiwan

This prospective study described diffusion change in perihematomal edema during acute stage (within 7 days) after primary intracerebral hemorrhage by using functional diffusion map (fDM). fDM allows a spatial, voxel by voxel tracking of changes in ADC values over time that more precisely reflect the pathophysiological heterogeneity within the edema. Using fDM to evaluate the perihematomal edema appears promising in this study. fDM is feasible in predicting clinical outcome of ICH patient during acute stage.

15:00 ***3979*. MRI of Acute (<6 Hours) Ischemic Stroke Patients: A Comparison Between Diffusion-Related Parameters**

Frank Peeters[1], Dennis Rommel[1], Andre Peeters[2], Cecile Grandin[1], Guy Cosnard[1], Thierry Duprez[1]
[1]Medical Imaging, Université Catholique de Louvain, Brussels, Belgium; [2]Neurology, Université Catholique de Louvain, Brussels, Belgium

The value of PW- and DW-related parameters for accurately predicting the ischemic penumbra at initial MR work-up in hyperacute stroke patients has remained probabilistic. In the frame we compared parameters obtained from DTI (2-points ADC, mono- and bi-exponential fits) and q-space imaging (tensor analysis) in a short preliminary cohort of seven hyperacute (<6 mours) stroke patients. Initial data analysis enhanced the value of using high b-values for stroke work-up. Anisotropic diffusion and QSI analysis added significantly to standard isotropic DWI and may have the potential to discriminate between worsening vs regressive infarction, and to delineate ischemic penumbra at admission work-up.

Diffusion in Normal Volunteers

Hall B Monday 14:00-16:00 Computer 55

14:00 ***3980*. The Reconstruction of Hippocampus Network by QBI Tractography**

Rung-Yu Tseng[1], Yi-Ping Chao[1], Ke-Hsin Chen[1], Ching-Po Lin[1]
[1]INSTITUTE OF NEUROSCIENCE, NATIONAL YANG-MING UNIVERSITY, TAIPEI, Taiwan

The hippocampus (HC) is one of the core regions in the limbic system. The function of HC was found to be related to some deficits in some psychological disorders. A current issue on HC is, however, the lack of the evidence to map appropriately between valid structure connectivity and the functional connectivity. In this study, Q-Ball Imaging (QBI) tractography technique was employed to provide advanced information in structural connectivity. On the other hand, resting-state functional Magnetic Resonance Imaging (rfMRI) brought the information of functional connectivity of HC. The combined information facilitates to understand the mechanism of HC clearly.

14:30 ***3981*. A DTI Study of Developmental Brain Changes During Puberty**

Jee Eun Lee[1], Nicholas Lange[2], Frances Haeberli[1], Richard J. Davidson[1], Andrew L. Alexander[1]
[1]Waisman Center, University of Wisconsin, Madison, WI, United States; [2]Neurostatistics Laboratory, Belmont, MA, United States

DTI measures of normal children during their pubertal period were investigated. When age was matched for the pre-adolescence group (Tanner score 1) and adolescence (Tanner score 3&4) group, there was no significant DTI measures between these groups. However, DTI measures showed strong correlations with age for the entire subjects. Our study may indicate that changes in DTI measures over age are not driven by puberty-related changes directly.

15:00 ***3982*. The Impact of White Matter Growth on the Maturation of Information Processing and Reaction Time**

Nadia CF Scantlebury[1], Conrad Rockel[1], William Gaetz[2], Nicole Law[1], Don Mabbott[1]
[1]Program in Neuroscience and Mental Health, The Hospital for Sick Children, Toronto, Ontario, Canada; [2]Biomagnetic Imaging Laboratory, Children's Hospital of Philadelphia, Philadelphia, PA

Here we use the latency between a visual cue and a motor response to measure reaction time and test the contributions of white matter on information processing in children. Combined MEG and DTI methods were employed to delineate tracts that are likely involved in the modulation of signal transmission for reaction time. Findings implicate the white matter integrity of the inferior fronto-occipital fasciculus and the cortico-spinal tracts as important players in modulating reaction time. Age-related changes in white matter organization of these tracts are likely involved in increasing the efficiency of signal transmission and information processing.

15:30 ***3983*. Dexterity and Age Relate Differently to White Matter Organization in Cervical Spinal Cord in Healthy Subjects**

Påvel Lindberg[1], Antoine Feydy[2], Marc A. Maier[3]
[1]Radiology B, Hopital Cochin, Paris, France; [2]Radiology B, Hôpital Cochin, Paris, France; [3]LNRS, Universite Paris Descartes, Paris, France

We hypothesized that spinal white matter organization relates to the level of dexterity in healthy subjects. Spinal white matter was analyzed using DTI and related to a precision grip tracking task. FA was lower in subjects with high tracking error and decreased with age. The closest relation between FA and tracking error was found in the lateral spinal cord whereas FA of the medial spinal cord correlated with age. The results suggest (i) a functionally relevant specialization of lateral spinal cord white matter and (ii) an increased sensitivity to age-related decline in medial spinal cord white matter in healthy subjects.

Tuesday 13:30-15:30 Computer 55

13:30 ***3984*. A Probabilistic White Matter Atlas Approach to Assessing Age Related Changes in the Brain**

Emma Claire Robinson[1,2], Fani Deligianni[1,2], Alexander Hammers[2], Daniel Rueckert[1], A. David Edwards[2]
[1]Department of Computing, Imperial College, London, United Kingdom; [2]Clinical Sciences Centre, Imperial College, London, United Kingdom

This abstract presents a study of fractional anisotropy (FA) variability in tracts passing from anterior to posterior regions of the brain during healthy ageing. Tracts are propagated in a common-co-ordinate space using a probabilistic white matter atlas. This is constructed by transforming uncertainty distributions on the principle diffusion directions for each subject to a common co-ordinate space and combining to generate a distribution for the population. FA is compared all voxels along the tract using permutation testing. Studying tracts in this way allows direct visualisation of FA changes along the full length of the tract

14:00 *3985*. **Development of a WM Atlas Based on Anatomical Connectivity Mapping**

Mara Cercignani[1], Karl Embleton[2], Geoff J. M. Parker[3], Marco Bozzali[1]
[1]Neuorimaging Laboratory, Santa Lucia Foundation, Rome, Italy; [2]Cognition and Cognitive Neuroscience Group, School of Psychological Sciences, University of Manchester, United Kingdom; [3]Imaging Science & Biomedical Engineering and the Biomedical Imaging Institute, University of Manchester, United Kingdom

Anatomical connectivity mapping (ACM) is obtained by initiating tractography streamlines from all parenchymal voxels, and counting the number of streamlines passing through each voxel of the brain, thus highlighting WM structures strongly connected to the rest of the brain. DTI data from 10 subjects were normalised and averaged to compute the mean tensor, from which FA and ACM were obtained. Colour-coded maps of principal eigenvector, modulated by ACM are displayed. Several structures typically visible on colour-coded FA maps are visible also on ACM. Many other structures, however, can be seen more clearly and with greater resolution on the ACM images

14:30 *3986*. **Probabilistic Atlas of the Connections Between the Basal Ganglia and the Cortex**

Linda Marrakchi-Kacem[1,2], Fabrice Poupon[1,2], Pauline Roca[1,2], Alan Tucholka[1,3], Christine Delmaire[4], Eric Bardinet[4,5], Michael Sharman[4,5], Romain Valabregue[4,5], Arnaud Messe, [2,6], Caroline Malherbe, [2,6], Habib Benali, [2,6], Alexandra Durr[7,8], Jean-François Mangin[1,2], Stephane Lehericy[4,5], Cyril Poupon[1,2]
[1]NeuroSpin, CEA, Gif-Sur-Yvette, France; [2]IFR49, Gif-Sur-Yvette, France; [3]Parietal, INRIA, Saclay, France; [4]CENIR, Pitie-Salpetrière Hospital, France; [5]INSERM U975, France; [6]UMR-S 678 INSERM-UPMC, France; [7]APHP, Pitie-Salpetrière Hospital, France; [8]INSERM S679, France

The basal ganglia are topographically connected to cortical areas. These connections define motor, associative and limbic territories. These basal ganglia are therefore involved in motor as well as cognitive and behavioral functions. Dysfunction of basal ganglia territories leads to various neurological diseases that are specifically associated with each territory. In this abstract, we present the design of a surface probabilistic atlas of the connections between the basal ganglia and the interface between the white matter (WM) and the cortex. Such an atlas can be built on a population of healthy subjects as well as on a population of specific patients. Statistical tools can then be used to detect the regions with significant differences on the cortex that may correspond to underlying abnormalities of the striato-pallido-cortical connections. Such differences could yield new biomarkers of neurological pathologies.

15:00 *3987*. **Constant and Variable Features of White Matter Anatomy in the Human Brain: An in Vivo Diffusion Tractography Study**

Michel Thiebaut de Schotten[1], Flavio Dell'acqua, Dominic ffytche[2], Matthew Allin[3], Muriel Walshe[3], Robin Murray[4], Steve Williams[2], Declan Murphy[1], Marco Catani[2]
[1]Brain Maturation, Institute of Psychiatry, London, United Kingdom; [2]Centre for Neuroimaging Sciences, Institute of Psychiatry, London; [3]Department of Psychiatry, Institute of Psychiatry, London; [4]Department of Psychological Medecine, Institute of Psychiatry, London

Increasing knowledge of white matter organization has recently been derived from diffusion tensor tractography but access to this knowledge has often been limited to Diffusion Tensor Imaging (DTI) experts. Therefore a tractography atlas of the human brain pathways is timely for a better comprehension of brain function. However, this endeavour may be compromised by methodological limitations of the DTI technique and the high degree of inter-individual anatomical variability. Here we combine group effect maps with a spatial overlap approach to develop a 3D probabilistic atlas that provides comprehensive information about inter-subject variability and general morphology of the tract.

Wednesday 13:30-15:30 Computer 55

13:30 *3988*. **Anatomy the Fronto Parietal Pathways Correlates with the Symmetrical Processing of Visual Scenes**

Michel Thiebaut de Schotten[1], Flavio Dell'Acqua[1], Stephanie Forkel[1], Marco Catani[2]
[1]Brain Maturation, Institute of Psychiatry, London, United Kingdom; [2]Centre for Neuroimaging Sciences, Institute of Psychiatry, United Kingdom

The fronto-parietal network has been reported as involved in a large panel of function including spatial processing. In the monkey brain, Petrides & Pandya used the term superior longitudinal fasciculus (SLF) to indicate the fronto-parietal connections and identified three separate branches. In this study we have used advanced diffusion imaging to dissect the three branches of the SLF in 14 human living brains, measure the pattern of lateralization of its components and correlate these patterns with the spatial processing performance assessed with the line bisection test.

14:00 *3989*. **Quantification of Perfusion Contributions Using DWI Using Low B-Values**

Jonathan Chia[1], Zhiyue J. Wang[2], Dah-Juu Wang[3], Nancy K. Rollins[2]
[1]Philips Healthcare, Cleveland, OH, United States; [2]Radiology, Children's Medical Center of Dallas, Dallas, TX, United States; [3]The Children's Hospital of Philadelphia

Diffusion weighted imaging is originally sensitive to all types of motions of the spins, including both diffusion and perfusion. Simultaneous perfusion measurement may be still possible by inclusion of sampling with low b-values. DWI was performed with low and high b-values in order to quantify and characterize perfusion contributions using DWI at 1.5T and 3T.

14:30 *3990*. **Multi-Center Reliability of Diffusion Tensor Imaging**

Vincent Alfonso Magnotta[1], Greg Bonett[2], Bradley Bolster[3], Bryon Mueller[4], Kelvin Lim[5], Susumu Mori[6], Karl Helmer[7], Jessica Turner[8], Sara Reading[9], Mark Lowe[10], Elizabeth Aylward[11], Laura Flashman[1,2], Jane Paulsen[1,3]

[1]Radiology, The University of Iowa, Iowa City, IA, United States; [2]Psychiatry, The University of Iowa, Iowa City, 52242, United States; [3]Siemens Medical Solutions, Rochester, MN, United States; [4]The University of Minnesota, Minneapolis, MN, United States; [5]Psychiatry, The University of Minnesota, Minneapolis, MN, United States; [6]Radiology, Johns Hopkins University, Baltimore, MD, United States; [7]Radiology, Massachusetts General Hospital, Boston, MA, United States; [8]Psychiatry and Human Behavior, University of California Irvine, Irvine, CA, United States; [9]Psychiatry, Johns Hopkins University, Baltimore, MD, United States; [10]Radiology, Cleveland Clinic Foundation, Cleveland, OH, United States; [11]Seattle Children's Research Institute, Seattle, WA, United States; [12]Psychiatry, Dartmouth, Hanover, NH, United States; [13]Psychiatry, The University of Iowa, Iowa City, IA, United States

A multi-center study of diffusion tensor imaging was conducted to evaluate the coefficient of variation for sequence, site, and vendor. Small variations of less than 1% were found within a site that increased to 3% across vendors.

15:00 *3991*. **Multi-Site Investigation of DTI Reproducibility**

Karl Gerard Helmer[1], Ming-Chung Chou[2], Allen Song[3], Jessica Turner[4], Barjor Gimi[5], Susumu Mori[6]

[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States; [2]Department of Computer Science and Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan; [3]Duke University, Durham, NC, United States; [4]University of California, Irvine, Irvine, CA, United States; [5]UT Southwestern Medical Center at Dallas, Dallas, TX, United States; [6]Johns Hopkins University School of Medicine, Baltimore, MD, United States

The addition of diffusion tensor imaging to the protocol of multi-site studies has become more common in recent years. However, few studies have been performed on the reproducibility of tensor metrics across site and scanner manufacturer. We present data using scanners from Siemens, Philips, and GE and look at the behavior of the fractional anisotropy as decreasing amounts of data and/or diffusion-weighted directions are used in the tensor calculation. The methods used in this study are also suitable for the site-reliability characterization before a multi-site study is begun or after upgrades during the study.

Thursday 13:30-14:00 Computer 55

13:30 *3992*. **Voxel-Based DTI of Longitudinal Changes Post Pediatric TBI Compared with Age-Matched Developing Controls**

Lian Xue[1], Khader M. Hasan, Larry A. Kramer, Linda Ewing-Cobbs

[1]Diagnostic and Interventional Imaging, University of Texas Health Science Center at Houston, Houston, TX, United States

Quantitative diffusion tensor imaging (DTI) has been used to detect serial microstructure changes post moderate and severe TBI. DTI metrics such as fractional anisotropy (FA), mean diffusivity (MD), axial and radial diffusivities, ƒÉ// and ƒÉ Û revealed subtle differences of grey matter (GM) and white matter (WM) during recovery from TBI. However, there is no systematic whole brain study on the longitudinal evolution of GM and WM diffusion abnormalities during recovery from pediatric TBI patients. In this work, we perform a longitudinal study of 25 pediatric TBI patients who sustained moderate and severe TBI and 21 age-matched pediatric orthopedic comparison subjects. DTI was acquired 3 months after injury for each participant and repeated at 24 months after injury for each participant to examine recovery in the TBI group in relation to normal neurodevelopment changes during childhood and adolescence. Voxel based morphometry (VBM) [3] is adopted for an unbiased longitudinal data analysis and an optimal VBM procedure using the recently available DARTEL technique in SPM8 is developed to minimize misregistration. The VBM results for FA, MD maps of GM and FA, ƒÉ// and ƒÉ Û maps of WM reveal different longitudinal changes in TBI patient cortical and subcortical structures compared with normal neurodevelopment changes, which provide insight into the significant impact of TBI on GM and WM.

Diffusion: Pulse Sequences

Hall B Monday 14:00-16:00 Computer 56

14:00 *3993*. **Reduced Field of View Diffusion Weighted Imaging of the Brain at 7T**

Cornelius von Morze[1], Douglas A. Kelley[2], Suchandrima Banerjee[2], Timothy M. Shepherd[1], Duan Xu[1], Christopher P. Hess[1]

[1]Department of Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States; [2]GE Healthcare, San Francisco, CA, United States

Ventral regions of the brain are an important research target in the early detection of Alzheimer’s disease, but standard single shot EPI diffusion weighted imaging of these areas at 7T is contaminated by severe imaging artifacts. To reduce these, we investigated a combination of reduced FOV acquisition, enabled by outer volume suppression with custom designed quadratic phase RF pulses, with existing parallel imaging and partial Fourier methods. The reduced FOV diffusion acquisition greatly reduced the level of artifacts in five human subjects (including four patients with early symptoms of dementia).

14:30 ***3994*. Diffusion Weighted Imaging at 7T with STEAM-EPI and GRAPPA**

Bibek Dhital[1], Robert Turner[1]
[1]Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Saxony, Germany

Standard diffusion sequences require long time to play diffusion gradients, especially for high b-values. At 7T,this compromises higher intrinsic SNR with shorter T2 relaxation. We used STEAM sequence for slice localization and EPI with parallel imaging to acquire diffusion weighted images. While STEAM-EPI loses half the signal, it still benefits from a long T1 of the tissue to achieve high b-values: parallel imaging shortens EPI echo train leading to reduced distortions. STEAM-EPI is thus, the method of choice for 7 Tesla.

15:00 ***3995*. Improving Sensitivity in Low SNR Diffusion Imaging Using Optimal SNR Coil Combinations**

Jennifer A. McNab[1,2], Jonathan A. Polimeni[1,2], Julien A. Cohen-Adad[1,2], Lawrence L. Wald[1,3]
[1]A.A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Sum-of-squares (SoS) is the standard method for combining multi-channel coil images. SoS implicitly assumes that the pixel intensity is a reasonable estimate of the coil sensitivity profile. While this may hold true for acquisitions with high SNR and ideal arrays, diffusion-weighted images often have low SNR. We demonstrate improved sensitivity to diffusion measures using coil sensitivity estimates from high SNR b = 0 images as well as a quick determination of the noise covariance between coil channels to improve the channel combination. This approach adds 20 s of scan time but can increase fractional anisotropy estimates, for example, by 30%.

15:30 ***3996*. Accelerated DWI Using Simultaneous Image Refocused EPI Optimized for Clinical Imaging**

Vibhas Deshpande[1], Sudhir Ramanna[2,3], David Feinberg[2,3]
[1]Siemens Medical Solutions USA., Inc., San Francisco, CA, United States; [2]Advanced MRI Technologies, Sebastopol, CA, United States; [3]University of California, Berkeley, CA, United States

To reduce imaging times in clinical diffusion imaging, the simultaneous image refocusing (SIR) technique can be utilized to acquire multiple slices in a single readout, thereby shortening the total scan time. With 2 simultaneously refocused echoes, an approximate acceleration factor of 1.5 can be achieved as compared to non-SIR imaging. Results showed that the image quality using the SIR sequence was comparable to the conventional EPI, non-SIR sequence. In conclusion, SIR with 2 simultaneous slices can reduce scan time in diffusion weighted imaging by a factor of 1.5 with a compromise in spatial distortions and a small penalty in SNR.

Tuesday 13:30-15:30 Computer 56

13:30 ***3997*. Diffusion Imaging with Prospective Motion Correction and Reacquisition**

Thomas Benner[1], Andre J.W. van der Kouwe[1], A. Gregory Sorensen[1]
[1]Radiology, Athinoula A. Martinos Center, Charlestown, MA, United States

Subject motion is a major source of image artifacts in diffusion imaging, causing misalignment of images and erroneous values in the derived maps. A method is proposed that includes prospective motion correction as well as reacquisition of image data affected by motion. Result show that motion tracking is comparable to offline methods and that detection of images with artifacts works well. The corrected data is comparable to data acquired without subject motion at the cost of slightly increased scan time.

14:00 ***3998*. Efficient DTI Artifact Correction Via Spatial and Temporal Encoding**

Zhikui Xiao[1], Hao Shen[1], Guang Cao[1], William Scott Hoge[2]
[1]Applied Science Lab, GE Healthcare, Beijing, China; [2]Radiology, Brigham and Women's Hospital, Boston, MA, United States

By adding an extra shifted b0 acquisition to the standard DTI sequence, we present a method to fuse spatial and temporal encoding to correct for both Nyquist ghosts and geometric distortion artifacts in DTI.

14:30 ***3999*. A Method for Gradient Calibration in Diffusion Weighted Imaging**

Oleg Posnansky[1], Yuliya Kupriyanova[2], N. J. Shah[1,3]
[1]Medical Imaging Physics, Institute of Neuroscience and Medicine - 4 , Forschungzentrum Juelich, Juelich, Germany; [2]Medical Imaging Physics, Institute of Neuroscience and Medicine - 4, Forschungzentrum Juelich, Juelich, Germany; [3]Department of Neurology, Faculty of Medicine,RWTH Aachen University, Aachen, Germany

A calibration method for diffusion-weighted imaging using a homogeneous water phantom is proposed. The key point of the method consists in finding optimised balancing times for different orientations of diffusion-encoding gradients followed by retrospective rescaling of the diffusion-weighted images. The correction protocol was applied to produce improved fractional anisotropy maps. The results demonstrate that the described scheme of systematic error reduction is a valid approach for quality control studies of gradient system performance for diffusion-weighted imaging.

15:00 **4000**. **Reduce Blurring Effects in PROPELLER QBI**

Ming-Chung Chou[1], Yen-Wei Cheng[2], Cheng-Wen Ko[1], Tzu-Chao Chuang[3], Fu-Nien Wang[4], Teng-Yi Huang[5], Hsiao-Wen Chung[2]
[1]Computer Science and Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan; [2]Electrical Engineering, National Taiwan University, Taipei, Taiwan; [3]Electrical Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan; [4]Biomedical Engineering and Environmental Science, National Tsing Hua University, Hsinchu, Taiwan; [5]Electrical Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan

Although PROPELLER QBI was demonstrated to reduce scan time and susceptibility distortions while resolving fiber crossings, the residual phase errors in blade DWIs will cause blurring effects in reconstructed image. The purpose of this study was to conduct distortion correction by using image registration in PROPELLER EPI reconstruction, so as to further reduce susceptibility distortions in PROPELLER QBI.

Wednesday 13:30-15:30 Computer 56

13:30 **4001**. **Using Absorption-Mode Images to Improve in Vivo DTI Quality**

Tsang-Wei Tu[1,2], Matthew D. Budde[3], James D. Quirk[2], Sheng-Kwei Song[2]
[1]Mechanical, Aerospace and Structural Engineering, Washington University in St. Louis, Saint Louis, MO, United States; [2]Radiology, Washington University in St. Louis, Saint Louis, MO, United States; [3]Radiology and Imaging Science, National Institutes of Health Clinical Center, Bethesda, MD, United States

Diffusion-weighted multiple spin echo (DW-MSE) sequences have been introduced to improve DTI quality without increasing scan time by combining the images of multiple echoes. Since complex image combination can cause artifacts due to phase variations between echoes, magnitude images are often employed. But this results in a noise distribution change from Gaussian to Rician leading to a SNR decline and biased tensor estimation. Our results demonstrate that absorption-mode addition of multiple echoes obtained using the DW-MSE sequence improves SNR by nearly 50% compared to a conventional DW-SE sequence and also overcomes the problem of phase variations without Rician noise complications.

14:00 **4002**. **7T Diffusion Imaging of Rat by Using SNAILS and Its Application in Stroke Study**

Jian Zhang[1,2], Joshua Chua[3], Chunlei Liu[4], Shangping Feng[1], Michael Moseley[2]
[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Department of Radiology, Stanford University, Stanford, CA, United States; [3]Department of Neurosurgery, Stanford University, Stanford, CA, United States; [4]Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, United States

Animal stroke studies with DWI are widely investigated to facilitate the development of stroke diagnosis. However, diffusion imaging on small animals at high fields is usually very challenging due to the resolution-SNR tradeoff and hardware imperfection. The widely used single shot EPI DWI technique is particularly vulnerable to these factors and tends to produce severe image artifacts. In this work, we demonstrate the implementation of the self-navigated interleaved spirals (SNAILS) technique on our 7T animal scanner. High quality DWI images can be acquired for stroke studies on rats. The preliminary diffusion tensor imaging (DTI) results are also presented.

14:30 **4003**. **Diffusion-Weighted Balanced SSFP (DW-BSSFP): A New Approach to Diffusion Tensor Imaging**

Matthew M. Cheung[1,2], Jerry S. Cheung[1,2], Li Xiao[1,2], April M. Chow[1,2], Kannie W. Chan[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong, China

Although DW-EPI offers high acquisition speed, it generally suffers from low spatial resolution and geometric distortion. SSFP is a possible alternative to perform diffusion imaging with higher resolution and with no distortion artifacts that is inherent in EPI. In this study, we modified the balanced SSFP sequence by adding a pair of bipolar diffusion sensitizing gradients. The diffusion effect in bSSFP sequence with a pair of bipolar diffusion gradients was formulated and DW-bSSFP experiment was performed on in vivo rat brain at 7T.

15:00 **4004**. **Improvements on Single-Shot STEAM with Optimised Signal Shaping for Diffusion Weighted Imaging at High Fields**

Rüdiger Stirnberg[1], Tony Stöcker[1], N. Jon Shah[1,2]
[1]Institute of Neuroscience and Medicine - 4, Medical Imaging Physics, Forschungszentrum Jülich GmbH, Jülich, Germany; [2]Faculty of Medicine, Department of Neurology, RWTH Aachen University, Aachen, Germany

It was recently shown that a diffusion weighted Single-shot Stimulated Echo Acquisition Mode (DW ss-STEAM) pulse sequence is an alternative to the standard DW EPI at high fields. By designing dedicated variable flip angles (vFA) for accurate, advanced signal shaping without RF spoiling, more signal is utilised. A clear advantage is drawn from parallel imaging due to less phase encoding lines. The results are: EPI-comparable SNR and acquisition time without geometrical distortions at high fields. A basis is now established to potentially incorporate all transverse coherences without interferences (current investigations) promising a further general SNR multiplication of two.

Thursday 13:30-15:30 Computer 56

13:30 ***4005***. **Evidence for Microscopic Diffusion Anisotropy in Spinal Cord Tissue Observed with DWV Imaging on a Whole-Body MR System**

Marco Lawrenz[1], Martin Koch[1], Jürgen Finsterbusch[1]
[1]Department of Systems Neuroscience, University Medical Center, Hamburg-Eppendorf, Hamburg, Germany

Double-wave-vector diffusion-weighted imaging is able to detect microscopic diffusion anisotropy in macroscopically isotropic samples. So far, corresponding experiments were performed on NMR systems with high performance gradient coils (>=300mT/m). Here, experiments are presented that provide evidence for the observation of the anisotropy effect on a standard whole-body MR system.

14:00 ***4006***. **Numerical Simulations of Double-Wave-Vector Diffusion-Weighting Experiments with Multiple Concatenations at Short Mixing Times**

Jürgen Finsterbusch[1,2]
[1]Department of Systems Neuroscience , University Medical Center Hamburg-Eppendorf, Hamburg, Germany; [2]Neuroimage Nord, University Medical Centers Hamburg-Kiel-Lübeck, Hamburg-Kiel-Lübeck, Germany

Double-wave-vector diffusion-weighting experiments where two diffusion weighting periods are applied successively in a single acquisition are a promising tool to investigate tissue microstructure, e.g. cell or compartment sizes. However, for the long gradient pulse durations required on whole-body MR systems the underlying signal modulation with the angle between the two wave vectors may be small which hampers the detectability of the effect. Here, it is shown that multiple concatenations of the two diffusion weightings in a single experiment can yield considerably higher signal modulations than expected theoretically because shorter gradient pulses are sufficient to achieve the desired diffusion weighting.

14:30 ***4007***. **Multiple Echo Multi Shot (MEMS) Diffusion Sequence**

Sergio Uribe[1,2], César Galindo[3], Cristian Tejos, [2,4], Pablo Irarrazaval, [2,4], Steren Chabert[3]
[1]Radiology Department, Pontificia Universidad Catolica de Chile, Santiago, Chile; [2]Biomedical Imaging Center, Pontificia Universidad Catolica de Chile, Santiago, Chile; [3]Biomedical Engineering Department, Universidad de Valparaiso, Valparaiso, Chile; [4]Electrical Engineering Department, Pontificia Universidad Catolica de Chile, Santiago, Chile

T2 and diffusion measurements are usually acquire in different scans. In this work we propose a multi echo multi shot diffusion sequence that allows us obtaining T2 and mean diffusivity from a single scan. The multi shot approach enable short echo times for both echoes. This characteristic makes this sequence suitable to be applied in tissues with short T2. Result of in vivo experiments show an excellent correlation of T2 and mean diffusivity of the muscle compare to standard scans.

15:00 ***4008***. **Extension of the Double Wave Vector Experiments at Long Mixing Times to Multiple Concatenations**

Marco Lawrenz[1], Jürgen Finsterbusch[1]
[1]Department of Systems Neuroscience, University Medical Center, Hamburg-Eppendorf, Hamburg, Germany

An extension of the tensor approach to the double wave-vector experiment for multiple concatenations is presented aiming at the examination of microscopic anisotropy in tissue for fully restricted diffusion. A detailed analysis of the generalized tensor expression to the fourth order does not only hold for the characterization of arbitrary pores in an idealized environment but can still derive a microscopic anisotropy measure on the pore size level with sufficient accuracy for timing parameters compatible to whole-body MR systems. Monte Carlo simulations confirm the theoretical considerations.

Tractography

Hall B Monday 14:00-16:00 Computer 57

14:00 ***4009***. **Fast Normalization of Probabilistic Tractography**

Stephen Edward Jones[1,2], Kenneth Sakaie
[1]Neuroradiology, Cleveland Clinic, Cleveland, OH, United States

Numerical computation of track density using probabalistic DWI can be inefficient, particularly for distant points. We present a method that uses a partial differential equation approach (Laplace's equation) to solve the special isotropic case of probablistic tracking. This provides a rapid solution for any two points within the brain, with arbitrary accuracy. This solution can be coupled with anisotropic probablistic tracking to obtain scalar measures of connectivity.

14:30 ***4010***. **A Minimal Model, Data-Driven Approach to Tractography**

Angela Downing[1], Daniel Rueckert[2], A David Edwards, [1,3], Jo V. Hajnal[1]
[1]Robert Steiner MRI Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom; [2]Visual Information Processing Group, Department of Computing, Imperial College London, London, United Kingdom; [3]Department of Paediatrics,

Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom

We present a minimal model approach to tractography using the diffusion-weighted MRI measurements to represent samples from a diffusivity profile. Using phantom data we show that it is possible to accurately reconstruct the fibre structure between regions of interest by simulating the diffusion process that gives rise to the data.

15:00 ***4011*****.** **A Principal Eigenvector Based Segmental Approach for Reproducible White Matter Quantitative Tractography**

Shruti Agarwal[1], Richa Trivedi[2], Rakesh Kumar Gupta[2], Ram Kishore Singh Rathore[1]
[1]Department of Mathematics & Statistics, Indian Institute of Technology Kanpur, Kanpur, Uttar Pradesh, India; [2]Department of Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Most common methods of fiber tracking rely on a knowledge based selection of ROIs on appropriate slice and then generating the fibers from there followed by cleaning and augmenting the bundle obtained. For a part of source and destination ROIs the procedure is similar. However, in practice the selection of the right ROIs and the subsequent additions and deletions are normally quite time consuming in practice and involves a considerable amount of trial and error. In this presentation we propose a principal eigenvector (e1) field segmentation using which the selection of ROIs becomes less time consuming.

15:30 ***4012*****.** **A New Mahalanobis Distance Measure for Clustering of Fiber Tracts**

Cheng Guan Koay[1], Carlo Pierpaoli[1], Peter J. Basser[1]
[1]NIH, Bethesda, MD, United States

In this work, we present a simple and novel generalization of Mahalanobis distance measure for the dyadics of the eigenvector for the purposes of clustering fiber tracts and fiber orientation. This approach is built upon a series of works by Koay et al. on the diffusion tensor estimation and the error propagation framework. The proposed Mahalanobis distance measure for the dyadics is the ideal measure for clustering of fiber tracts as it does not depend on ad hoc combinatorial optimization that is typical in the eigenvector-clustering techniques, which is due to the antipodal symmetry of the eigenvector.

Tuesday 13:30-15:30 Computer 57

13:30 ***4013*****.** **A Multi-Structural Fiber Crossing Anisotropic Diffusion Phantom for HARDI Reconstruction Techniques Validation**

Danilo Scelfo[1,2], Laura Biagi[1], Lucia Billeci[1,3], Michela Tosetti[1]
[1]MR Laboratory, Stella Maris Scientific Institute, Pisa, Italy; [2]Department of Physics, University of Pisa, Pisa, Italy; [3]Inter-departmental Research Center “E. Piaggio”, University of Pisa, Pisa, Italy

There is significant interest in evaluating the performance and reliability of white matter fiber tractography algorithms. DTI-based fiber tracking gives insights into the complex architecture of the brain. However, it is well known that it presents a number of limitations, especially in presence of fiber crossing, The validation of fiber reconstruction by these different approaches remains challenging and requires suitable test phantoms. An experimental model with different fiber crossing configurations has been projected and realized (PIVOH, Phantom with Intra-Voxel Orientation Heterogeneity), in order to simulate the structural complexity of the white matter, in correspondence of fiber intersection

14:00 ***4014*****.** **A Novel Average Curves Tractography Technique - Validation Using a Physical Phantom**

Nagulan Ratnarajah[1], Andy Simmons[2], Ali Hojjat[1]
[1]Medical Image Computing, University of Kent, Canterbury, United Kingdom; [2]Institute of Psychiatry, Kings College London, United Kingdom

Probabilistic tractography algorithms differ from deterministic algorithms in that they take into account the uncertainty in fibre orientation. However, visualization of deterministic streamline trajectories is similar to the expected white matter fibre tracts, whereas the output of probabilistic methods may be harder to interpret and connectivity maps from probabilistic methods can leak into unexpected regions of white matter. In this study, we present a deterministic version of probabilistic tractography, which results in a single well defined trajectory for every major connection from a seed point using an average-curves approach. We evaluated the method on a physical-phantom and compared the results with the ground-truth.

14:30 ***4015*****.** **How Many Streamlines Should I Use?**

Matthew George Liptrot[1], Tim Bjørn Dyrby[1]
[1]Danish Research Centre for Magnetic Resonance (DRCMR), Copenhagen University Hospital, Hvidovre, Copenhagen, Denmark

In probabilistic streamline tractography, the choice of the number of streamlines to employ is the source of much confusion as no feasible analytical solution exists, and ensuring “sufficient” sampling is therefore problematic. Herein we describe an investigation into the influence that the number of streamlines imposes upon free-tracking, compare the parameter’s effect within Anatomical Connectivity Map generation and show how, via use of the ICE-T Framework (a recent technique to iterate conventional tractography routines), as few as 10 streamlines per voxel can be sufficient to overcome the omnipresent problem of path length dependency.

15:00 **4016. Application of Rotational Tensor Interpolation to Tractography**

Marta Morgado Correia[1,2], Guy B. Williams[2]
[1]MRC Cognition and Brain Sciences Unit, Cambridge, Cambridgeshire, United Kingdom; [2]Wolfson Brain Imaging Centre, Cambridge, Cambridgeshire, United Kingdom

Diffusion MRI was the first imaging modality to allow the visualization of white matter fibre paths in vivo, and non-invasively. Tensor interpolation methods have often been used to improve the reproducibility and reliability of tractography results.
In this abstract we will introduce a new method for 3D tensor interpolation based on work by Batchelor and colleagues, and use simulated data to compare its performance to well established methodologies.

Wednesday 13:30-15:30 Computer 57

13:30 **4017. Identification of Corresponding Tracks in Diffusion MRI Tractographies**

Eleftherios Garyfallidis[1,2], Matthew Brett[3], Vassilis Tsiaras[4], George Vogiatzis[5], Ian Nimmo-Smith[1]
[1]MRC Cognition and Brain Sciences Unit, Cambridge, United Kingdom; [2]University of Cambridge, Cambridge, United Kingdom; [3]University of California, Berkeley, United States; [4]Department of Computer Science, University of Crete, Greece; [5]Computer Vision Group, Toshiba Research Europe, Cambridge, United Kingdom

Identifying manually corresponding tracks in different brain tractogaphies is a very complicated task, typically requiring lots of expertise, and lots of time. Moreover different local diffusion models and different tractography algorithms generate tractographies with wide differences in numbers of tracks and in shape characteristics. We address these problems by introducing an automatic method for detecting corresponding tracks in different dMRI (diffusion weighted MRI) datasets.

14:00 **4018. Automatic Tractography Segmentation by Morphological Continuity Clustering**

Fang-Cheng Yeh[1], Wen-Yih Isaac Tseng[2]
[1]Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA, United States; [2]Center for Optoelectronic Biomedicine, National Taiwan University College of Medicine, Taipei, Taiwan

We present a tractography segmentation algorithm called morphological continuity clustering (MCC), which is a fully automatic, unguided method that clusters fiber tracts without predefining the cluster number. This algorithm is based on the concept that the fibers of the same cluster share the morphological continuity, a feature used to determine whether two tracts should be grouped. The performance was evaluated on tractography with a total of 100,000 fibers tracts generated by streamline tracking method on generalized q-space imaging (GQI). The results showed that MCC is able to generate several clusters that correspond to well-known fiber tracts. Further study is needed to improve the accuracy and robustness of the proposed method.

14:30 **4019. False Positive Detection Using Filtered Tractography**

Yogesh Rathi[1,2], James Malcolm, [23], Sylvain Bouix[1], C-F Westin[4], Martha E. Shenton[1,5]
[1]Psychiatry, Harvard Medical School, Boston, MA, United States; [2]Georgia Institute of Technology, Atlanta, GA, United States; [3]Brigham and Women's Hospital, United States; [4]Radiology, Harvard Medical School, Boston, MA, United States; [5]VA Clinical Neuroscience Division, Boston, MA, United States

Existing methods perform model estimation independently at each voxel and tractography is performed in the next step. We use a nonlinear Kalman filter for simultaneous model estimation and tractography. The method not only provides an estimate of the model parameters, but also a confidence in the estimation in terms of the covariance matrix. We utilize measures derived from this covariance matrix to detect false positives in the tracts generated.

15:00 **4020. Systematic Assessment of Effects of Noise and Resolution on Metrics of DTI Tractography**

Virendra Radheshyam Mishra[1,2], Xin Fan[2], Hao Huang[3,4]
[1]Biomedical Engineering, The University of Texas at Arlington , Arlington, TX, United States; [2]Advanced Imaging Research Center, The University of Texas Southwestern Medical Center , Dallas, TX, United States; [3]Advanced Imaging Research Center, The University of Texas Southwestern Medical Center , Dallas, TX, United States; [4]Department of Radiology, The University of Texas Southwestern Medical Center , Dallas, TX, United States

Fiber volume and fiber count are two important metrics derived from DTI tractography. However, no systematic description of the relationship between these two measures and noise or resolution has been reported so far. In this study, we measured fiber count and fiber volume of left cingulum with DTI datasets of different SNR and resolution. Our results indicate that resolution plays a more important role on both measures than SNR. With a normal range of SNR, both measures are almost constant for a normal resolution. Compared to fiber count, fiber volume is a more stable measure.

Thursday 13:30-15:30 Computer 57

13:30 **4021. SWI-Informed Diffusion Tensor Tractography**

Michiel Kleinnijenhuis[1,2], Markus Barth[1,3], Daniel C. Alexander[4], Anne-Marie van Cappellen van Walsum[2,5], David Gordon Norris[1,3]
[1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands; [2]Department of Anatomy, University Medical Centre St. Radboud, Nijmegen, Netherlands; [3]Erwin L. Hahn

Institute for Magnetic Resonance Imaging, Essen, Germany; [4]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom; [5]MIRA Institute for Biomedical Technology and Technical Medicine, University of Twente, Enschede, Netherlands

Diffusion tensor tractography suffers from limited spatial resolution in the reconstruction of white matter structure. Susceptibility weighted images (SWI) also shows white matter structure, but can be acquired at a much higher resolution. A method is proposed to inform the tractography algorithm with gradient information (structure tensor) of the SWI intensity. Tracking was informed by SWI by projecting the DT tracking direction onto the plane orthogonal to the first eigenvector of the structure tensor. Main pathways were largely similar for DT and SWI-informed tractography, but tracts also showed marked differences between branching patterns and tract paths.

14:00 ***4022***. **3D Tracking of Magnetic Pathways in White Matter Based on Magnetic Susceptibility Anisotropy**

Chunlei Liu[1,2], Yi Jiang[3], G. Allan Johnson[3]
[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States; [2]Radiology, Duke University, Durham, NC, United States; [3]Center for In Vivo Microscopy, Duke University, Durham, NC, United States

We propose a method for tracking a magnetic network existing in the white matter. The proposed method utilizes a previously unexplored magnetic property of white matter fibers. We found that the magnetic moment of white matter varies significantly when measured at different brain orientations with respect to the external field. This orientation dependence can be modeled by an apparent susceptibly tensor. Decomposing this tensor into its eigensystem revealed a spatially coherent network. Following the orientation of the major eigenvector, we were able to map distinctive magnetic pathways in 3D. The relationship between the magnetic network and fiber pathways is discussed.

14:30 ***4023***. **BootGraph: Probabilistic Fiber Tracking Using Bootstrap Algorithm and Graph Theory**

Robert Stefan Vorburger[1], Carolin Reischauer[1], Peter Boesiger[1]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Bootstrap algorithms and graph theory are sophisticated methods in diffusion tensor imaging to obtain probabilistic connectivity maps in the human brain. In the present work the two methods are combined by weighting the graph edges with the statistics derived from the bootstrap approach. Hence, the resulting connectivity maps reflect not only directional probabilities but also the uncertainty in the measured data. Thereby, the time consuming bootstrap calculations have to be performed only once and can be used for different settings of tracking parameters, such as the FA threshold or curvature restriction.

15:00 ***4024***. **Dual Tensor Tracking in Low Angular Resolution Diffusion Weighted MRI**

Matthan W.A. Caan[1,2], M. M. van der Graaff[1], S. D. Olabarriaga[1], C. A. Grimbergen[1], L. J. van Vliet[2], F. M. Vos[1,2]
[1]Radiology, Academic Medical Center, Amsterdam, North-Holland, Netherlands; [2]Imaging Science and Technology, Delft University of Technology, Delft, Netherlands

In Diffusion Weighted MRI, the diffusion weighting should be high enough to facilitate fiber tracking through crossings. We propose to estimate a dual tensor model on an entire cohort with low diffusion weighting and a limited number of gradient directions. Diffusion attenuation profiles of multiple subjects are regarded as realizations of a single underlying fiber distribution. Non-rigid coregistration ensures spatial correspondence. Increased angular resolution is ensured by random subject positioning in the scanner, as well as by anatomical heterogeneity. In our dual tensor atlas, we tracked fibers which proceeded contralaterally through the decussation of the superior cerebellar peduncle.

HARDI & Diffusion Modeling

Hall B Monday 14:00-16:00 Computer 58

14:00 ***4025***. **Boosting the Angular Resolution of Q-Space Imaging Methods by Diffusion ODF Deconvolution**

Fang-Cheng Yeh[1], Van Jay Wedeen[2], Wen-Yih Isaac Tseng[3]
[1]Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA, United States; [2]MGH Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, MA, United States; [3]Center for Optoelectronic Biomedicine, National Taiwan University College of Medicine, Taipei, Taiwan

We present a deconvolution method that estimates fiber orientation distribution function (ODF) from diffusion ODF. Instead of applying deconvolution on spherical harmonic parameters, the proposed method performs deconvolution on the diffusion ODF directly, thereby extending its applicability to diffusion spectrum imaging (DSI) and generalized q-space imaging (GQI). To test the performance of the proposed method, we applied it to q-ball imaging (QBI), DSI, and GQI, with diffusion weighted images acquired by single-shell, grid, and two-shell sampling schemes, respectively. The result showed that the fiber ODFs obtained by the proposed method presented sharper contours in all tested q-space imaging method.

14:30 ***4026*. Classification of Non-Gaussian Diffusion Profiles for HARDI Data Simplification**

Vesna Prškovska[1], Anna Vilanova[1], Cyril Poupon[2], Bart ter Haar Romeny[1], Maxime Descoteaux[3]
[1]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [2]NeuroSpin, CEA Saclay, Gif-sur-Yvette, France; [3]Computer Science, Université de Sherbrooke, Québec, Canada

This work presents a HARDI study of the classification power of different anisotropy measures. This classification aims towards separating the data into three compartments: Isotropic, Gaussian and Non-Gaussian. Afterwards the data can be simplified in the first two compartments by simpler diffusion models. To quantify the classification power of the measures, ex-vivo phantom data is used, and the findings are qualitatively illustrated on real data under different b-values and gradient sampling schemes. The benefits from the data simplification are clinically attractive due to the possibility of significantly decreasing the post-processing time of the HARDI models and faster, more intuitive visualization.

15:00 ***4027*. Effect of Diffusion Time on Diffusion Kurtosis in Neural Tissues**

Edward S. Hui[1,2], Steve H. Fung[2,3], Ed X. Wu[1,4]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, Hong Kong; [2]Department of Radiology Research, The Methodist Hospital Research Institute, Houston, TX, United States; [3]Department of Radiology, Weill Medical College of Cornell University, New York, United States; [4]Department of Electrical & Electronic Engineering, The University of Hong Kong, Hong Kong, Hong Kong

As diffusion-weighted (DW) signal attenuation not only depends on diffusion gradient strength but also the time separation between the 2 diffusion gradients (Δ), it is important to examine the effect of Δ on the kurtosis of the water displacement profile which could be estimated by a recently proposed robust and efficient technique known as diffusion kurtosis imaging (DKI). It quantifies the kurtosis of the water diffusion profile, by acquiring DW signal at multiple b-values by varying the diffusion gradient strength at fixed Δ. The effect of Δ on kurtosis has been studies in vivo for the first time to assess its potential in teasing biological information underlying neural microstructures.

15:30 ***4028*. Diffusional Kurtosis Imaging (DKI) in the Normal Cervical Spinal Cord at 3 T : Baseline Values and Diffusion Metric Correlations**

Eric Edward Sigmund[1], Maxim Bester[1,2], Ali Tabesh[1], Matilde Inglese[1], Joseph A. Helpern[1]
[1]Radiology, New York University Langone Medical Center, New York, NY, United States; [2]Neuroradiology, University Hamburg-Eppendorf, Hamburg, Germany

The microstructural sensitivity of diffusion-weighted imaging is a powerful diagnostic in degenerative spinal cord (SC) disorders, and its specificity to different pathologies can be amplified with advanced protocols that exceed the Gaussian diffusion approximation. To that end, this study presents diffusional kurtosis imaging in the cervical spinal cord of healthy control subjects at 3 T. A set of diffusion tensor (MD, FA, D_{axial},D_{radial}) and kurtosis tensor (MK, K_{axial},K_{radial}) metrics are derived. Diffusion and kurtosis metrics are observed to inversely correlate (e.g. low radial diffusion with high radial kurtosis), which is discussed in the context of SC microstructure.

Tuesday 13:30-15:30 Computer 58

13:30 ***4029*. A Theoretical Framework to Model Diffusion MRI Signals Taking Into Account Cell Membranes**

Jing-Rebecca Li[1], Cyril Poupon[2], Denis Le Bihan[2]
[1]Institut national de recherche en informatique et automatique (INRIA)

, Rocquencourt, France; [2]NeuroSpin, CEA, Saclay, France

We model diffusion in biological tissue and simulate MRI signal attenuation by solving a partial differential equation model with several diffusion compartments, coupled with appropriate interface and boundary conditions. We use a method based on heat layer potentials derived from the relevant Green's function. This method is an alternative to Monte-Carlo or finite difference based simulation methods. An advantage is that much larger time steps can be used in simulation, while preserving accuracy and stability of the numerical method.

14:00 ***4030*. In Vivo DTI Parameter Choice Using Monte-Carlo Diffusion Simulations in a Model of Brain White Matter**

Franck Mauconduit[1], Hana Lahrech[1]
[1]Functional and Metabolic Neuroimaging - Team 5, Grenoble Institute of Neuroscience, La Tronche, France

In this study, simulated diffusion-weighted signal in a model of white matter was developed in order to study the relationship between diffusion time (tdif) and ADC values. In vivo water diffusion experiments on the corpus callosum of the rat brain were performed and compared to the simulated data. For in vivo experiments and according to our simulated results, maximal and minimal ADC values were found independent on tdif. Therefore in vivo measurements would rather be acquired with a short tdif than with a larger one, resulting in a higher Signal to Noise Ratio.

14:30 **_4031_. Monte-Carlo Simulation Software Dedicated to Diffusion Weighted MR Experiments in Neural Media**

Chun-Hung Yeh[1,2], Denis Le Bihan[1], Jing-Rebecca Li[1], Jean-Francois Mangin[1], Ching-Po Lin[2], Cyril Poupon[1]
[1]NeuroSpin, I2BM, CEA, Gif-sur-Yvette, France; [2]National Yang-Ming University, Taipei, Taiwan

We develop a novel Monte-Carlo simulation tool dedicated to DW MR experiments by combining a Brownian dynamics simulator capable of simulating water diffusion in arbitrary geometries reproduced using meshes with a DW signal integrator emulating various MR pulse sequences. Complicated configurations mimicking neural tissue components (e.g. neurons) can be emulated, as well as tissue features (e.g. membrane permeability) and basic diffusion mechanisms in different compartments. This framework allows to bridge the gap between elementary processes and the resulting DW signal, providing a better understanding of the features observed in DW-MRI (e.g. ADC), and to optimize acquisition schemes for different applications.

15:00 **_4032_. Comparison of Spin Echo and Steady-State Free Precession Sequences for Diffusion Tractography of Whole, Ex-Vivo Human Brains**

Karla L. Miller[1], Gwenaelle Douaud[1], Saad Jbabdi[1], Timothy EJ Behrens[1], Jennifer A. McNab[2]
[1]FMRIB Centre, Oxford University, Oxford, Oxon, United Kingdom; [2]AA Martinos Center, Massachusetts General Hospital, Charlestown, MA, United States

Despite its popularity, there is relatively little data validating diffusion tensor imaging and tractography against gold-standard histology or dissection methods. Diffusion imaging of whole, ex-vivo human brains could provide this link by allowing comparison in the same tissue. We present results obtained using diffusion-weighted spin echo (DW-SE) and steady-state free precession sequences (DW-SSFP), each with 6 hours scan time on a clinical scanner. Both methods are able to track the corticospinal tract and corpus callosum. However, tractography of DW-SSFP data produces better quality tracking due to the lower uncertainty on principal tract direction.

Wednesday 13:30-15:30 Computer 58

13:30 **_4033_. Effect of Diffusion Time and B-Value on Quantitative DTI**

Edward S. Hui[1,2], Steve H. Fung[2,3], Ed X. Wu[1,4]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, Hong Kong; [2]Department of Radiology Research, The Methodist Hospital Research Institute, Houston, TX, United States; [3]Department of Radiology, Weill Medical College of Cornell University, New York, United States; [4]Department of Electrical & Electronic Engineering, The University of Hong Kong, Hong Kong, Hong Kong

Diffusion-weighted (DW) signal attenuation depends on not only the diffusion gradient strength but also the separation between the two diffusion gradients (i.e., diffusion time Δ). In this study, the effect of Δ and diffusion weighting factor b-value was examined and documented for conventional DTI by acquiring DW signals with various b-values at different Δ from normal adult rat brains in vivo.

14:00 **_4034_. Combined T1- And DTI Weighted Contrast for High Resolution Human Brain Mapping Using 3D MPRAGE**

marzieh Nezamzadeh[1,2], Gerald B. Matson, [23], Yu Zhang[1,2], Michael W. Weiner[1,2], Norbert Schuff[1,2]
[1]radiology, University of California San Francisco, san francisco, CA, United States; [2]Center for Imaging of Neurodegenerative Diseases, CIND, VA medical center, San Francisco, san francisco, CA, United States; [3]Pharmaceutical Chemistry, University of California San Francisco, san francisco, CA, United States

Previously, magnetization-prepared rapid gradient-echo (MPRAGE) has been combined with diffusion encoding to achieve diffusion tensor imaging (DTI). However, an incorporation of DTI contrast in 3D-MPRAGE has not been shown before on human brain data. Furthermore, a combination of T1 and DTI weighted contrast should benefit assessment of gray/white matter boundaries, which has important implications for accurately imaging brain atrophy. The overall goal of this study was to develop multiple contrast high resolution MRI. Specifically, we show the incorporation of DTI contrast, e.g. fractional anisotropy (FA) and mean diffusivity (MD), into T1-weighted 3D-MPRAGE using simulations and experimental results from human brain at 4T.

14:30 **_4035_. Effects of B-Matrix Correction on Fiber Tractography in High Resolution DTI with Short-Axis Propeller EPI**

Murat Aksoy[1], Samantha Jane Holdsworth[1], Stefan Tor Skare[1,2], Roland Bammer[1]
[1]Department of Radiology, Stanford University, Stanford, CA, United States; [2]Karolinska Institute, Stockholm, Sweden

Due to the prolonged acquisition time in DTI, the likelihood of patient motion increases. It is essential to correct for motion to assure the diagnostic quality and accuracy of tensor orientation in DTI. For interleaved sequences, such as Short-Axis Propeller-EPI, patient motion causes the b-matrix to vary between different parts of k-space. It was previously shown that correction of motion artifacts in this case requires non-linear methods. In this study, we investigated the effects of b-matrix correction on fiber tractography with high resolution DTI. Results showed that b-matrix correction is necessary to get accurate fiber tracts in moving subjects.

15:00 **4036. Sensitivity of Motion Estimation to the Anisotropic Diffusion of White Matter in Diffusion MRI**

Kwan-Jin Jung[1]
[1]Brain Imaging Research Center, Univ. of Pittsburgh and Carnegie Mellon University, Pittsburgh, PA, United States

Motion correction is critical in diffusion weighted (DW) imaging, but the motion correction quality depends on the accurate motion estimation of the DW images. However, the motion estimation of the DW images can be sensitive to the anisotropic white matter. This has been confirmed using the DW images obtained from an anesthetized and immobilized monkey's head and from a volunteer's head. The error in the motion estimation was increased significantly at a higher b value such as b=2400 s/mm^2. It is required to develop a new method of motion estimation that is insensitive to the white matter anisotropy.

Thursday 13:30-15:30 Computer 58

13:30 **4037. A Generalized Diffusivity for Tuning Diffusion-Weighted Imaging Contrast**

Mariana Lazar[1], *Jens H. Jensen*[1], *Joseph A. Helpern*[1]
[1]Department of Radiology, New York University School of Medicine, New York, United States

In this abstract we introduce a new measure, the generalized diffusivity, to characterize diffusion in biological tissues. The generalized diffusivity include a tuning parameter,α , that allows differential weighting of diffusion paths on different length scales. For α=2, the generalized diffusivity reduces to the conventional mean diffusivity.

14:00 **4038. Dependence of Fractional Anisotropy on Diffusion Time: A Frequency-Domain Analysis Using Temporal Diffusion Spectroscopy**

Junzhong Xu[1], *Ha-Kyu Jeong*[1], *Mark D. Does*[1], *Adam W. Anderson*[1], *Li Min Chen*[1], *John C. Gore*[1]
[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States

The FA dependence on diffusion time was studied using temporal diffusion spectroscopy, which employs an oscillating gradient spin echo sequence and has the ability to probe much shorter diffusion times. A clear dependence of white matter factional anisotropy on effective diffusion time has been observed in a fixed monkey brain. The results were also predicted by computer simulations. The dependence observed in this study provides a means to probe diffusion restriction and hindrance at sub-cellular length scales, e.g. intracellular structures, and may provide insights into the microstructure of biological tissues and clarify the origins of anisotropy diffusion in white matter.

14:30 **4039. Improved, Real-Time Artifact Detection and Reacquisiton for Diffusion Tensor Imaging (DTI)**

Yue Li[1,2], *Steven M. Shea*[2,3], *Hangyi Jiang*[3], *Christine H. Lorenz*[2,3], *Susumu Mori*[3]
[1]Biomedical Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Center for Applied Medical Imaging, Siemens Corporate Research, Baltimore, MD, United States; [3]Russell H. Morgan Department of Radiology and Radiological Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, United States

Subpixel motion artifacts caused by pulsation often introduces severe artifacts in diffusion weighted images and incorrect tensor estimation. Previously fitting-based outlier rejection methods have been proposed to obtain robust tensor estimation. This presentation extended the past efforts from two aspects. First, a new non-fitting-based quality criterion was added, which outperforms the existing method when fitting becomes unstable due to multiple outliers. Second, we implemented this algorithm into Siemens Image Calculation Environment such that reacquisition of corrupted slices can occur inline. Preliminary test results showed improvements with our method and reacquisition of data in real-time reduced the presence of artifacts.

15:00 **4040. Combining Registration and Outlier Rejection in Preterm DTI Data**

Drew Morris[1], *Revital Nossin-Manor*[1], *Margot J. Taylor*[1], *John G. Sled*[2,3]
[1]Diagnostic Imaging, Hospital for Sick Children, Toronto, Ontario, Canada; [2]Physiology Experimental Medicine, Hospital for Sick Children, Toronto, Ontario, Canada; [3]Department of Medical Biophysics, University of Toronto, Toronto, Ontario, Canada

When processing DTI data it is unclear as to whether outlier rejection should be done before or after correction steps which involve registration and resampling. Resampling outliers can corrupt adjacent data, while detecting outliers in uncorrected data can cause false outlier detection. We investigate this problem in processing pipelines for DTI in preterm neonates. We propose a method to tackle outlier rejection and registration based corrections simultaneously.

Diffusion Perfusion: Animal Models

Hall B Monday 14:00-16:00 Computer 59

14:00 ***4041*. Hippocampal Neurogenesis Visualized by Diffusion Tensor Imaging**

Chiao-Chi V. Chen[1], Kuan-Chi Mo[1], Chen Chang[1]
[1]Functional and Micro-Magnetic Resonance Imaging Center, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan

In vivo assessment of neurogenesis may serve as an important indication of brain functionality during brain development or pathologies. The present study utilizes diffusion tensor imaging (DTI) to capture this process alive, corroborated by immunohistology.

14:30 ***4042*. Assessment of Myocardial Heterogeneity Using the Supertoroid-Based Representation of Dt-Mri**

Choukri Mekkaoui[1,2], Marcel Jackowski[3], Roberto Martuzzi[1], Donald Dione[1], Albert Sinusas[1]
[1]Yale University School of Medicine, New Haven, CT, United States; [2]Harvard Medical School, Boston, MA, United States; [3]University of São Paulo

Supertoroids are a novel DT-MRI representation that provides indices of diffusivity (toroidal volume:TV) and anisotropy (toroidal curvature:TC). The purpose of this study is to establish the normal myofiber structure of the left ventricle (LV) using toroid-based indices and compare to traditional diffusion indices in normal porcine hearts. These new indices showed that the LV macrostructure was heterogeneous for both diffusivity and anisotropy between segments (Septum, RV/LV junction, and Free Wall) and within levels (basal, mid-ventricular, and apical). TV and TC demonstrate that diffusivity and anisotropy measures are complimentary, which may enhance the understanding of LV macrostructure in the normal heart.

15:00 ***4043*. Correlation of in Vivo DWI Injury Patterns with Finite Element Analysis of Mouse Spinal Cord Injury**

Tsang-Wei Tu[1,2], Philip V. Bayly[1], Sheng-Kwei Song[2]
[1]Mechanical, Aerospace and Structural Engineering, Washington University in St. Louis, Saint Louis, MO, United States; [2]Radiology, Washington University in St. Louis, Saint Louis, MO, United States

Knowledge of the biomechanical properties of the spinal cord is crucial to understanding the mechanisms and damage thresholds of spinal-cord-injury (SCI). Numerical analysis, such as Finite Element Analysis (FEA), relies on accurate knowledge of the in vivo material properties to model the stress and strain fields in the spinal cord during rapid impact. In the present study, we compare the extent of SCI, evaluated using in vivo DWI, to the predictions of FEA modeling, using published values of mechanical parameters obtained in vitro. Our results support the hypothesis that that SCI injury pattern correlated with stress-strain fields predicted by FEA.

15:30 ***4044*. Stability of Repeat Measures of CBF in Aged Tg2576 and Wild Type Mice *via* CASL**

James A. Goodman[1], Zhiyong Xie[2]
[1]BioImaging Center of Emphasis, Pfizer, Inc., Groton, CT, United States; [2]BioImaging Center of Emphasis, Pfizer, Inc, Groton, CT, United States

Cerebral blood flow is a physiological parameter that varies within populations and is subject to significant physiological noise. In order to quantify the test/retest stability of CBF measurement via MR, arterial spin labeling was performed three times in three different imaging session on each of five aged App(+)Tg2576 mice (TG) and five age-matched controls (WT). The coefficient of variation of repeat measurements within each animal was about two times larger in the TG group than in the WT group. Since measurements from both groups were interspersed, it appears as though physiological noise was the dominant noise component in these measurements.

Tuesday 13:30-15:30 Computer 59

13:30 ***4045*. k-Means and Graph Cuts Clustering of Diffusion MRI in Rat STN**

Ellen Brunenberg[1], Erik Pelgrim[1], Bart ter Haar Romeny[1], Bram Platel[2]
[1]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [2]Biomedical Engineering, Maastricht University Medical Center, Maastricht, Netherlands

Deep Brain Stimulation of the STN for Parkinson's alleviates motor symptoms, but often causes cognitive or emotional side effects. In this abstract, we present the results of different clustering algorithms in order to separate the rat STN motor and cognitive/emotional parts. We performed k-means and graph cuts clustering on spherical harmonics coefficients for each voxel in an atlas-based ROI around the STN. Graph cuts clustering results in a medial STN cluster, which might correspond to the cognitive/emotional part of the rat STN. Future research could focus on other HARDI distance measures and on fiber tracking projections as clustering input.

14:00 ***4046*. Effects of Hypercapnia on DTI Quantification**

Abby Ying Ding[1,2], 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

The accuracy of DTI derived parameters can directly affect the interpretation of underlying biological microstructures. However, the diffusivity measurements are likely to be confounded by the presence of vasculature. Nevertheless, little is known about to what degree blood signal from vasculature affects the diffusion quantitation. In this study, we examined the effects of hypercapnia on DTI quantification indices in anesthetized rat brains. It was found statistically significant changes occurred in all parametric DTI maps indicating that hemodynamic alterations can potentially affect the DTI indices and detection of tissue microstructures. Therefore, cautions must be taken when interpreting DTI parameters in vivo.

14:30 ***4047*. Resolving of Crossing Pathways in the Optic Chiasm of Marmoset Monkey Using Diffusion Tractography with High Spatial and Angular Resolution**

Keigo Hikishima[1,2], Masayuki Yamada[3], Kanehiro Fujiyoshi[4], Suketaka Momoshima[5], Kenji Kawai[1], Masaya Nakamura[4], Norikazu Tamaoki[1], Hideyuki Okano[2]
[1]Central Institute for Experimental Animals, Kasawaki, Kanagawa, Japan; [2]Department of Physiology, Keio University; [3]Fujita Health University; [4]Department of Orthopaedic Surgery, Keio University; [5]Department of Radiology, Keio University

The marmoset has a well-developed visual pathway; therefore, it has been used for studying the development of the optic chiasm. We performed high angular resolution diffusion imaging (HARDI) with high spatial resolution of the ex vivo optic chiasm in order to resolve the crossing pathways. We succeeded in visualizing the precise fiber structure in the optic chiasm with semidecussation, therefore ex vivo HARDI will be powerful tool for studying the neuroanatomic features of the optic chiasm.

15:00 ***4048*. The Structural Basis of Functional Improvement in Post-Infarct Rat Hearts with Stem Cell Treatment**

Yong Chen[1,2], Jia Zhong[1,2], Walter C. Low[3], Jianyi Zhang[4], Xin Yu[1,2]
[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Case Center for Imaging Research, Case Western Reserve University, Cleveland, OH, United States; [3]Department of Neurosurgery, University of Minnesota; [4]Division of Cardiology, University of Minnesota

In this study, we combined in vivo functional assessment with ex vivo characterization of myocardial structure to investigate the long-term effects of stem cell therapy on the structural and functional remodeling in post-infarct rat hearts. Our results suggest that stem cell treated hearts manifested preserved myocardial structure, which provided structural basis for improved cardiac function.

Wednesday 13:30-15:30 Computer 59

13:30 ***4049*. White Matter Microstructural Alterations Induced by Chronic Cocaine Self-Administration: A Diffusion Tensor Imaging Study in the Rat**

Alessandro Gozzi[1], Michela Tessari[1], Federica Agosta[1], Lisa Dacome[1], Mauro Corsi[1], Angelo Bifone[1]
[1]Neuroscience CEDD, GlaxoSmithKline, Verona, Verona, Italy, Italy

Cocaine abuse is often modelled in experimental paradigms where rats are trained to self-administer the drug. However, the exact degree to which these models replicate the neurofunctional and microstructural alterations observed in neuroimaging studies of cocaine-addicts remains unknown. Here we used Diffusion Tensor Imaging to investigate white matter integrity in a rodent model of long-term, long-access self-administration of cocaine. We found substantial microstructural alterations in the frontal corpus callosum, a hallmark of reduced white matter integrity consistently observed in cocaine abusers. These findings strengthen the construct-validity of this self-administration model to investigate the neuroanatomical substrates involved in the transition from occasional drug use to chronic drug consumption.

14:00 ***4050*. Chimpanzees' Primary Motor Cortex Asymmetry and Its Association with Handedness – a Combined T1- And Diffusion-Weighted Magnetic Resonance Imaging (MRI) Study**

Longchuan Li[1], Todd M. Preuss[2], James K. Rilling[3], William D. Hopkins[4], Matthew F. Glasser[5], Bhargav Kumar[6], Roger Nana[6], Xiaodong Zhang[2], Xiaoping Hu[6]
[1]Biomedical Imaging Technology Center, School of Medicine, Georgia Institute of Technology/Emory University, Atlanta, GA, United States; [2]Division of Neuroscience, Yerkes National Primate Research Center, Atlanta, GA, United States; [3]Center for Behavioral Neuroscience, Emory University, Atlanta, GA, United States; [4]Division of Psychobiology, Yerkes National Primate Research Center, Atlanta, GA, United States; [5]Department of Anthropology, Emory University, Atlanta, GA, United States; [6]Department of Biomedical Engineering, Georgia Institute of Technology/Emory University, Atlanta, GA, United States

Recent studies indicate that chimpanzees show a population-level bias for the use of the right hand for certain tasks. Here we studied the chimpanzees' hemispheric asymmetry in the precentral corticospinal tracts (pCST) using diffusion magnetic resonance imaging and its association with handedness. The depth of the central sulcus was also measured and their relationship with handedness and the asymmetry of the pCST were studied. The results show that handedness has an effect on the asymmetry of the central sulcus depth,

but not the asymmetry of the pCST fractional anisotropy (FA). It is likely that the asymmetries of central sulcus depth and that of corticospinal FA are largely functionally independent in chimpanzees and hand dominance is related more strongly to interhemispheric differences in cortical gray matter volume than to interhemispheric differences of the corticospinal tract white matter indexed by FA.

14:30 ***4051*. A Comparative Study of MRI Diffusion-Related Parameters for the Early Detection of Radiation-Induced Tissue Changes in a Rodent Tumour Model**

Frank Peeters[1], Dennis Rommel[1], Jorge Abarca-Quinones[1], Vincent Gregoire[2], Thierry Duprez[1]
[1]Medical Imaging, Université Catholique de Louvain, Brussels, Belgium; [2]Center for Molecular Imaging and Experimental Radiotherapy, Université Catholique de Louvain, Brussels, Belgium

The diagnostic accuracy of diffusion MRI related parameters derived from different techniques should be empirically assessed. We have performed a comparative study for the assessment of early effects of radiation therapy in a rodent tumour model (rhabdomyosarcoma in rats). Parameters obtained from DTI (2-points ADC, mono- and bi-exponential fits) and q-space imaging (tensor analysis) were compared. Our study shows that diffusion coefficients were very sensitive to radiation-induced tissue changes. Q-space analysis yielded at least the most sensitive parameter: the excess kurtosis of the distribution. The mean value and anisotropy of the tensors detected different sub-areas within irradiated tissue.

15:00 ***4052*. The Power of the Linear, Planar, and Tubular Tensor in Experimental Stroke**

Miia Pitkonen[1], Aysan Durukan[2], Eric Pedrono[3], Ivan Marinkovic[2], Turgut Tatlisumak[2], Usama Abo-Ramadan[4]
[1]Biomedicum Helsinki, Experimental MRI laboratory , Helsinki, Finland; [2]Department of Neurology, Helsinki University Central Hospital, Helsinki, Finland; [3]Biomedicum Helsinki, Experimental MRI Laboratory, Helsinki, Finland; [4]Biomedicum Helsinki, Experimental MRI Laboratory, Helsinki, Finland

Diffusion tensor imaging can approximates the linear, planar, and tubular tensor using CL, CP, and CS. We want to characterize the evolvement of these indices following brain ischemia. We followed the evolvement of these indices in 3 cortex, subcortex, and corpus callosum. Following brain ischemia, no such systematic approach over an extended period of time, with CL, CP, and CS, has not yet been reported. Wistar rats were subjected to focal cerebral ischemia by transient suture occlusion (n = 9). They were imaged in the hyperacute (2 and 3.5 hours), acute (1, 2, and 3 days), subacute (4 days, 1, and 2 week), and in the chronic phase (4, 6, and 8 weeks) after the MCAO. The MRI measurements were performed with a 4.7 T MR Scanner. Following acute ischemia, indices indicated damage in the neuronal cell bodies and in the chronic ischemic tissue possible recovery.

Thursday 13:30-15:00 Computer 59

13:30 ***4053*. Imaging Experience-Dependent Changes in White Matter Microstructure in Rats**

Jan Scholz[1], Cassandra Sampaio[1], Stephen Mchugh[2], David Bannerman[2], Alexandr Khrapichev[3], Nicola Sibson[3], Heidi Johansen-Berg[1]
[1]FMRIB Centre, Oxford, United Kingdom; [2]Experimental Psychology, Oxford, United Kingdom; [3]Gray Institute for Radiation Oncology & Biology, Oxford, United Kingdom

Structural brain plasticity in response to experience or learning can be found even in the adult mammal brain. Here we use diffusion MRI to determine the scope and location of white matter changes in rodents which learn the morris water maze task. Comparing MRI data to histology within the same animal will potentially yield a useful association between the two. This association can then be applied to human MRI data where histology or other information about neuro-cellular changes in unavailable.

14:00 ***4054*. DYT1 Dystonia of Mice and Men**

Aziz M. Ulug[1], An Vo[1], Miklos Argyelan[1], Wynne K. Schiffer[1], Lauren Tanabe[2], William T. Dauer[3], David Eidelberg[1]
[1]The Feinstein Institute for Medical Research, Manhasset, NY, United States; [2]Columbia UNiversity, New York, United States; [3]University of Michigan Medical School, Ann Arbor, MI, United States

Dystonia is a neurological disease characterized by sustained involuntary muscle contractions. Eight DYT1 heterozygous mice and six littermate controls using invivo MRI, FDG microPET and exvivo MRDTI were studied. We compared changes in mouse "genecopy" of DYT1 dystonia with their wild type littermate controls. We found that DYT1 mice exhibit metabolic and FA abnormalities that resemble the DYT1 patients. The correlation between striatum and cerebellum metabolic activity and the correlation between the metabolic activity and the FA abnormalities are also shown.

14:30 ***4055*. Co-Registration of DTI Tractography with Gd-Enhanced T1 Imaging in Evaluation of CED Studies in the Rhesus Macaque**

Elizabeth Zakszewski[1,2], Nagesh Adluru[1], Marina Emborg, [23], Andrew L. Alexander[1,2]
[1]Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin, Madison, WI, United States; [2]Dept. of Medical Physics, University of Wisconsin, Madison, WI, United States; [3]Wisconsin National Primate Research Center, University of Wisconsin, Madison, WI, United States

We use landmark-based registration methods to co-register diffusion tensor images with T1-Weighted images of the same animal taken during a Convection Enhanced Delivery (CED) study to the rhesus putamen. We then use the area of Gd-enhanced infusate at various time points as seeds to perform white-matter tractography, with the intent of visually evaluating the accuracy of the infusion.

Arterial Spin Labeling: Methods

Hall B Monday 14:00-16:00 Computer 60

14:00 ***4056*.** **Improved Quantification of Cerebral Blood Flow Change Using Phase Information of SWI, Corrected by Arterial Oxygen Saturation**

Yuri Zaitsu[1], Kohsuke Kudo[2], Rie Yazu[1], Kinya Ishizaka[3], Noriyuki Fujima[1], Satoshi Terae[1], Makoto Sasaki[2], Hiroki Shirato[1]
[1]Hokkaido University Graduate School of Medicine, Sapporo, Hokkaido, Japan; [2]Advanced Medical Research Center, Iwate Medical University, Japan; [3]Hokkaido University Hospital, Japan

The phase difference between vein and background tissue is able to lead oxygen saturation in vein and flow. We propose a new formula, in which arterial oxygen saturation is taken into account, to calculate venous flow change using phase information. The purpose of this study is to compare two formulas (previous studies and our proposal), in the measurements of venous flow change under the drug and physiological load, and to compare the results with cerebral blood flow change measured by arterial spin labeling (ASL) technique. The flow calculating from previous formula had no correlation with CBF changes using ASL, whereas, the flow calculating from present one had weak correlation. The flow formula corrected arterial oxygen saturation supposes to be more useful than previous formula without correction.

14:30 ***4057*.** **Imaging of Oxygen Extraction Fraction Using Velocity Selective Excitation with Arterial Nulling (VSEAN)**

Jia Guo[1], Eric C. Wong[2]
[1]Department of Bioengineering, University of California San Diego, La Jolla, CA, United States; [2]Department of Radiology and Psychiatry, University of California San Diego, La Jolla, CA, United States

We introduced a new method to image oxygen extraction fraction noninvasively using velocity selective excitation with arterial nulling (VSEAN). Compared to the QUIXOTIC method, VSEAN has following advantages: 1) higher SNR due to more relaxed venous blood; 2) no subtraction gives higher time efficiency; 3) insensitive to physiological noise; 4) a T2 map is generated every TR from multi-echo acquisition. Sequence design details were discussed and results from a human subject were presented.

15:00 ***4058*.** **A Straightforward Approach for Measuring Blood Transit Time in Major Blood Vessels**

Qin Qin[1,2], Peter C.M. van Zijl[1,2]
[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 Institute, Baltimore, MD, United States

Knowledge of blood transit time in major blood vessels can provide important clinical information about vascular circulation. It can also facilitate the selection of labeling delay in ASL for quantification of CBF. Here a novel method of measuring blood transit time is proposed, which used slice-selective spin labeling followed by multiple delay time points with very short interval. Transit time estimation in different blood circulation segments was demonstrated.

15:30 ***4059*.** **STAR-TFE Sequence for Arterial Spin Labeling in Abdominal Organs at 3T**

Jing Yuan[1], Heather Ting Ma[1,2], Yi-Xiang Wang[1], David K.W. Yeung[1], James F. Griffith[1]
[1]Department of Diagnostic Radiology and Organ Imaging, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong; [2]Department of Electronic and Information Engineering, Harbin Institute of Technology Shenzhen Graduate SchoolGradu, Shenzhen, Guangdong, China

Arterial spin labeling (ASL) is having many applications outside the brain. In the abdomen, many problems arise with the traditional single shot EPI acquisition for ASL such as distortion, low spatial resolution, susceptibility artifact, Nyquist ghost, and chemical shift. A turbo field echo (TFE) acquisition with STAR labeling (STAR-TFE) was developed to overcome these problems and applied for abdominal ASL at 3T. Significant image quality improvement was achieved. STAR-TFE has comparable temporal resolution with HASTE and b-ssfp acquisition, but with lower SAR and no banding artifact. STAR-TFE should be promising for abdominal perfusion in spinal bone marrow and kidney.

Tuesday 13:30-15:30 Computer 60

13:30 ***4060*.** **MT Effect of Q2TIPS in Multiple Inversion Time ASL Acquisitions**

Enrico De Vita[1,2], David L. Thomas[2,3], Matthias Günther[4,5], Xavier Golay[1,3]
[1]Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, United Kingdom; [2]Medical Physics and Bioengineering, University College London, London, United Kingdom; [3]Institute of Neurology, University College London, London, United Kingdom; [4]Mediri GmbH, Heidelberg, Germany; [5]Fraunhofer MEVIS-Institute for Medical Image Computing, Bremen, Germany

In arterial spin labelling (ASL) acquisitions, multiple post-labelling delays (TI) are often used to quantify cerebral blood flow (CBF) without the potential errors associated with assumptions on bolus arrival time. Q2TIPS saturation is often additionally used to precisely define the temporal width of the tagged bolus and facilitate CBF estimation. However the Q2TIPS pulse train modifies tissue and blood signal via magnetisation transfer effects. Here, we examine this undesired effect in multi-TI ASL with 3D-GRASE, in

particular how it alters the effectiveness of background suppression of static tissue and therefore impacts on the SNR of the ASL measurement.

14:00 ***4061*. Aliasing, Off-Resonance Saturation, and Residual Signal Analysis for PCASL**

Tejas Nair[1], Rolf Pohmann[2], Michael Gach[1]
[1]Research Imaging Facility, Nevada Cancer Institute, Las Vegas, NV, United States; [2]MRT, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany

The aliasing, off-resonance saturation, and residual signal (control-label) characteristics of pulsed continuous arterial spin labeling (PCASL) were measured in a 2% agar phantom using various values of label and control RF (B1) and gradient (Gmax) amplitudes. Aliasing and off-resonance saturation for both the label and control increased with increasing B1 but decreased with increasing Gmax. The residual signal also decreased with increasing Gmax.

14:30 ***4062*. Correction of Partial Volume Effects in PASL Perfusion Measurements**

Marco Pimentel[1], Pedro Vilela[2], Inês Sousa[3,4], Patricia Figueiredo[3]
[1]Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Lisbon, Portugal; [2]Imaging Department, Hospital da Luz, Lisbon, Portugal; [3]Instituto Superior Técnico, Lisbon, Portugal; [4]Healthcare Sector, Siemens, S.A., Portugal

We developed a simple model to correct for partial volume effects (PVE's) in ASL imaging and studied its performance in the estimation of grey matter (GM) and white matter (WM) perfusion, as well as in the application of ASL to brain activation measurements in fMRI, in a group of 15 healthy subjects at 3T. Our results reveal the importance of performing an accurate segmentation in order to achieve a good correction of PVE’s, which can strongly influence the measured GM to WM perfusion ratio and also the perfusion changes due to activation.

15:00 ***4063*. Effects of Slice Orientation and Parallel Acquisition on EPI-Based PASL Perfusion Imaging in Areas with Susceptibility Artifact**

Shih Yu Cheng[1], Yuan Yu Hsu[2], Wan Chun Kuan[3], Mei Yu Yeh[1], Kun Eng Lim[2], Ho Ling Liu[1,4]
[1]Medical imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan; [2]Medical Imaging, Buddhist Tzu Chi General Hospital, Taipei, Taiwan; [3]Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan; [4]Division of Medical Imaging and Intervention, Chang Gung Memorial Hospital, Taoyuan, Taiwan

ASL MRI using gradient-echo EPI suffers from susceptibility artifact in areas near air/tissue interfaces. Previous fMRI studies investigated the optimal slice tilt to reduce the signal dropout in those areas. Besides, parallel imaging can help by having shorter echo trains which reduces intra-voxel dephasing. This study focused on the orbitofrontal cortex region and evaluates the effects of slice angle combined with parallel imaging on ASL image quality. The results indicated that using parallel imaging could reduce the signal dropout caused by dephasing effect of susceptibility related field gradient. Parallel imaging is also preferable due to less subject to slice orientation.

Wednesday 13:30-15:30 Computer 60

13:30 ***4064*. Minimizing Acquisition Time for Quantification of Regional Cerebral Blood Flow (RCBF) and Arterial Transit Time (ATT) Using Pseudo-Continuous ASL at 3.0T**

Yasuhiro Fujiwara[1], Hirohiko Kimura[2], Tsuyoshi Matsuda[3], Tomokazu Ishida[1], Kyouji Higashimura[1]
[1]Radiological Center, University of Fukui Hospital, Fukui, Japan; [2]Radiology, University of Fukui, Fukui, Japan; [3]GE Healthcare Japan, Tokyo, Japan

The purpose of this study was to evaluate the effect of the number of post labeling delay times and averages to reproduce and minimize acquisition time for precise rCBF quantification. As result of this study, When performing pCASL at post label delay of 0.5, 1.0, 1.5s, reproducible perfusion images were obtained with sufficient SNR in the condition of 12 averages. Using 3 time points protocol, scanning time can be minimized as short as 5 minutes.

14:00 ***4065*. A Modified Version of Hrabe-Lewis Model to Account Dispersion of Labeled Bolus in Arterial Spin Labeling**

Onur Ozyurt[1], Alp Dincer[2], Cengizhan Ozturk[1]
[1]Bogazici University, Biomedical Engineering Institute, Istanbul, Turkey; [2]Acibadem University, School of Medicine, Department of Radiology

We propose a modified version of Hrabe-Lewis model for pulsed arterial spin labeling (pASL) signal and discuss its parameter estimation in a simulation with a realistic noise data coming from in vivo ASL measurements

14:30 ***4066*. Accounting for Dispersion in Arterial Spin Labeling Using the Mass Transport Model: Validation Using the Arterial Input Function**

Samira Kazan[1], Michael Chappell[1,2], Mathias Gunther[3], Stephen Payne[1]
[1]Biomedical Engineering, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]Centre for Functional MRI of the Brain, University of Oxford, Oxford, Oxfordshire, United Kingdom; [3]Department of Neurology , University of Heidelberg, Heidelberg

Dispersion of labelled blood water is a known issue in the quantification of cerebral blood flow using arterial spin labelling. A mass transport model (MTM) of the dispersion of a bolus of labelled blood within an artery has been recently presented. Here the MTM is validated by examining ASL data containing arterial signal. It is found to fit the data with lower error than alternative models. It also captured the increasing dispersion of the bolus during transit along the arterial tree, as evidenced by estimates of path length and mean flow speed.

15:00 ***4067*. Separation of Intravascular Signal in Multi-Inversion Time Arterial Spin Labelling MRI**

Michael A. Chappell[1], Bradley J. MacIntosh[1,2], Manus J. Donahue[1], Matthias Günther[3,4], Peter Jezzard[1], Mark W. Woolrich[1]
[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom; [2]Imaging Research, Sunnybrook Research Institute, Toronto, Canada; [3]Department of Neurology, Universitätsklinikum Mannheim, University of Heidelberg, Mannheim, Germany; [4]mediri GmbH, Heidelberg, Germany

An important artefact in ASL measurements arises from labelled water that is still intravascular (IV) at the time of imaging. One solution is the application of flow suppression. An alternative, for multi-TI ASL, is to include the IV component within the Kinetic model whilst ensuring that this component is only used where the data supports it. In this work the two alternatives were compared in both healthy subjects and patients with stenoses. The model fitting approach was found to be a viable alternative to flow suppression, making it suitable where flow suppression is not desirable or feasible.

Thursday 13:30-15:30 Computer 60

13:30 ***4068*. Selective Arterial Spin Labeling After Extra-Intracranial Bypass Surgery**

Simon Konstandin[1], Patrick Michael Heiler[1], Johann Scharf[2], Lothar Rudi Schad[1]
[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany; [2]Department of Neuroradiology, Heidelberg University, Mannheim, Germany

Perfusion originating from the summed supply of all brain feeding arteries is commonly assessed. In this study, a slice selective inversion was compared to a multidimensional RF pulse to label only the artery of interest. By tagging the bypass of a patient, perfusion signal only exists in the according hemisphere of the brain. The perfusion measured by these SASL methods is consistent with a standard angiography. Therefore, these presented MR techniques may in part replace the assessment of revascularization success by conventional angiography.

14:00 ***4069*. From Optimized Vessel Encoded PCASL (Opt-VEPCASL) to Randomly-Encoded VEPCASL (Re-VEPCASL)**

Jia Guo[1], Eric C. Wong[2]
[1]Department of Bioengineering, University of California San Diego, La Jolla, CA, United States; [2]Department of Radiology and Psychiatry, University of California San Diego, La Jolla, CA, United States

While optimized Vessel Encoded Pseudo-Continuous ASL (opt-VEPCASL) provides higher SNR efficiency, randomly-encoded VEPCASL (re-VEPCASL) may provide other benefits such as: 1) no planning or angiogram is needed; and 2) it is potentially insensitive to resonance offsets. These advantages may benefit clinical users. In this abstract, the advantages of opt-VEPCASL and re-VEPCASL are discussed, and the efficiency of random encoding is examined by simulation.

14:30 ***4070*. Distribution of Cerebral Blood Flow in the Nucleus Caudatus, Nucleus Lentiformis and Thalamus: A Territorial Arterial Spin Labeling Mri Study**

Jeroen Hendrikse[1], Esben Thade Peteresen[2], Soke Miang Chng[2], Xavier Golay[3]
[1]Radiology, UMC Utrecht, Utrecht, Netherlands; [2]National Neuroscience Institute, Singapore; [3]University College London, United Kingdom

We investigate the effect of variations in the circle of Willis anatomy on the perfusion territory contributions to the deep brain structures.. Perfusion territory MRI could evaluate the deep brain structures in 119 of159 patients. In patients with a fetal type circle of Willis, there was a contribution from the ipsilateral ICA to the thalamus in all 41 hemispheres (100%), compared to 96 of the 197 hemispheres (49%) without a fetal type circle of Willis ($p<0.01$). In patients with a hypoplastic A1 segment, there was more often a contribution of the contralateral ICA to the ipsilateral deep brain structures.

15:00 **4071**. **A Comparison of 3D-GRASE and EPI for Vessel-Encoded Arterial Spin Labeling**

Thomas William Okell[1,2], Michael Chappell[1], Matthias Günther[3,4], Peter Jezzard[1]
[1]FMRIB Centre, Clinical Neurology, University of Oxford, Oxford, Oxfordshire, United Kingdom; [2]Department of Medical Physics and Clinical Engineering, Oxford Radcliffe Hospitals NHS Trust, Oxford, Oxfordshire, United Kingdom; [3]Faculty for Physics and Electrical Engineering, University Bremen, Bremen, Germany; [4]Fraunhofer MEVIS-Institute for Medical Image Computing, Bremen, Germany

In this study we compare echo planar imaging (EPI) and 3D-GRadient and Spin Echo (3D-GRASE) readouts with a vessel encoded arterial spin labelling preparation. Comparable vascular territory maps were obtained in both cases. The 3D-GRASE images had twice the signal-to-noise ratio and reduced signal drop-out but suffered from some blurring in the slice direction despite the use of parallel acceleration in one dimension. We conclude that 3D-GRASE is a viable option for vascular territory imaging but would be improved by reduced blurring which could be achieved by using parallel acceleration in two dimensions, for example.

ASL: Applications & Reproducibility

Hall B Monday 14:00-16:00 Computer 61

14:00 **4072**. **Cerebral Autoregulation Impairment Measured at the Brain Tissue Level with Arterial Spin Labeling MRI in Patients with a Symptomatic Carotid Artery Stenosis**

Reinoud Pieter Harmen Bokkers[1], Matthias J.P. van Osch[2], H Bart van der Worp[3], Gert J. de Borst[4], Willem P Th M Mali[1], Jeroen Hendrikse[1]
[1]Department of Radiology, UMCU, Utrecht, Netherlands; [2]Department of Radiology, LUMC, Leiden, Netherlands; [3]Department of Neurology, UMCU, Utrecht, Netherlands; [4]Department of Vascular Surgery, UMCU, Utrecht, Netherlands

Patients with a stenosis of the internal carotid artery have a high risk of ischemic stroke. In these patients, impairment of the vasodilatory capacity of the cerebral vasculature is an important measure of the degree of hemodynamic compromise. The aim of our study was to measure the cerebral autoregulatory status of the brain tissue supplied by the individual brain feeding arteries using arterial spin labeling MRI and to compare this to healthy controls. Our results show, that ASL is able to visualize and quantify the vasodilatory capacity in the flow territories of the major cerebral arteries at brain tissue level.

14:30 **4073**. **High Flavonoid Cocoa Changes Regional Cerebral Blood Flow**

Laura M. Parkes[1,2], Jonathan A. Goodwin[2], Andrew Irwin[2], Roeland van Kerckhoven[3], Richard Draijer[3]
[1]Imaging Sciences, University of Manchester, Manchester, United Kingdom; [2]MARIARC, University of Liverpool, Liverpool, United Kingdom; [3]Unilever Research & Development, Vlaardingen, Netherlands

The aim was to investigate the effect of high-flavonoid cocoa on CBF in a group of 15 subjects using arterial spin labeling, and determine any link between CBF and cognitive performance. We used a randomized cross-over design with 2 treatments: Cocoa soy-drink and a placebo drink, each taken for two weeks with CBF and cognitive performance measured at the end of each period. Consumption of high-flavonoid cocoa increased CBF in the temporal lobe and hippocampal regions involved in long-term memory function and decreased CBF to regions involved in working memory, in agreement with cognitive results.

15:00 **4074**. **Resting Cerebral Blood Flow as a Biomarker of HIV in the Brain**

Jewell Thomas[1], Huiling Peng[1], Tammie Benzinger[2], Avi Snyder[1], David Clifford[1], Beau Ances[1]
[1]Neurology, Washington University in St. Louis, St. Louis, MO, United States; [2]Radiology, Washington University in St. Louis, St. Louis, MO, United States

HIV causes hypoperfusion within cortical and subcortical brain structures. We used arterial spin labeling (ASL) to measure resting cerebral blood flow (rCBF) within HIV+ participants (both naïve and on stable highly active antiretroviral therapy (HAART)) and HIV- controls. HIV- controls had a significantly higher rCBF (61.7 ± 1.7 mL/100gm/min) compared to HIV+ participants (48.4 ± 1.9 mL/100gm/min). rCBF was significantly diminished in HIV+ naïve patients (44.8 ± 1.9 mL/100gm/min) compared to HIV+ subjects on stable HAART (52.6 ± 2.0 mL/100gm/min). Our results suggest that rCBF may provide a sensitive biomarker for efficacy of HAART in the brain of HIV+ participants.

15:30 **4075**. **Hemodynamic Characterization of Dementias Via Pseudo Continuous ASL**

Simone Chaudhary[1,2], Rafal Janik[1], Amy Scouten[1], Adrienne Dorr[1], Wayne Lee[3], Graeme Schwindt[1], Sandra Black[1], John Sled[3], Bojana Stefanovic[1]
[1]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [2]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada; [3]Hospital for Sick Children, Toronto, Ontario, Canada

A number of neurodegenerative diseases are characterized by compromised cerebral hemodynamics. Cerebral blood flow (CBF) and arterial transit time have been mapped in healthy elderly, MCI, and AD via pulsed continuous ASL at varying inversion times. Two compartment theory was employed in the analysis. MCI showed a trend toward decreased CBF relative to healthy volunteers, whereas AD was associated with a pronounced, statistically significant hypoperfusion. Arterial transit time decreases suggested compensatory vasodilation in a subset of subjects.

Tuesday 13:30-15:30 Computer 61

13:30 ***4076*. Effect of Arterial Blood Signal Measurements on the Repeatability and Accuracy of Whole Brain CBF Values with 3D-PULSAR Imaging**

Neville D. Gai[1], Sardha L. Talagala[2], John A. Butman[1]
[1]Radiology & Imaging Sciences, National Institutes of Health, Bethesda, MD, United States; [2]NINDS, National Institutes of Health, Bethesda, MD, United States

3D-PULSAR and 3D-IR-PULSAR provide whole brain perfusion imaging in about 5 minutes. Quantification of CBF is done using the Buxton model in conjunction with a QUIPSS II saturation pulse to define bolus length. Measurement of the arterial blood signal (M_{0A})is considered the single most important factor affecting accuracy and repeatability of CBF values in such a model. We investigated repeatability across volunteers with and without this source of error. It is shown that M_{0A} does not contribute significantly more than other sources of errors as long as parial volume and saturation effects are avoided. In addition, experiments with the same volunteers and different sessions provided average CBF values that were within 3% of each other.

14:00 ***4077*. Measurement Stability in Arterial Spin Labeling Investigated Using Multiple Sites**

Jerod Michael Rasmussen[1], Tom Liu[2], Bryon Mueller[3], Greg Brown[2], Christina Wierenga[2], Gary H. Glover[4]
[1]University of California, Irvine, Irvine, CA, United States; [2]University of California, San Diego; [3]University of Minnesota; [4]Stanford University

This study uses multiple scanners to investigate the effect of varying the number of repetitions used in CBF measurement of Gray Matter tissue (GM) and establishes recommendations for the minimum scan time necessary for a stable calculation. Data was combined across 2 traveling subjects studies and the number of repetitions used for analysis ranged from 16 to 104 in control/tag pairs. Gray Matter masked CBF statistics showed an expected inverse decrease in noise with acquisitions and converged on a recommendation of 92 repetitions for a stable CBF measurement.

14:30 ***4078*. Comparison of Reproducibility Between Continuous, Pulsed, and Pseudo-Continuous Arterial Spin Labeling**

Yufen Chen[1], Jiongjiong Wang[1], Marc Korczykowski[1], Maria Fernandez-Seara[2], John A. Detre[1]
[1]Center of Functional Neuroimaging, University of Pennsylvania, Philadelphia, PA, United States; [2]Center for Applied Medical Research, University of Navarra, Pamplona, Navarra, Spain

Pseudo-continuous arterial spin labeling is a recent addition to the family of ASL methods that combines the high signal-to-noise ratio (SNR) of continuous methods and the lower duty cycle of pulsed methods. To date, no formal within- and across-session comparison between the methods has been performed. Here, we compare the reproducibility of three variants of ASL: continuous, pulsed and pseudo-continuous. Our results demonstrate that pCASL and PASL have the lowest degree of variations (~13%) in scans repeated after one week, pCASL also has higher temporal SNR, which makes it a favorable method for measuring cerebral blood flow.

15:00 ***4079*. Regional Distribution, Laterality, and Reliability of Volumetric Cerebral Perfusion Imaging in Healthy Adults**

Adolf Pfefferbaum[1,2], Ajit Shankaranarayanan[3], David Alsop[4,5], Sandra Chanraud, [1,2], Anne-Lise Pitel[2], Torsten Rohlfing[1], Edith V. Sullivan[2]
[1]Neuroscience Program, SRI International, Menlo Park, CA, United States; [2]Psychiatry&Behavioral Sciences, Stanford University, Stanford, CA, United States; [3]MR Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [4]Radiology, Harvard Medical School, Boston, MA, United States; [5]Radiology, Beth Israel Deaconess Medical Center, Boston, m, United States

The regional distribution, laterality and reliability of volumetric arterial spin labeling (ASL) measurements of CBF in cortical, subcortical, and cerebellar regions was determined in normal volunteers. Regional CBF, normalized for global perfusion, was highly reliable when measured on separate days. There was considerable regional variability and several regions of significant lateral asymmetry. The posterior cingulate cortex had the highest perfusion and the globus pallidus the lowest, may be due to iron-induced signal attenuation. High rCBF in the posterior cingulate cortex in this task-free acquisition is consistent with its identification as a principal node of the "default mode network."

Wednesday 13:30-15:30 Computer 61

13:30 ***4080*. Comparison Between Total CBF Values Measured by ASL and Phase Contrast Over Increased Range of CBF Values**

Noam Alperin[1], Murat Bagci, Sang H. Lee, Lara Eftimov[2], Birgit Ertl-Wagner[2]
[1]University of Miami, Miami, FL, United States; [2]University of Munich, Germany

ASL utilizes the water in arterial blood as endogenous contrast agent to assess cerebral blood perfusion and therefore is becoming more commonly used. A perfusion image is generated by subtracting a tagged image from a control image, where the tagged image is acquired following the “labeling” of the blood upstream. The time delay between the labeling and the image acquisition is the transient time. The choice of this delay can affect the derived CBF values. This project aims to compare between measurements of total CBF obtained with ASL and phase contrast MRI. The comparison was done over a wide range of CBF values by manipulating the subjects end tidal pCO2 level. Results from this comparison suggest that the PC based tCBF values could be used for "calibrations" of relative ASL derived CBF values.

14:00 ***4081*. Comparison of Arterial Transit Times Estimated Using FEAST and LL-FAIR**

Yufen Chen[1], jiongjiong Wang[1], Marc Korczykowski[1], John A. Detre[1]
[1]Center of Functional Neuroimaging, University of Pennsylvania, Philadelphia, PA, United States

Arterial transit time is a physiological parameter measured by arterial spin labeling. Look-locker (LL-FAIR) and Flow Encoded Arterial Spin Tagging (FEAST) are two ASL variants that can quantify arterial transit time. Comparison of the estimated arterial transit times show good correlation between the two methods in gray matter of major vascular regions (r=0.46, p=0.02), despite a difference of ~1s. This is because FEAST is sensitive to arterial transit time to tissue, while LL-FAIR measures the arrival of labeled blood in the imaging slice. Combination of the two can improve understanding of pathology of cerebrovascular diseases.

14:30 ***4082*. The Porcine Kidney as a Biological Phantom for MR ASL Perfusion Measurements**

Keith Heberlein[1], Ulrike Haberland[1], Ernst Klotz[1], Micahel Lell[2]
[1]Siemens AG, Healthcare Sector, Erlangen, Germany; [2]Oberarzt Radiologisches Institut, Universitätsklinikum Erlangen

The porcine kidney is an effective biological phantom due to a dense capillary system, high rates of in vivo perfusion and an accessible vascular supply which is integrated easily into a flow circuit. This work demonstrates ASL based perfusion imaging and reproduces previous results based on CT dye dilution perfusion measures. A robust, stable model for multi-modality imaging of perfusion is presented.

15:00 ***4083*. Perfusion Imaging of the Human Cervical Spinal Cord**

Govind Nair[1], Xiaoping P. Hu[1]
[1]Department of Biomedical Engineering, Emory University and Georgia Institute of Technology, Atlanta, GA, United States

Perfusion imaging of the cervical cord, while challenging due to anatomical constraints and pattern of blood flow, may prove to be valuable in diagnosing and evaluating pathologies like ischemia, tumor and neurodegeneration. In this study, perfusion imaging of the cervical enlargement was performed on healthy human subjects using pulsed ASL technique with varying inversion times. We estimate an arterial transit time of 2s and observed the peak perfusion signal at 4s from the inversion pulse. The quantitative spinal cord perfusion rate was determined to be 26±11 ml/100g/min, which was lower than those in the brain.

Thursday 13:30-15:30 Computer 61

13:30 ***4084*. Increased Basal Ganglia Metabolism by the Dopamine Antagonist Metoclopramide Measured by Perfusion MRI**

Maria Asuncion Fernandez-Seara[1], Maite Aznarez-Sanado[1], Franz Heukamp[2], Maria Asuncion Pastor[1]
[1]Neuroscience, Center for Applied Medical Research. University of Navarra, Pamplona, Navarra, Spain; [2]IESE Business School. University of Navarra

The effects on cerebral perfusion of an oral dose of the dopamine antagonist antiemetic Metoclopramide were assessed in a group of young healthy volunteers, using phase contrast imaging and arterial spin labeling perfusion MRI. Metoclopramide significantly reduced mean blood velocity and blood flow through the internal carotid arteries and cerebral blood flow in distributed areas of the cortex. However, Metoclopramide intake selectively increased perfusion in the striatum. A similar perfusion pattern has been observed in patients with Parkinson´s disease. Our results suggest that hyperperfusion in the striatum could be a very early marker of PD and that ASL perfusion MRI could aid in the early diagnosis of the disease.

14:00 ***4085*. Quantification of Cerebral Blood Flow, Oxygen Extraction Fraction, and Oxygen Metabolic Index in Human with Inhalation of Air and Carbogen**

Hongyu An[1], Souvik Sen[1], Yasheng Chen[1], William Powers[1], Weili Lin[1]
[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

In this study, we have demonstrated that using CASL and ASE methods, CBF and OEF can be consistently measured in human under repeated air and carbogen inhalation. In agreement with previous PET study, an increase of CBF along with a reciprocal decrease of OEF, and an unchanged OMI were detected with carbogen inhalation.

14:30 ***4086*. Comparison of Cerebral Blood Flow Using Arterial Spin Labeling and Phase Contrast Angiography Under Hyperoxia and Hypercarbia.**

John Robert Cain[1], Samantha J. Mills[1], Alan Jackson[1], Laura M. Parkes[1,2]
[1]Imaging Science, University of Manchester, Manchester, United Kingdom; [2]Biomedical Imaging Institute, University of Manchester, Manchester, United Kingdom

Four healthy subjects (aged 24-29) underwent MRI imaging, inhaling 100% O_2, medical air and carbogen gas (95%O_2 5%CO_2). Imaging consisted of STAR ASL sequence followed by a PCA acquisition under each gas. CBF values were higher during carbogen inhalation compared to medical air with both PCA and ASL. 100% O_2 CBF results were not significantly different from medical air

using both methods but the difference between the ASL label and control signal (ΔM) was decreased compared to medical air and increased during CO_2 inhalation. ASL was able to detect changes in CBF with equal precision to PCA CBF measurements.

15:00 ***4087*.** **Human Retinal Blood Flow MRI Using Pseudo-Continuous Arterial Spin Labeling and Balanced Steady State Free Precession**

Sung-Hong Park[1], Yi Zhang[1], Jinqi Li[1], Qi Peng[1], Jiongjiong Wang[2], Timothy Q. Duong[1]
[1]Research Imaging Institute, Ophthalmology/Radiology, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States; [2]Radiology and Neurology, University of Pennsylvania, Philadelphia, PA, United States

Mapping human retinal blood flow has not been easy with EPI-based arterial spin labeling (ASL) techniques because of significant susceptibility effects around eyes. In this study, we propose to use a combination of pseudo-continuous ASL and balanced steady state free precession (bSSFP) readout for mapping blood flow in the human retina. The results showed reproducible human retinal blood flow, free of motion artifacts, image distortion, signal drop out and bSSFP banding artifacts.

Dynamic Contrast Enhancement MRI

Hall B Monday 14:00-16:00 Computer 62

14:00 ***4088*.** **Design and Testing of a Phantom for Calibration of MRI Systems Used in DCE-MRI Clinical Trials**

Michael H. Buonocore[1], David H. Gultekin[2], Michael A. Jacobs[3], Steffen Sammet[4], Natarajan Raghunand[5], Joshua Levy[6], Michael V. Knopp[4]
[1]Radiology, UC Davis Imaging Research Center, Sacramento, CA, United States; [2]Memorial Sloan-Kettering Cancer Center, New York, NY, United States; [3]Radiology, Johns Hopkins University, Baltimore, MD, United States; [4]Radiology, Ohio State University, Columbus, OH, United States; [5]Radiology, University of Arizona, Tucson, AZ, United States; [6]The Phantom Laboratory, Inc., Salem, NY, United States

This study presents a new DCE-MRI phantom designed for calibration of MRI systems to be used in multi-site clinical trials. Preliminary results at four clinical sites show the ability of the phantom to reveal critical similarities but also expected and unexpected differences in the images and derived DCE-MRI parameters.

14:30 ***4089*.** **Monte Carlo Simulation to Study the Robustness of Empirical DCE-MRI Kinetic Parameters to Gaussian Noise**

Ka-Loh Li[1], Alan Jackson[1], Gerard Thompson[1], Xiaoping Zhu[1]
[1]Imaging Science and Biomedical Engineering, The University of Manchester, Manchester, United Kingdom

Using empirical descriptors to assess T1-weighted DCE-MRI data is easy to perform. However, the effects of MRI noise on the reliability of empirical kinetic parameters have not been systematically investigated. This study investigated the robustness of several empirical parameters to Gaussian noise under various pharmacokinetic and noisy conditions using Monte Carlo simulation. We found that area under the enhancement curves was most robust to Gaussian noise. Signal enhancement ratio is mostly sensitive to noise and pharmacokinetic conditions. The study improved our understanding of the noise effect on empirical kinetic parameters, leading to better interpretation of these parametric images.

15:00 ***4090*.** **Optimal Period of Linearity Using Patlak Analysis in Brain Tumors**

Rajan Jain[1], Hassan Bagher-Ebadian[2,3], Jayant Narang[1], Siamak Pourabdollah Nejad-Davarani[2], Sona Sakesna[1], Lonni Schultz[4], Mohammad H. Asgari[2], James R. Ewing[2,3]
[1]Radiology, Henry Ford Hospital, Detroit, MI, United States; [2]Neurology, Henry Ford Hospital, Detroit, MI, United States; [3]Physics, Oakland University, Rochester, MI, United States; [4]Biostatistics and Research Epidemiology, Henry Ford Hospital, Detroit, MI, United States

In Patlak analysis, contrast agent transport is assumed to be unidirectional (from plasma space into extracellular extravascular space). Although this model has the advantage of simplicity, it is important to note that it will give inaccurate results when this assumption is incorrect as in leaky brain tumors. Using longer acquisition fit-times will probably yield overestimates of fV and underestimates of Ktrans in the leaky regions as these will fall into the non-linear part of the Patlak plot. Hence, understanding of the optimal fit-times as well as proper modeling used for Patlak analysis is important for measuring the physiologic parameters accurately.

15:30 ***4091*.** **The Patlak Plot in MRI Pharmacokinetic Analysis**

Charles S. Springer, Jr. [1], William D. Rooney[1], Xin Li[1]
[1]Advanced Imaging Research Center, Oregon Health & Science University, Portland, OR, United States

An honored method for pharmacokinetic interpretation is the Patlak Plot – the popular linearization technique introduced over 25 years ago for graphical tracer data analyses. In (Dynamic-Contrast-Enhanced) DCE-MRI, the injected contrast reagent (CR) plays the tracer role. However, there are crucial differences between the molecular mechanisms underlying the detection of tracers and CRs. This contribution discusses how these differences impact the use of the Patlak Plot for the analysis of DCE-MRI data.

Tuesday 13:30-15:30 Computer 62

13:30 ***4092*.** **Background Correction of Phase-Based Arterial Input Functions**

Anders Garpebring[1], Patrik Brynolfsson[1], Ronnie Wirestam[2], Nils Östlund[3], Mikael Karlsson[1]
[1]Radiation Sciences, Umeå University, Umeå, Sweden; [2]Medical Radiation Physics, Lund University, Lund, Sweden; [3]Biomedical Engineering and Informatics, Umeå University Hospital, Umeå, Sweden

Phase sensitive MRI has shown great potential for quantification of the Arterial Input Function (AIF). However, motion induced phase artefacts are problematic for in-vivo measurements and must be compensated for. The purpose of this study was to compare three different background ROI selection procedures for compensation of phase errors. Results showed that efficient correction of motion induced phase shifts requires a background ROI placed close to the vessel from which the AIF is sampled. Some further improvement can also be achieved by tracking and compensating for any in-plane motion of the vessel.

14:00 ***4093*.** **Preliminary Results with 3D DCE-MRI Curve Pattern Analysis of Treatment Response in Osteosarcoma**

Junyu Guo[1], Qing Ji[1], Mary E. McCarville[1], Najat C. Daw[2], Wilburn E. Reddick[1]
[1]Radiological Science, St Jude Children's Research Hospital, Memphis, TN, United States; [2]Department of Oncology, St Jude Children's Research Hospital, Memphis, TN, United States

A new osteosarcoma treatment protocol in our Institute includes a multiagent chemotherapy with an anti-angiogenic agent (bevacizumab). Serial DCE-MRI was performed at six different time points during neoadjuvant therapy, and a recently developed DCE-MRI data analysis method, the CPA method, was used to process the data and assess treatment response in the first eight patients. According to our preliminary results, it is feasible to assess the tumor treatment response to neoadjuvant therapy using the CPA method in DCE-MRI. Further investigation of this CPA method on a larger cohort of patients will be performed.

14:30 ***4094*.** **The Effect of Blood Inflow and B_1-Field Inhomogeneity on Measurement of the AIF in Axial 3-D SPGR DCE-MRI**

Caleb Roberts[1,2], Ross A. Little[1,2], Yvonne Watson[1,2], Sha Zhao[1,2], David L. Buckley[3], Geoff J M Parker[1,2]
[1]Imaging Science and Biomedical Engineering, The University of Manchester, Manchester, United Kingdom, United Kingdom; [2]The Biomedical Imaging Institute, The University of Manchester, Manchester, Greater Manchester, United Kingdom; [3]Division of Medical Physics, University of Leeds, Leeds, United Kingdom

A major potential confound in axial 3-D dynamic contrast-enhanced MRI (DCE-MRI) studies is the blood inflow effect and therefore the choice of slice location for arterial input function (AIF) measurement within the imaging volume must be considered carefully. Using a combination of computer simulations, flow phantom and *in vivo* studies we describe and understand the effect of blood inflow on the measurement of the AIF. We demonstrate that reliable AIFs are achievable in 3-D DCE-MRI but the use of inflow affected AIFs in tracer kinetic modeling result in large errors in tissue microvascular parameters.

15:00 ***4095*.** **Introducing New DCE Parametric Maps to Quantify Vascular Changes Induced by the Anti-Angiogenic Drug Sunitinib**

Areen Al.Bashir[1,2], Gilda Hillman[3], Meng Li[2], Yashwanth Katkur[2], E. Mark Haacke[1,2]
[1]Department of Biomedical Engineeringt, Wayne State University, Detroit, MI, United States; [2]Department of Radiology, Wayne State University, Detroit, MI, United States; [3]Department of Radiation Oncology, Wayne State University

DCE-MRI has been routinely used to quantify the effectiveness of new anti-angiogenic drugs on the tumor vasculature using Gd-DTPA as a contrast agent. However, this quantification is not easy. DCE has a lot of parameters that make it a very complex technique, such as finding AIF and choosing the pharmacokinetic model. Hence, in this study, we introduced the new DCE parametric maps which was calculated from Gd concentration, C(t), data. Regional analysis were preformed on 4 groups of mice treated with different dose of the anti-angiogenic drug, sunitinib, and the results compared. Our results demonstrate that DCE parametric maps have the potential to quantify the effect of new anti-angiogenic drugs on tumor and normal tissues. These findings were confirmed with histological observations.

Wednesday 13:30-15:30 Computer 62

13:30 ***4096*. Evaluation of Tracer Kinetics Parameters in Brain Gliomas Using Combined T1W and T2*W Contrast-Enhanced Dynamic MR Imaging: Comparison with Pathological Findings**

Keiichi Kikuchi[1], Shohei Kouno[2], Hitoshi Miki[1], Shogo Oda[1], Teruhito Mochizuki[1], Shiro Ohue[2], Kenya Murase[3]
[1]Radiology, Ehime University, Toon City, Ehime, Japan; [2]Neurosurgery, Ehime University, Toon City, Ehime, Japan; [3]Medical Engineering, Osaka University, Suita, Osaka, Japan

We evaluated various tracer kinetics parameters of brain gliomas using combined DCE-MRI and DSC-MRI in one examination. The tracer kinetics parameters are high in grade IV gliomas; especially the K1 value has a significant correlation with MIB-1 and MVD. These parameters derived from DSC-MRI and DCE-MRI should be correlated with the tumor vascularity and/or tissue permeability, and will provide additional information for diagnosis and prediction prognosis. Our protocol, which can derive the various tracer kinetics parameters of brain tumors in one examination, will be a promising protocol to evaluate the characteristics of brain tumors.

14:00 ***4097*. Quantitative Analysis of Perfusion Parameters in Osteoporotic Patients with Acute Vertebral Fracture Using Dynamic-Contrast-Enhanced MRI**

Gerwin P. Schmidt[1], Andreas Biffar, Steven P. Sourbron, Melvin D'Anastasi, Mike Notohamiprodjo, Maximilian F. Reiser, Andrea Baur-Melnyk
[1]Department of Radiology, University Hospitals Munich, Munich, Bavaria, Germany

The analysis of dynamic contrast-enhanced data provides reproducible quantitative perfusion parameters in healthy and pathologic bone marrow. Perfusion is strongly increased in acute osteoporotic fractures yielding areas of different perfusion parameters, potentially representing different sites of reactive and reparative process. Furthermore, perfusion parameter changes correlate with severity of osteoporosis and may serve as a tool to differentiate various stages of the disease.

14:30 ***4098*. Qualitative and Quantitative Assessment of Osteosarcoma Treatment Response Using DCE-MRA**

Junyu Guo[1], Wilburn E. Reddick[1]
[1]Radiological Science, St Jude Children's Research Hospital, Memphis, TN, United States

A DCE-MRA method is presented to provide a new way of rendering DCE-MRI data, which greatly simplifies the process for the large volume of DCE-MRI data and enables qualitative and quantitative assessment of the treatment response. The qualitative DCE-MRA method provides a simple and quick way for a radiologist to make an overall assessment of tumor response to neoadjuvant chemotherapy. This method makes it potentially possible for a radiologist to identify a likely nonresponder. The quantitative measures were evaluated and the shape of plot curves of the two patients was consistent with that from direct observation of MIP images.

15:00 ***4099*. Evaluating the Response to the Radiation Therapy of the Head and Neck Neoplasms by Dynamic Contrast-Enhanced MRI**

Shin-Lei Peng[1], Chih-Feng Chen[2], Ho-Ling Liu[3], Fu-Nien Wang[1]
[1]Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan, Taiwan; [2]Department of Radiology, Chang Gung Memorial Hospital Kaohsiung Medical Center, Kaohsiung, Taiwan, Taiwan; [3]Medical Imaging and Radiological Sciences , Chang Gung University, Taoyuan, Taiwan, Taiwan

Most of the DCE-MRI studies analyzed averaged signal time curves from a tumor region in a single slice. However, the averaged signal could not totally represent the heterogeneity of the whole tumor. The goal of this study was analyzing the histogram distribution of all initial slopes of enhancement from pixel-by-pixel signal time curves and distinguishing the malignant tumor from radiation necrosis in the hand and neck neoplasms. And the results show that the histogram distribution improved the specificity of diagnosis and provided the information about the heterogeneity of tumor compositions.

Thursday 13:30-15:30 Computer 62

13:30 ***4100*. Direct Measurement of Arterial Input Function in White Matter**

Vishal Patil[1], Jens H. Jensen[1], Glyn Johnson[1]
[1]Radiology, NYU School of Medicine, New York, United States

Estimating the arterial input function (AIF) is the first step in most DSC and DCE MRI analyses. Problems associated with measuring an AIF in a large vessel are partially resolved by AIF measurements in normal white matter. However, an accurate relationship between relaxivity and contrast agent concentration, *C*, has never been determined in white matter *in vivo*. In this study we compared AIFs derived from blood and white matter using two relaxivity models: 1) A nonlinear model which interpolates between both short and long static dephasing regime times. 2) A linear model while only considers long dephasing times. The results demonstrate that the nonlinear model provides an accurate relationship between relaxivity and *C*.

14:00 ***4101*. Nonlinear Partial Volume Effects in DCE-MRI**

Matthias C. Schabel[1], Edward V R DiBella[1]
[1]Radiology/Utah Center for Advanced Imaging Research, University of Utah, Salt Lake City, UT, United States

In the presence of partial voxel blood volume, conventional quantitative methods of converting signal to concentration in DCE-MRI result in significant biases in pharmacokinetic parameter estimates. Direct modeling and nonlinear regression of signal dependence on concentration avoids these biases, giving accurate and unbiased parameter estimates.

14:30 ***4102*. Non-Linear Contrast Agent Relaxivity and the Accuracy and Sensitivity of DCE MRI Measurements**

Vishal Patil[1], Glyn Johnson[1]
[1]Radiology, NYU School of Medicine, New York, United States

DCE MRI is increasingly used to determine the prognosis and diagnosis of various pathologies. The accuracy of DCE MRI parameter estimates is dependent on a variety of factors including the relationship between relaxivity and contrast agent concentration, *C*. Recent studies have demonstrated that relaxivity is not linearly dependent on *C* but is more accuratly described by a quadratic model. In this study we investigate the effect of neglecting non-linear components on DCE MRI parameter estimates derived using a Tofts/Kety model with both T_1 and T_2*-weighted protocols.

15:00 ***4103*. Optimal Flip Angle Set in Spoiled Gradient-Echo MR Imaging Technique**

Hassan Bagher-Ebadian[1,2], Ramesh Paudyal[1], Rajan Jain[3], Jayant Narang[3], James Russle Ewing[1,2]
[1]Neurology, Henry Ford Hospital, Detroit, MI, United States; [2]Physics, Oakland University, Rochester, MI, United States; [3]Radiology, Henry Ford Hospital, Detroit, MI, United States

In spoiled gradient echo sequences, the T1-weighting of image contrast is strongly affected by a nonlinear interaction of two sequence parameters, repetition time (TR) and flip angle (á) . Since the T1 is filed dependant, optimal set of á is chosen to produce a field-dependent contrast behavior in MR imaging. Therefore, a pulse sequence with an optimal set of flip angle which provides a best Signal-to-Noise ratio would be useful in various quantitative methods. In the proposed study, a set of optimal flip angles which yield a better tissue contrast at different magnetic field strengths (3T, 7T) is determined.

DSC Perfusion

Hall B Monday 14:00-16:00 Computer 63

14:00 ***4104*. Comparison of Different Algorithms for Minimizing Macro Vessel Signal in Cerebral Perfusion Imaging**

Gernot Reishofer[1], Karl Koschutnig[2], Christian Enzinger[3], Stefan Ropele[3], Franz Ebner[2]
[1]Radiology, Medical University Graz, Graz, Austria; [2]Neuroradiology, Medical University Graz; [3]Neurology, Medical University Graz

Parameter values obtained by DSC-MRI are often overestimated compared to PET and SPECT, which is due to the high sensitivity of DSC-MRI to large vessel. Two methods for minimizing macro vessel signal are compared in this work. First, the ICA method which is based on the separation of independent flow patterns using independent component analysis and second, the ELV method which is based on clustering of parameters derived from the dynamic contrast-enhanced first-pass curve. Our results indicate that the ICA method has some advantages over the ELV method and should be preferred for minimizing macro vessel signal in DSC-MRI data.

14:30 ***4105*. Tissue Similarity Map of High Resolution Perfusion Weighted MR Imaging of the Brain**

Meng Li[1], Areen Bashir[1], Yanming Yu[2], Yang Xuan[1], Zahid Latif[1], James Garbern[1], Jiani Hu[1], E M. Haacke[1,3]
[1]Wayne State University, Detroit, MI, United States; [2]Peking University, Beijing, China; [3]MRI Institute of Biomedical Research, Detroit, MI, United States

Tissue similarity map (TSM) is a new approach to reveal the brain tissue perfusion status directly from their signal intensity time course characteristics s(t) rather than indirectly through the concentration time curve c(t). It avoids the need for defining AIF as well. The purpose of this study is to use high resolution perfusion weighted MR imaging to create a tissue similarity map to demonstrate the differences in perfusion between tissues and inter-tissue. It may have immediate applications in clinic.

15:00 ***4106*. Voxel-Specific Brain Arterial Input Functions from DSC-MRI and Blind Deconvolution in a Group of Healthy Males**

Renate Gruner[1,2], Håkon Nordli[1], Gunnar Moen[1], Torfinn Taxt[1,2]
[1]Haukeland University Hospital, Bergen, Norway; [2]University of Bergen, Norway

Voxel specific arterial input functions were estimated in a group of 44 healthy males using a recently published blind deconvolution approach in order to investigate how the estimated functions varied across participants and brain regions. Qualitatively, variations in arterial input functions were consistent with expectations of normal vascular supply. The quantitative differences in the arterial input functions between brain regions suggested that the functions could be useful in reducing delay and dispersion effects in cerebral flow estimates. Differences in delays and dispersion were larger within one brain region across participants, than across regions within one participant.

15:30 ***4107*. Performance Analysis of the Inline Quantitative Cerebral Perfusion Measurements with MR**

Anindya Sen[1], Sameer Maheshwari[1], Jessy J. Mouannes[2], Chris Eddleman[3], Sven Zuehlsdorff[4], Saurabh Shah[4], Timothy J. Carroll[1,2]
[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Biomedical Engineering, Northwestern University, Chicago, IL, United States; [3]Neurological Surgery, Northwestern University; [4]CMR Research and Development, Siemens Healthcare, Chicago, IL, United States

The American Heart Association has deemed the quantification of cerebral perfusion in stroke to be of paramount importance. Hence accurate automated determination of perfusion image maps are essential for analyzing the tissue of risk after an ischemic stroke event. The need for offline post-processing of Dynamic Susceotibility Contrast (DSC) images can delay the availability of time critical information (i.e. the extent of the perfusion diffusion mismatch predicts the response to intra venous thrombolysis in ischemic stroke) Therefore we have developed a inline protocol to eliminate the offline generation of quantitative perfusion maps with evaluation.

Tuesday 13:30-15:30 Computer 63

13:30 ***4108*. A Method to Remove Large Blood Vessel Contribution in Brain Tumor Perfusion Imaging**

Kelvin K. Wong[1,2], Hui You[3], Geoffrey S. Young[3,4], Stephen TC Wong[1,2]
[1]Department of Radiology, The Methodist Hospital Research Institute, Houston, TX, United States; [2]Department of Radiology, Weill Cornell Medical College, New York, United States; [3]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States; [4]Department of Radiology, Harvard Medical School, Boston, MA, United States

Regional cerebral blood volume is a useful marker for brain tumor evaluation. However, large blood vessels also contribute to high blood volume, which may have nothing to do with tumor angiogenesis. Prior studies focused on multi-parametric methods to remove a blood vessel which is complex to implement and have a lot of assumptions in the automatic identifications. We propose a simple method to identify the regions affect by large blood vessels using a blood flow map generated by a novel deconvolution technique and successfully identifies the blood vessel contribution in the tumor blood volume map.

14:00 ***4109*. Quantification of Vessel Permeability with Dynamic Susceptibility Contrast MRI**

Yen-Peng Liao[1], Yi-Ying Wu[2], Yuan-Yu Hsu[3], Yau-Yau Wai, [1,4], Ho-Ling Liu[1,4]
[1]Department of Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan; [2]Department of Radiology, Taichung Veterans General Hospital, Taiwan; [3]Department of Medical Imaging, Buddhist Tzu Chi General Hospital, Taipei, Taiwan; [4]Division of Medical Imaging and Intervention, Chang Gung Memorial Hospital, Taoyuan, Taiwan

In DSC-MRI, the leakage of contrast agent which results in additional T1 and T2* relaxation effects in disrupted BBB causes the contamination of T2*-weighted signal. The relative CBV (rCBV) may be overestimated with uncorrected signal information. This phenomenon can be described with a theoretical model considered T1 and T2* relaxation effects and the rCBV can be corrected. Based on the model, the T1 of pre-contrast tissue measurement was an essential parameter for quantifying permeability surface area product (PS). This study provides a method for absolutely quantification of PS. The results showed comparable values to those in literatures.

14:30 ***4110*. Assessment of the Vascularity of Glioblastoma Multiforme Using Alternate-Echo Multislice Perfusion-Weighted MRI with the First-Pass Pharmacokinetic Model**

Tatsuya Yamamoto[1], Hidemasa Uematsu[1], Hiroaki Takeuchi[2], Hirohiko Kimura[1]
[1]Department of Radiology, University of Fukui, Fukui, Japan; [2]Department of Neurosurgery, University of Fukui, Fukui, Japan

T1 shortening effect due to the leakage of contrast agent causes underestimation of the tumor vascularity using single-echo perfusion-weighted MR imaging. On the other hand, T2* shortening due to contrast material present in the extravascular space causes overestimation. To incorporate the effects of the extravascular compartment containing contrast material residue, pharmacokinetic modeling with two compartments: the intravascular space; and the extravascular space: is required. We demonstrate here that the combination of an alternate-echo, single shot SPIRAL acquisition and first-pass pharmacokinetic model can correct for the T1 shortening effect, as well as for the T2* shortening in order to evaluate the exact tumor vascularity of enhancing glioblastoma multiforme.

15:00 ***4111*. Intraoperative DSC-MRI (IDSC-MRI): Feasibility and Clinical Application**

Stephan Ulmer[1], Gesa Hartwigsen[2], Michael Helle[1], Olav Jansen[1], Maximillian Hubertus Mehdorn[3], Arya Nabavi[3]
[1]Institute of Neuroradiology, University Hospital of Schleswig-Holstein, Kiel, Germany; [2]Department of Neurology, University Hospital of Schleswig-Holstein, Kiel, Germany; [3]Department of Neurosurgery, University Hospital of Schleswig-Holstein, Kiel, Germany

Dynamic susceptibility contrast MRI (DSC-MRI) was applied in a model with an air-fluid-level and in a flow phantom to assess possible artifacts of an intraoperative setting. In 6 patients with glioblastoma multiforme iDSC-MRI was performed. In both models there were only minor distortions. In 5 patients complete removal of the lesion was already achieved by the time of iDSC-MRI. In the remaining case tumor could be depicted that demonstrated identical perfusion ratio as in the preoperatively acquired scans. DSC-MRI is technically feasable intraoperatively and enables a differentiation of residual tumor from contrast-enhancement caused by surgical manipulation in these intraoperative MRIs.

Wednesday 13:30-15:30 Computer 63

13:30 ***4112***. **Comparison of Cerebral Blood Volume and Contrast Leakage Correction Efficiency with Dynamic Susceptibility Contrast Enhanced Perfusion Imaging**

Hiroyuki Kabasawa[1], Malancha Hore[2], Patrice Hervo[3], Tetsuji Tsukamoto[1]
[1]Japan Applied Science Laboratory, GE Healthcare Japan, Hino, Tokyo, Japan; [2]MR Engineering, GE Healthcare, Bangalore, India; [3]MR Clinical Development, GE Healthcare, Buc, France

Post-processing correction methods have been proposed to correct this contrast leakage effect in disrupted BBB and to obtain accurate CBV estimation from DSC data. The estimated leakage effect from DSC can vary with the reference time course used in the post-processing. Here, we evaluated the impact of reference time course to estimate the leakage effect using numerical simulation and clinical data. This study showed that appropriate selection of reference time course is an important factor to obtain reasonable contrast leakage index using DSC MRI. Reference time course with wider width may introduce false positive signal in leakage map.

14:00 ***4113***. **Comparison of a Data Processing Method Accounting for Contrast Agent Extravasation with the Pre-Load Approach in Bolus-Based CBV Estimates in Tumors**

Irène Troprès[1,2], Nicolas Pannetier, [23], Sylvie D. Grand, [2,4], Alexandre Krainik, [2,4], Jean-François Le Bas, [2,4], Emmanuel L. Barbier, [23]
[1]Unité IRM 3T, IFR1, La Tronche - Grenoble, France; [2]Universite Grenoble 1, Grenoble, France; [3]U836, INSERM, Grenoble, France; [4]Neuroradiology, Grenoble Hospital, Grenoble, France

Estimate of relative Cerebral Blood Volume (rCBV) obtained with DSC methods suffers from contrast agent (CA) extravasation in brain tumors. The aim of this study is to compare a data processing method accounting for CA dilution with the pre-load approach. In nine patients, a DSC protocol was performed twice within the same session. A gamma-variate fit was used to compute rCBV maps, with and without considering the dilution. This study suggests that the dilution method is relevant when CA pre-load is performed and that normalization of rCBV estimates by white matter values should be handled with care.

14:30 ***4114***. **Effects of Pre-Loading Dose on DSC-MRI with Contrast Agent Extravasation**

Yi-Ying Wu[1,2], Jyh-Wen Chai[1], Chi-Chang Chen[1], Ho-Ling Liu[2,3]
[1]Department of Radiology, Taichung Veterans General Hospital, Taichung, Taiwan; [2]Institute of Medical Physics and Imaging Science, Chang Gung University, Taoyuan, Taiwan; [3]MRI Center, Chang Gung Memorial Hospital, Taoyuan, Taiwan

Disruption of blood-brain barriers in brain lesions usually causes difficulty in accurate quantification if rCBV in DSC-MRI. In this study, a simulated model was proposed to evaluate the dependence of the pre-loading dose on the rCBV measurements. The results showed an underestimate of rCBV without pre-loading or with low pre-loading dose at 1.5T. The underestimation was improved with larger pre-loading dose. Significant overestimation of rCBV happened with pre-loading of contrast agents at 3.0T, particularly with higher dose and a longer TE. In conclusion, this experiment provided important evidence that how the pre-loading dose affect the accurate quantification of rCBV measurement.

15:00 ***4115***. **Modeling Relaxation Effects During Bolus Passage Through Leaky Vasculature Using the Finite Perturber Method**

David Bonekamp[1], Barney Douglas Ward[2], Richard Leigh[3], Peter B. Barker[1], Arvind P. Pathak[1]
[1]Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States; [2]Department of Biophysics, Medical College of Wisconsin,, Milwaukee, WI, United States; [3]Department of Neurology, Johns Hopkins University, Baltimore, MD, United States

Extravasation of contrast during bolus passage alters the dynamic susceptibility contrast MRI signal. Reliable quantification of microvascular parameters in common brain pathologies depends on the ability to account for effects of leaky vasculature. Analytical solutions are hampered by mathematical approximations. We extend the computational finite perturber model (FPM) by incorporating a compartmental model to simulate arterial bolus passage and contrast agent extravasation. We find that known characteristics of DSC-MRI signal curves can be successfully modeled. This approach provides a powerful framework to optimize imaging sequences and to examine the complicated interaction of pathological, physiological and biophysical phenomena that result in the observed DSC-MRI signal.

Thursday 13:30-15:30 Computer 63

13:30 ***4116*.** **Direct Comparison of Dynamic Susceptibility Weighted MR Perfusion with CT Perfusion in Brain Tumors**

Hassan Bagher-Ebadian[1,2], Jayant Narang[3], James Russel Ewing[1], Siamak Pourabdollah Nejad-Davarani[1,4], Mohammad Hossein Asgari[1], Sona Saksena[3], Rajan Jain[3]
[1]Neurology, Henry Ford Hospital, Detroit, MI, United States; [2]Physics, Oakland University, Rochester, MI, United States; [3]Radiology, Henry Ford Hospital, Detroit, MI, United States; [4]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

The purpose of this study is comparison of Dynamic susceptibility contrast enhanced MR perfusion (DSC-MRP) and CT Perfusion (CTP) in brain tumors patients in normal as well as abnormal regions. CTP maps were calculated using the Johnson and Wilson Model and DSC-MRP maps were calculated based on conventional singular value decomposition (SVD) technique. The results imply that there is underestimation of all perfusion parameters by SVD technique as compared to CTP mostly due to the fact that DSC-MRP only measures CBV from the microvasculature as well as due to the non-linearity of arterial input function with Contrast Agent (CA) concentration.

14:00 ***4117*.** **Measuring CBV by the Recirculation Part of Dynamic Susceptibility Contrast MRI on Rat Model**

Yi-Ling Wu[1], Chien-Chung Chen[1], Yi-Chun Wu[1], Chia-Hao Chang[1], Fu-Nien Wang[1]
[1]Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsin-Chu, Taiwan, Taiwan

Measuring Relative CBV from the recirculation part of concentration time curve is investigated on rat model. Since the first pass of DSC method is relative fast on rat, more data points could be recruited for CBV quantification in the recirculation part. The results showed better regression lines between MION CBV and recirculation CBV, and therefore the feasibility is proved in this study.

14:30 ***4118*.** **Quantification of Systematic Error in Standard Formula for Computing Transverse Relaxation Rates in DSC–MRI. Implications for Blood Volume and Flow Calculations**

José Rufino Solera Ureña[1], Salvador Olmos[1]
[1]Aragon Institute of Engineering Research, Universidad de Zaragoza, Zaragoza, Spain

In dynamic susceptibility contrast (DSC) MRI experiments, the increase in the tissue transverse relaxation rate due to the passage of a bolus of intravascular paramagnetic contrast agent is routinely calculated (up to a constant) as the logarithm of the tracer dependent MR intensity normalised to baseline intensity, assuming that T1 effects are negligible. This assumption is revisited by developing the enhancement condition for a typical GE pulse sequence and the associated enhancement angle. The systematic error associated with the usual formula is analysed. Error expressions for the blood volume and flow calculations in DSC–MRI experiments are also presented and their implications discussed.

15:00 ***4119*.** **Comparison of Four Techniques That Directly Use Residue Function Characteristics When Estimating Cerebral Blood Flow During DSC MRI Studies**

Michael R. Smith[1,2], Juan Qiao[1], Marina Saluzzi[1,3], Richard Frayne, [1,3]
[1]Electrical and Computer Engineering, University of Calgary, Calgary, Alberta, Canada; [2]Radiology, University of Calgary, Calgary, Alberta, Canada; [3]Seaman Family MR Research Centre, Foothills Hospital, Calgary, Alberta, Canada

Current filtering techniques used in dynamic susceptibility contrast (DSC) studies to remove deconvolution noise are based on characteristics of the arterial signal C_a (t) and lead to CBF maps that decrease in accuracy as the tissue mean transit time (MTT) gets smaller. Our hypothesis is that greater CBF accuracy and CBF precision can be achieved by using techniques based on characteristics of the residue function; either in the time domain R(t) or in the frequency domain R(f). Of the four techniques investigated, one approach shows the most promise. This technique uses multiple points along the tissue residue function in time and frequency domains to obtain MTT estimates, and then derives CBF using CBF = CBV / MTT where CBV is the cerebral blood volume.

MR-Guided Focused Ultrasound

Hall B Monday 14:00-16:00 Computer 64

14:00 ***4120*.** **Multislice Treatment Planning and Control for Real Time MR-Guided Prostate Ablation with Transurethral Multisectored Ultrasound Applicators**

Andrew B. Holbrook[1,2], Punit Prakash[3], Peter Jones[3], Catherine Planey[2], Juan M. Santos[4,5], Chris J. Diederich[3], Kim Butts Pauly[2], F. Graham Sommer[2]
[1]Bioengineering, Stanford University, Stanford, CA, United States; [2]Radiology, Stanford University, Stanford, CA, United States; [3]Radiation Oncology, UCSF, San Francisco, CA, United States; [4]HeartVista, Los Altos, CA, United States; [5]Electrical Engineering, Stanford University, Stanford, CA, United States

Targeted prostate ablation with transurethral multisectored ultrasound applicators could be improved with an integrated imaging platform that minimizes procedural setup and treatment time. The purpose of this work was to integrate device localization, prostate-specific planning tools, and multi-slice MR thermometry into a single imaging platform. Various phantom experiments were

performed to validate each of these steps. Device localization and MR tracking was validated in a phantom, and an ablation was performed in another phantom with multi-slice thermometry and ROI feedback. The platform successfully measured temperature rises and relayed that data to external power control software that regulated the ablation.

14:30 ***4121*. Towards Real-Time Tracking of Anatomic Features for HIFU Beam Steering**

David A. Hormuth[1,2], Brian J. Zappia[2], Andrew B. Holbrook[3], Kim Butts-Pauly[3], Charles L. Dumoulin[2]

[1]Biomedical Engineering, Rose Hulman Institute of Technology, Terre Haute, IN, United States; [2]Imaging Research Center, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States; [3]Radiology, Stanford University, Stanford, CA, United States

Software for identifying and following anatomic features during real-time imaging was developed. This software was tested in real-time images of the liver during free breathing. It was able to successfully locate and follow the diaphragm and selected blood vessels within the liver during free breathing. These feature locations were used to generate the coordinates of an arbitrary target within the liver with sufficient speed and robustness to provide real-time offsets to a HIFU beam. It is anticipated that these algorithms will permit real-time ablation of liver lesions using HIFU during free-breathing and overcome the difficulties associated with breath held approaches.

15:00 ***4122*. MRI-Based Temperature Analysis of Transcranial MRI-Guided Focused Ultrasound Surgery for Functional Neurosurgery**

Nathan McDannold[1], Beat Werner[2], Daniel Jeanmonod[3], Eyal Zadicario[4], Rita Schmidt[4], Ernst Martin[2]

[1]Radiology, Brigham & Women's Hospital/Harvard Medical School, Boston, MA, United States; [2]MR-Center, University Children’s Hospital Zurich, Zurich, Switzerland; [3]Department of Functional Neurosurgery, University Hospital Zurich, Zurich, Switzerland; [4]InSightec, Ltd., Tirat Carmel, Israel

This work used MR temperature imaging (MRTI) to evaluate focal and skull-induced heating in nine patients treated for neuropathic pain in order to characterize the safety profile of a Transcranial MRI-guided Focused Ultrasound system. The ratio between focal and skull-induced heating was 11.3 using a conservative approach, approximately 2.7 times higher than in previous tests of an earlier version in glioblastoma patients, presumably due to improvements in the system, MRTI, and differences in target location. These results suggest an improved treatment window that can potentially increase the volume of the brain that can be safely targeted by the system.

15:30 ***4123*. Focal Spot Visualization in MRgFUS of the Breast: MR-ARFI Vs. T1-Weighted FSE**

Elena Kaye[1,2], Rachel Rinat Bitton[1], Kim Butts Pauly[1]

[1]Radiology, Stanford University, Palo Alto, CA, United States; [2]Electrical Engineering, Stanford University, Palo Alto, CA, United States

The goal of this study was to compare MR-ARFI and T1-w FSE approaches to focal spot visualization during breast MRgFUS. An ex vivo human breast tissue sample was imaged on a 3T MRI scanner equipped with an InSightec HIFU system. MR-ARFI displacement were compared with the magnitude difference images obtained by subtraction of FSE images with ultrasound on and off. The results of the study showed that both T1-w imaging and MR-ARFI allow visualization of the FUS focal spot., however, the MR-ARFI approach deposits 10 times less ultrasound energy and gives 3 times greater SNR than an FSE-based approach.

Tuesday 13:30-15:30 Computer 64

13:30 ***4124*. Integrated MRI and HIFU Control System: Towards Real Time Treatment of the Liver**

Andrew B. Holbrook[1,2], Chuck L. Dumoulin[3], Juan M. Santos[4,5], Yoav Medan[6], Kim Butts Pauly[2]

[1]Bioengineering, Stanford University, Stanford, CA, United States; [2]Radiology, Stanford University, Stanford, CA, United States; [3]Imaging Research Center, University of Cincinnati College of Medicine, Cincinnati, OH, United States; [4]HeartVista, Los Altos, CA, United States; [5]Electrical Engineering, Stanford University, Stanford, CA, United States; [6]InSightec Ltd, Tirat Carmel, Israel

We have developed an integrated MRI and high intensity focused ultrasound (HIFU) real time system. The system allows for both flexible control and monitoring of both systems, from device localization utilizing MR tracking to treatment planning and therapy monitoring utilizing MR thermometry pulse sequences. Additionally, the software allows for prescription of complex sonication spots, including treatment paths and regions. The system was tested both in a phantom and in vivo to assess its effectiveness in guiding HIFU therapy. Prescribed treatment plans were achieved in both experiments.

14:00 ***4125*. In Vivo Characterization of Tissue Thermal Properties of the Kidney by HIFU Local Hyperthermia Under MR-Thermometry with Modulation of the Arterial Flow**

François Cornelis[1,2], Nicolas Grenier[1,2], Chrit Moonen[1], Bruno Quesson[1]

[1]UMR 5231, Laboratory for molecular and functional imaging, CNRS/ Université Bordeaux 2, Bordeaux, France; [2]Radiology Department, CHU de Bordeaux, Bordeaux, France

The purpose was to evaluate in vivo quantitatively the tissue thermal properties (perfusion, absorption, thermal diffusivity). A total of 42 localized HIFU heating were performed in the kidney of 6 pigs monitored by MR thermometry. Arterial flow was modulated by an

angioplasty balloon in the aorta. The resulting temperature data were analyzed with the Bio Heat Transfer model and an excellent correspondence was observed. Absorption and thermal diffusivity were found independent from the flow, whereas perfusion was directly linked to arterial flow. This method could improve the quality of the planning of the non invasive therapy with MR guided HIFU.

14:30 ***4126*****.** **Mechanical Focal Spot Scanning with a Robotic Assistance System for MRgFUS Therapy**

Axel Joachim Krafft[1], Jürgen Walter Jenne[2,3], Florian Maier[1], Peter E. Huber[3], Wolfhard Semmler[1], Michael Bock[1]

[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany; [2]Mediri GmbH, Heidelberg, Germany; [3]Clinical Cooperation Unit Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany

Magnetic Resonance imaging guided Focus Ultrasound Surgery (MRgFUS) is a highly precise method for non-invasive tissue ablation. Existing MRgFUS systems are mostly integrated into the patient table of the MR scanner. The objective of this ongoing project is to establish an MRgFUS therapy unit combining a commercial robotic assistance system with a fixed focus transducer as add-on. The combined system's targeting precision was evaluated during focal spot scanning procedures. The system proved to allow for accurate and highly flexible focus positioning, and thus, might enable novel FUS treatment access.

15:00 ***4127*****.** **Navigator Based FUS Transducer Tracking Without the Micro-RF Coil Setup**

Naveen Bajaj[1]

[1]GE Healthcare, Bangalore, Karnataka, India

Focused ultrasound transducer tracking is of great significance in various new Magnetic Resonance guided Focused Ultrasound (MRgFUS) applications like in pain palliation of bone metastases and prostate tumor treatment. In this work, a navigator based novel method is described to demonstrate the feasibility of transducer tracking without the micro RF-coil setup. The algorithm is verified experimentally and provides highly accurate estimates, thereby making it suitable for the new applications. A novel tracking pulse sequence is also developed for the same, which is interleaved within the main thermal imaging pulse sequence.

Wednesday 13:30-15:30 Computer 64

13:30 ***4128*****.** **Effect of Water Resonance Thermal Shift on Methylene T1 Estimation with Multiple Flip Angle Multipoint Dixon Technique for Fat Temperature Imaging**

Mie Kee Lam[1,2], Taku Iwabuchi[1], Kensuke Saito[1], Kagayaki Kuroda[3,4]

[1]School of Engineering, Tokai University, Hiratsuka, Kanagawa, Japan; [2]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [3]Graduate School of Engineering, Tokai University, Hiratsuka, Kanagawa, Japan; [4]Medical Device Development Center, Foundation for Biomedical Research and Innovation, Kobe, Hyogo, Japan

Numerical simulations were performed to investigate the effect of thermal shift of water proton resonance on the accuracy of methylene T1 estimation for fat temperature quantification with multiple flip angle, multipoint Dixon acquisitions and a least square estimation scheme. The performance of separating methylene and methyl, and estimating T1's of those species were successful as far as the frequency separations between those species and water was exact. The results with incomplete setting of the frequency separations showed that the error in methylene T1 would be controlled and an accuracy of ±4°C can be achieved by adjusting the separation within an error of ±0.05 ppm.

14:00 ***4129*****.** **MR Guidance, Monitoring and Control of Brain Focused Ultrasound Therapy: In Vivo Demonstration in Rats at 7T**

Benoit Larrat[1], Mathieu Pernot[1], Elvis Dervishi[2], Danielle Seilhean[2], Yannick Marie[2], Anne-Laure Boch[2], Jean-François Aubry[1], Mathias Fink[1], Mickael Tanter[1]

[1]ESPCI Paristech - Institut Langevin, CNRS UMR 7587, Paris, France; [2]Hôpital de la Pitié Salpêtrière

A complete therapeutic workflow is developed to induce necrosis in the rat brain using a focused ultrasonic transducer under the guidance and monitoring of a 7T MR system. Three sequences are combined to monitor the procedure at different steps. Before the treatment, acoustic radiation force imaging shows the ability to accurately locate the focal spot in vivo. Furthermore, the MR signal is shown to provide a reliable quantification of the maximum acoustic pressure in situ. Then, the heating step is followed up via MR-thermometry. Finally, MR-Elastography.is evaluated as a tool to assess necrosis. 15 rats with and without injected tumors are treated. Induced lesions are confirmed at histology.

14:30 **_4130_. Polyethylene Glycol (PEG) Labeled Liposomal Drug Delivery Systems as a Source for Dynamic Absolute MR Thermometry**

Roel Deckers[1], Sara M. Sprinkhuizen[1], Bart J. Crielaard[2], J H. Ippel[3], R Boelens[3], Twan Lammers[2,4], C. J. Bakker[1], L W. Bartels[1]

[1]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands; [2]Department of Pharmaceutics, Utrecht University, Utrecht, Netherlands; [3]Department of NMR Spectroscopy, Bijvoet Center for Biomolecular Research, Utrecht University, Utrecht, Netherlands; [4]Department of Experimental Molecular Imaging, RWTH Aachen, Aachen, Germany

Dynamic absolute MR thermometry may be of great interest for the precise and accurate spatio-temporal control of hyperthermia in local drug delivery applications using MR guided HIFU. In this study we evaluate the use an mFFE sequence in combination with polyethylene glycol (PEG) labeled liposomes for dynamic absolute MR thermometry. PEG provides a temperature insensitive proton resonance frequency (PRF) that can serve as reference for the temperature sensitive PRF of water. The frequency difference between the PRFs of PEG and water, and thus the absolute temperature, can be deduced from the signal evolution in time over 32 echoes acquired with the mFFE sequence.

15:00 **_4131_. Volumetric Ablation of Tissue Using Magnetic Resonance Imaging Guided High Intensity Focused Ultrasound (MRgFUS) with Feedback Control and Multi-Slice Thermal Monitoring: Initial Experience in a Pig Model**

Jiming Zhang[1], Ann Marie Marciel[2], Tiina Karjalainen[3], Ari Partanen[4], Charles Mougenot, Amol Pednekar[3], Gil Costas[5], Jesse Rios[5], Fredd Clubb[5], John Fischer[2], Robert Zurawin[6], Pei Hor[1], Raja Muthupillai[2]

[1]Dept of Physics, University of Houston, Houston, TX, United States; [2]Diagnostic and Interventional Radiology, St. Luke's Episcopal Hospital, Houston, TX, United States; [3]Clinical Science, Philips Medical Systems, Cleveland, OH, United States; [4]Clinical Science, Philips Healthcare, Cleveland, OH, United States; [5]Texas Heart Institute; [6]Baylor College of Medicine

Preliminary results from a pig model suggest that it is feasible to create volumetric thermal lesions within in-vivo tissue using dynamic movement of the focal point of a High-Intensity Focused Ultasound beam with real-time multi-slice monitoring, and feedback control. The measured thermal dose diameters and lengths correspond closely with planned dose diameters for treatment cell sizes ranging from 4-16 mm in diameter.

Thursday 13:30-15:30 Computer 64

13:30 **_4132_. SNR Trade-Offs in MR-ARFI of Focused Ultrasound in the Brain**

Elena Kaye[1,2], Kim Butts Pauly[1]

[1]Radiology, Stanford University, Palo Alto, CA, United States; [2]Electrical Engineering, Stanford University, Palo Alto, CA, United States

MRgFUS is of interest in the treatment of various brain pathologies, such as tumors and neuropathic pain. One way to visualize the focal spot prior to the treatment relies on MR acoustic radiation force imaging. A recent implementation of MR-ARFI used a diffusion-weighted 2DFT sequence with a low b-value. The goal of this work was to find the optimum b-value for the displacement sensitizing gradient in MR-ARFI, relevant to in vivo human imaging. The optimal b-value of 33 s/mm2 was found to minimize the ghosting artifacts in vivo human brain images, and maximize displacement in the focal spot of ex vivo porcine brain, while keeping ultrasound energy minimal.

14:00 **_4133_. Therapeutic MRI-Guided High Intensity Focused Ultrasound Ablation of Uterine Fibroids with Volumetric Heating Technique: Early Clinical Experience in South Korea**

Bilgin Keserci[1,2], Young-sun Kim[3], Max Oskar Köhler[4], Hyunchul Rhim[3], Hyo Keun Lim[3]

[1]Philips Healthcare, Seoul, Korea, Republic of; [2]Samsung Medical Center,Department of Radiology, Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of; [3]Samsung Medical Center, Department of Radiology, Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of; [4]Philips Healthcare, Finland

As an alternative sonication method in magnetic resonance guided high intensity focused ultrasound treatment, volumetric sonication method with feedback control under volumetric MRI thermometry for the ablation of uterine fibroids was presented. This method efficiently utilizes the inherent heat diffusion by electronically switching the focal point between a number of predetermined locations situated at outwards-moving concentric circles with diameters of upto 16 mm. A significant improvemet in symptom severity score at 1month follow-up over baseline was observed. Volumetric treatment allows for complete and uniform cell coverage, and the delivery of optimal thermal dose significantly minimizing the risk of overtreatment.

14:30 ***4134*.** **Optimal Ultrasonic Focusing Through Strongly Aberrating Media Using Radiation Force Magnetic Resonance Guidance**

Benoit Larrat[1], Mathieu Pernot[2], Laurent Marsac[3], Benjamin Robert[3], Gabriel Montaldo[1], Jean-François Aubry[1], Mathias Fink[1], Mickael Tanter[2]
[1]ESPCI Paristech - Institut Langevin, CNRS UMR 7587, Paris, France; [2]ESPCI Paristech - Institut Langevin, INSERM, Paris, France; [3]SuperSonic Imagine, Aix en Provence, France

The non invasive correction of phase aberrations of ultrasonic waves is mandatory in the framework of human transcranial brain High Intensity Focused Ultrasound (HIFU) therapy at relatively high frequency (> 500 kHz). This study proposes an adaptive focusing technique based on the measurement of the acoustic intensity at the focus via MRI. The main objective is here to demonstrate the ability of acoustic radiation force MR imaging to learn experimentally how to correct strong medium aberrations with a few ultrasonic transmissions. Sharp focal spots and optimal acoustic energies are restored through several aberrating layers.

15:00 ***4135*.** **Continuous Liver Tracking During Free Breathing MRI Guided Focused Ultrasound**

Yuval Zur[1]
[1]GE Healthcare Haifa, Tirat Carmel, Israel

MRI guided focused Ultrasound (FUS) tissue ablation of the liver during free breathing requires continuous tracking of all the points to be treated (target points) throughout the treatment so that the FUS transducer can deliver energy to the right position. We present a tracking method using the liver blood vessels. The tracking is done with a restricted FOV single shot EPI suitable for temperature measurement. At first the landmarks are assigned to the blood vessels. These landmarks are then tracked during heating. The location of the target point is found by 2D interpolation of the landmarks coordinates.

Thermotherapy

Hall B Monday 14:30-16:00 Computer 65

14:30 ***4136*.** **Interleaved Slice Excitation for Echo-Shifted Acquisition of Orthogonal Proton Resonance Frequency Temperature Images**

Axel Joachim Krafft[1], Jaane Rauschenberg[1], Florian Maier[1], Jürgen Walter Jenne[2,3], Wolfhard Semmler[1], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany; [2]Mediri GmbH, Heidelberg, Germany; [3]Clinical Cooperation Unit Radiation Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany

Proton resonance frequency temperature images are acquired with gradient echo techniques. As the temperature induced frequency shift is very small, long echo times have to be used. In such long-TE gradient echo pulse sequences, the available time for application of the encoding gradients between RF excitation and data readout is only partly used. In this work, we present a novel interleaved excitation and readout technique for the acquisition of two orthogonal slices. Compared to conventional gradient echo techniques, this strategy is substantially more time-efficient and allows for temperature monitoring along all three spatial directions around the temperature focus.

15:30 ***4137*.** **In Vivo Evaluation of MRgHIFU Volumetric Sonication Using Interleaved Electronic-And-Mechanical Displacement of Focus**

Lorena Petrusca[1,2], Jacqueline Ngo[1], Vincent Auboiroux[1,2], Francois Cotton, [23], Jean-Yves Chapelon[1], Rares Salomir[1]
[1]Inserm U 556, Lyon, France; [2]University Lyon 1, Lyon, France; [3]CHU Lyon Sud

Phased-array HIFU transducer under MR-guidance can bring important improvements in actual clinical strategy for prostate cancer treatment. The performances of a MR-compatible transrectal HIFU device with 16 circular rings were in vivo investigated on rabbit thigh. Dual-mode displacements of the focus was performed: electronically, along the ultrasound propagation axis and mechanically XZ 2D-translations and rotation around B0. Online fast MR-thermometry in 2 orthogonal planes, MRI assessment 5 days after the treatment and the histological analyze showed that a homogenous lesion was induced in the predefined zone. Dual-mode sonication paradigm offer the possibility to induce the lesion desired shape in a reasonable time period, and minimizing the side-effects.

Tuesday 13:30-15:30 Computer 65

13:30 ***4138*.** **Experimental Comparison Ex Vivo of Different Sonication Patterns for Volumetric MRgHIFU Ablation**

Lorena Petrusca[1], Thomas Goget[1], Magalie Viallon[1], Loredana Baboi[1], Christoph Becker[1], Rares Salomir[1]
[1]Geneva University Hospital, Geneva, Switzerland

Different sonication patterns (i.e. trajectories of the focus) were performed ex-vivo with a phased-array transducer: lines, unitary circles and concentric circles of different lengths/diameters for comparison purpose. The temperature profile along the ultrasound propagation axis was analyzed. For the same value of the line length and circle diameter and identical applied powers and durations of sonication, a significant drift of the maximum heating location below the treatment plane towards the transducer was noticed for circle or disk trajectories. Line scan sonications up to 24mm size provided symmetric and drift-free thermal build up. The latter pattern should be considered for fast and safe volumetric ablation with MRgHIFU.

14:00 ***4139*.** **inter-Costal Liver Ablation Under Real-Time MR-Thermometry with Partial Activation of a HIFU Phased Array Transducer**

Bruno Quesson[1], Mathilde Merle[1], Max Köhler[2], Charles Mougenot[3], Sebastien Roujol[1], Baudouin Denis de Senneville[1], Chrit T. Moonen[1]

[1]laboratory for molecular and functional imaging, bordeaux, France; [2]Philips healthcare, Vantaa, Finland; [3]Philips Healthcare, bordeaux, France

The partial obstruction of the High Intensity Focused Ultrasound beam by the rib cage complicates the treatment of liver tumors. A method for selective deactivation of the transducer elements located in front of the ribs (visualized on 3D anatomical MR images) is proposed. The effectiveness of the method for HIFU liver ablations is demonstrated ex vivo and in vivo in pigs during breathing with real-time, motion compensated, MR thermometry. No loss in heating efficacy was observed at the focal point and an important reduction of the heating in tissues surrounding the bones was obtained with deactivation of the transducer elements.

14:30 ***4140*.** **Multi-Parametric Monitoring of Thermal Ablations Using Rapid Chemical Shift Imaging**

Brian Allen Taylor[1,2], Andrew M. Elliott[1], Ken-Pin Hwang, [1,3], John D. Hazle[1], Roger Jason Stafford[1]

[1]Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States; [2]The University of Texas Graduate School of Biomedical Sciences, Houston, TX, United States; [3]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States

A rapid chemical shift imaging technique is presented that provides T2* values and T1-W amplitudes of multiple chemical species in addition to accurate and precise temperature estimates. Temperature response of each parameter is correlated with Arrhenius rate analysis to determine if measurements can aid in verifying treatment goals.

15:00 ***4141*.** **Real-Time Bioheat Transfer Models for Computer Driven MR Guided LITT**

David Fuentes[1], Yusheng Feng[2], Andrew Elliott[1], Anil Shetty[1], Roger McNichols[3], J Tinsley Oden[4], R Jason Stafford[1]

[1]Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States; [2]The University of Texas at San Antonio; [3]BioTex Inc; [4]ICES, The University of Texas at Austin

Treatment times of computationally assisted MR guided LITT are determined by the convergence behavior of PDE constrained optimization problems. This work investigates the feasibility of applying real-time bioheat transfer constrained model calibration to patient specific data and rigorously validates model calibrations against MR temperature imaging data. The calibration techniques attempt to adaptively recover the patient specific bio-thermal heterogeneities within the tissue and result in a formidable real time PDE constrained optimization problem. The calibrations are critical to the predictive power of the simulation during therapy which may be further exploited for treatment optimization to maximize the efficiency of the therapy control loop.

Wednesday 13:30-15:30 Computer 65

13:30 ***4142*.** **MR-Guided Trans-Perineal Cryoablation of Locally Recurrent Prostate Adenocarcinoma Following Radical Prostatectomy**

David Arthur Woodrum[1], Lance Mynderse[2], Akira Kawashima[1], Krzysztof Gorny[1], Thomas Atwell[1], Fred Mcphail[2], Bradley Bolster[3], Wesley Gilson[3], Kimberly Amrami[1], Haraldur Bjarnason[1], Matthew Callstrom[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States; [2]Urology, Mayo Clinic, Rochester, MN, United States; [3]Siemens Medical Solutions, Inc.

Prostate cancer recurrence after definitive therapy can be as high as 25% after 15 years. Detection of these recurrences can be achieved using serial PSA coupled with dynamic contrast enhanced (DCE) MRI. Our hypothesis is MR-guided cryoablation can be used in the setting of prostate bed PAC recurrence to perform a precise image-guided focal ablation. Two patients with prior RRP and dynamic contrast enhancement(DCE) MRI abnormalities in the prostate bed were treated using MR-guided cryoablation. Both patients with recurrent prostate cancer in the prostate bed were successfully treated with MR-guided cryoablation. Immediate post-ablation DCE MRI demonstrated no definite residual tumor.

14:00 ***4143*.** **Truly Simultaneous Clinical US/MRI: Dual Mode Visualization of Bubble Creation During RFA Inducing Susceptibility Variations Corrupting PRFS Thermometry**

Magalie Viallon[1], Joerg Roland[2], Sylvain Terraz[1], Christoph D Becker[1], Rares salomir[1]

[1]Radiologie, Hopital Universitaire de Genève, Geneva, Switzerland; [2]MREA, Siemens Medical Solutions, Erlangen, Germany

Recent work reported spatially related errors in temperature maps and TD during power application, while using 2D GRE-EPI PRFS imaging with orthogonal interleaved slices (1). We demonstrate that RFA induced cavitationâ€™s effects are the primary source of errors in PRFS imaging using truly simultaneous ultrasonography and MRI.

14:30 **_4144_. TMAP @ IFE - A Framework for Guiding and Monitoring Thermal Ablations**

Eva Rothgang[1,2], Wesley David Gilson[2], Joerg Roland[3], Joachim Hornegger[1], Christine H. Lorenz[2]
[1]Pattern Recognition Lab, Department of Computer Science, University of Erlangen-Nuremberg, Erlangen, Germany; [2]Center for Applied Medical Imaging, Siemens Corporation, Corporate Research, Baltimore, MD, United States; [3]Siemens Healthcare, Erlangen, Germany

Thermal ablations are increasingly used for minimally invasive local treatment of solid malignancies, supplementing systemic treatment strategies such as chemotherapy and immunotherapy. We present an intuitive application for monitoring thermal treatment independent of heating source, in real-time, with multiplanar MRI. Systematic quality control of thermal maps is carried out on-line to ensure reliability of the displayed thermal data. The application is fully integrated into the Interactive Front End (IFE) which allows real-time MRI-guided placement of the heating device. Thus, the presented application supports the thermal ablation workflow from placing the ablation device to online monitoring the progress of ablation.

15:00 **_4145_. Imitation of Radiofrequency Ablation Scars with Laser System for MR Guided Ablation of Atrial Fibrillation**

Can Kerse[1,2], Bulent Oktem[3], Fatih Omer Ilday[4], Ergin Atalar, [2,5]
[1]Department of Electrical and Electronics Engineering , Bilkent University, Ankara, Turkey; [2]UMRAM (National Research Center for Magnetic Resonance), Ankara, Turkey; [3]Material Science and Nanotechnology Graduate Program, Bilkent University, Ankara, Turkey; [4]Physics Department, Bilkent University, Ankara, Turkey; [5]Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey

Fiber delivery of laser energy has no MR compatibility issues and is used with MR guidance in the field. But, it is not widely used as the cure of Atrial Fibrillation, since there is risk of perforating the myocardial wall. Several diffusing tip designs to emit light in cylindrical symmetry exist, but, due to their orientation with respect to the cardiac chamber, common RF delivery methods cannot be applied directly. In our study, we propose a novel multiple fiber laser energy delivery with catheter approach and a system that imitates the scars created with RF probes under MR guidance.

Thursday 13:30-15:30 Computer 65

13:30 **_4146_. Feasibility of Multipolar Radiofrequency Ablation in the Pig Liver Under Simultaneous Real-Time MR Thermometry**

Matthieu Lepetit-Coiffe[1], Alexandru Cernicanu[2], Olivier Seror, [1,3], Thomas Stein[4], Yasmina Berber[1], Mario Ries[1], Chrit T. Moonen[1], Bruno Quesson[1]
[1]Laboratoire IMF CNRS UMR 5231 / Universite Bordeaux 2, Bordeaux, France; [2]Philips Healthcare, Suresnes, France; [3]Service de Radiologie, Hopital Jean Verdier, Bondy, France; [4]Celon/Olympus, Teltow, Germany

The feasibility of real-time MR thermometry for monitoring multipolar RF ablation was demonstrated both ex vivo and in vivo on a pig liver. The quality of the real-time thermal dose maps appeared satisfactory in the presence of respiratory motion and cyclic switching between the different pairs of RF electrodes. The large (about 250 cm3) resulting thermal coagulation volume was spatially homogeneous as predicted by the real-time lethal thermal dose maps and confirmed by the post procedural MR imaging and histology.

14:00 **_4147_. Breath Hold Phase Correction for Water-Fat Separated MR Thermometry Using B0 Field Changes**

Cory Robert Wyatt[1], Brian J. Soher[2], James R. MacFall[2]
[1]Department of Biomedical Engineering, Duke University, Durham, NC, United States; [2]Department of Radiology, Duke University Medical Center, Durham, NC, United States

Proton resonance frequency shift (PRFS) thermometry of the breast is often confounded not only by the presence of fat in the tissue but also by respiration-induced B0 changes even in the absence of detectable breast motion. In this work, field fitting techniques used previously are used to extrapolate fat referenced B0 changes measured using fat-water separation methods to B0 changes in a water-only simulated tumor in a fat-water breast phantom. Results show that the B0 map extrapolation method reduces PRFS temperature errors between breath holds from a maximum of 5.55°C to less than 0.53°C.

14:30 **_4148_. Real-Time Non Subtraction Thermometry Using Artificial Neural Networks**

Manivannan Jayapalan[1]
[1]MR SW & Applications Engg, GE Healthcare, Bangalore, Karnataka, India

Thermal monitoring in focused ultrasound applications is crucial step where MR is most widely used as it provides better thermal monitoring capability than others. Regular PRF shift technique involves, some form of image subtraction using a baseline pre-treatment images. Subject motion and tissue deformation due to coagulation can severely distort these techniques. Self-referenced methods require a large area of tissue around the ablation for polynomial fitting and can't be used when tissue cooling is applied to sensitive structures. Here a new method of thermal monitoring using Radial Basis Function Neural Network (RBFNN) trained by orthogonal least square algorithm is proposed. This method eliminates the need for baseline subtraction and also tolerates subject motion to a great extent. A feed forward, radial basis neural network is used with 2 input, 1 output and a hidden layer where the number of units in that layer is obtained using orthogonal least square algorithm learning method. Gaussian function is used as kernel whose centers are obtained through network learning. 2-D surface co-ordinates of phase image in a selected ROI is used as inputs while its corresponding phase value are used as output to train the network. Then the network is tested, where, the phase values obtained from the network and the actual values are compared. It was observed that the network output matches very well with the actual values which clearly proves that the neural networks approximates the phase distribution function very well.

15:00 **_4149_. 3D Reduced-FOV MR Thermometry with Fat Suppression Using a Hybrid Method Combining a 2DRF Pulse, Parallel Imaging, and UNFOLD**

Chang-Sheng Mei[1,2], Jing Yuan[3], Lawrence P. Panych[4], Bruno Madore[4], Nathan J. McDannold[4]

[1]Department of Physics, Boston College, Chesnut Hill, MA, United States; [2]Department of Radiology, Brigham and Women's Hospital,, Harvard Medical School, Boston, MA, United States; [3]Department of Diagnostic Radiology and Organ Imaging, Chinese University of Hong Kong, Shatin, Hong Kong; [4]Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

3D MR thermometry using PRF shift has issues due to the requirement of relatively long TE and the presence of fat. A hybrid method combining 2DRF pulse, parallel imaging, and UNFOLD in a 3D sequence is proposed here, which offers advantages in terms of spatial coverage and measurement accuracy, as compared to typically-used 2D sequences.

Cardiovascular Interventional & Devices

Hall B Monday 14:00-16:00 Computer 66

14:00 **_4150_. Mr Guided Transmyocardial Delivery of Hepatocyte Growth Factor Gene Into Infarct Scar with Established Remodelled Left Ventricle**

Maythem Saeed[1], David Saloner[1], Phillip Ursell[2], Loi Do[1], Mark Wilson[1], Alastair J. Martin[1]

[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, Ca, United States; [2]Pathology, University of California San Francisco, San Francisco, Ca, United States

It is unknown whether MR-guided transendocardial delivery of hepatocyte growth factor gene (HGF) is effective in ameliorating LV remodelling. XMR suite (x-ray cath-lab and a 1.5T MR scanner) for real-time imaging, transendocardial delivery and assessing the gene effects in swine with remodelled LV. Six MR sequences were used for evaluation of the efficacy of therapy. MR-guided transendocardial delivery of HGF a) ameliorated global function and 3D strain, b) activated perfusion, neovascularization and myogenesis in scar and c) reduced infarct. The combination of this therapy and XMR technique may be useful in patients with ischemic myocardium and cell loss (apoptosis).

14:30 **_4151_. Visualization of Ablation Lesions by Dynamic Contrast Enhanced MRI**

Andriy Shmatukha[1], Bharathi Sundaram[2], Xiuling Qi[2], Samuel Oduneye[2], Jeff A. Stainsby[1], Graham A. Wright[2], Eugene Crystal[2]

[1]Applied Science Laboratory, GE Healthcare, Toronto, Ontario, Canada; [2]Sunnybrook Health Sciences Centre, Canada

An approach for rapid and reliable visualization of radiofrequency (RF) ablation lesions using dynamic contrast enhanced MRI is presented. Novel processing algorithms are presented that demonstrate the ability to identify distinct regions within RF lesions and can do so more rapidly than traditional dynamic contrast enhanced processing methods.

15:00 **_4152_. An Approach for MRI Based Pre-Operative Planning of Cardiac Interventions Via Trans-Apical Access**

Erol Yeniaras[1], Nikhil Navkar[1], Zhigang Deng[1], Mushabbar A. Syed[2], Nikolaos V. Tsekos[1]

[1]Computer Science, University fo Houston, Houston, TX, United States; [2]Division of Cardiovascular Medicine, University of Kentucky, United States

The aim of this work is to implement an approach for pre-operative planning of cardiac interventions via a trans-apical access using CINE cardiac images. Multislice sets of short and long axis planes were analyzed to identify access corridors in 3D, from the apex to the base of the heart, which ensure that a tool may transverse the ventricle without contact to the epicardial wall for all heart phases. Studies illustrate that apical areas can be delineated through which a tool may be inserted to access the mitral valve along a straight path and the aortic valve through a curved one.

15:30 **_4153_. MR-Guided Electrophysiology System for Activation and Pace Mapping in Left Ventricle**

Samuel O. Oduneye[1], Andriy Shmatukha[2], Vladimir Verpakhovski[3], Charles L. Dumoulin[4], Ehud Schmidt[5], Eugene Crystal[6], Graham A. Wright[1]

[1]Medical Biophysics, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada; [2]GE Healthcare, Toronto, Ontario, Canada; [3]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [4]GE Global Research Center, Niskayuna, NY, United States; [5]Brigham and Women's Hospital & Massachusetts General Hospital, Boston, MA, United States; [6]Arrhythmia Services, Sunnybrook Health Sciences Centre, Toronto, Canada

In recent studies, electrophysiology information has been compared with pre-acquired MR images to determine the relation between the two measurements; however, that approach is sensitive to registration errors and changes in anatomical conditions. Here, we present an MR-compatible EP system for real-time MR imaging able to directly locate and characterize electrical properties of potential arrhythmogenic regions in the left ventricle (LV) by measuring local conduction velocities at different pacing frequencies.

Tuesday 13:30-15:30 Computer 66

13:30 ***4154*. An Active Delivery Cable for VSD Closure Under MRI-Guidance**

Jamie A. Bell[1], Christina E. Saikus[1], Kanishka Ratnayaka[1,2], Israel M. Barbash[1], Anthony Z. Faranesh[1], Michael C. Slack, [1,2], Robert J. Lederman[1], Ozgur Kocaturk[1]

[1]Translational Medicine Branch, Division of Intramural Research, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD, United States; [2]Cardiology Division, Children's National Medical Center, Washington, DC, United States

We have created an active MRI-compatible delivery cable incorporating a loopless antenna that enables greater visualization of the occlusion device during percutaneous delivery and deployment of the device under MRI. During in vivo use, deployment and positioning of the occlusion device in the ventricular septum was apparent with the increased signal provided by the active delivery system. The device appearance provided by this active delivery cable combined with the superior soft-tissue visualization of MRI makes the treatment of a wide range of structural heart disease under MRI guidance feasible and promising.

14:00 ***4155*. Deflectable Catheter for Interventional Cardiovascular MRI**

Ozgur Kocaturk[1], Jamie A. Bell[1], Christina E. Saikus[1], Vincent Wu[1], Merdim Sonmez[1], Kanishka Ratnayaka[1,2], Robert J. Lederman[1]

[1]Translational Medicine Branch, Division of Intramural Research, National Heart Lung and Blood Institute, National Institutes of Health, Bethesda, MD, United States; [2]Cardiology Division , Children's National Medical Center, Washington DC , United States

The mechanical characteristics of most commercially available catheter devices are provided by metallic components such as metal braiding or pulling wires in deflectable devices which make them unsuitable for the MR environment. We have developed a deflectable catheter that utilizes Kevlar fiber instead to produce the same shaft support and torquability with a braided tubing and tension mechanism for tip deflection. This device could enable a wide range of MRI-guided cardiovascular interventions in difficult to reach anatomies.

14:30 ***4156*. Simultaneous Imaging and Catheter Tracking: More Robust Performance with Joint Use of All Data**

Steve Kecskemeti[1], Ethan Brodsky[1], Walter Block[1], Orhan Unal[1]

[1]Medical Physics, University of Wisconsin, Madison, WI, United States

Current methods of catheter tracking [1] interrupt the imaging sequence at some predefined update rate to acquire several projections to determine the position of the catheter. We have a taken a different approach and have developed a robust method to extract the tracking data directly from the imaging data using an interleaved 3D radial (VIPR) k-space acquisition. The method presented in this abstract uses the information from all the projections within a VIPR interleaf to determine the catheter location. This results in a more robust prediction of the catheter location and reduces the perception of jitter in the catheter position.

15:00 ***4157*. Model-Based Catheter Shape Reconstruction for Interventional MRI**

Carsten Oliver Schirra[1], Philip G. Batchelor[1], Reza Razavi[1], Sebastian Kozerke[1,2], Tobias Schaeffter[1]

[1]Division of Imaging Sciences, King's College London, London, Greater London, United Kingdom; [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Conventional MR imaging methods result in prohibitively long measurement times hampering 3D catheter imaging in real-time. Despite progress in applying spare signal sampling theorems to catheter imaging, undersampling factors remain limited. In the present work a model-based reconstruction technique is proposed which determines the parameters describing the catheter shape directly in undersampled *k*-space data exploiting the limited degrees of freedom necessary. A parameterized model of a catheter is fitted by minimizing the l_2-norm. It is demonstrated that the catheter shape can be reconstructed from highly undersampled data indicating the potential of the method for 3D real-time imaging of catheter devices.

Wednesday 13:30-15:30 Computer 66

13:30 ***4158*. Development of a 0.014-Inch Anti-Solenoid Loop Coil: Toward Intracoronary 3.0T MRI and Interventions**

Huidong Gu[1], Feng Zhang[1], Yanfeng Meng[1], Bensheng Qiu[1], Xiaoming Yang[1]

[1]Image-Guided Bio-Molecular Intervention Researchers, Department of Radiology, Institute for Stem Cell and Regenerative Medicine; University of Washington School of Medicine, Seattle, WA, United States

Atherosclerotic coronary artery disease is the main cause of heart attack. Unlike plaques in carotid arteries, the atherosclerotic plaques in coronary arteries are difficult to be detected using conventional MRI techniques with surface coils. To solve this problem, a 0.014-inch intracoronary MR imaging-guidewire (a loopless RF coil) was invented, which enabled to generate intracoronary MRI at 1.5T and interventions under MRI guidance. In this study, we developed a 0.014-inch anti-solenoid loop coil, an alternative to the loopless coil which might be used for generating intracoronary high-resolution 3.0T MRI and interventions.

14:00 ***4159***. **Real-Time Navigation of a Catheter with Ferromagnetic Tip in Interventional MRI**

Ke Zhang[1], Axel Krafft[1], Reiner Umathum[1], Florian Maier[1], Wolfhard Semmler[1], Michael Bock[1]

[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

Manoeuvring the interventional devices over complicated vessel branches into the target area is difficult. In this study we present a catheter with a deflectable, ferromagnetic tip and a real-time sequence for tip navigation, localization and imaging. The direction of the magnetic forces for navigation of the catheter's tip is controlled via an iterative input device. The pulse sequence combines the acquisition of imaging and interleaved projection data for automatic alignment of imaging slice according to the tip position. The results from pig experiments proved that our application can help endovascular intervention to be easier, faster and safer.

14:30 ***4160***. **Simultaneous Visualization of Passive Marker and Anatomical Image with Rephasing Gradient Integrated Double Echo**

Ke Zhang[1], Ann-Kathrin Homagk[1], Wolfhard Semmler[1], Michael Bock[1]

[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

Identification of passive markers can be challenging in in vivo applications due to motion and flow artifacts. In this study we implemented a dual echo pulse sequence which acquires simultaneously a conventional MR image together with a dephased image to highlight the marker materials. After overlaying of two images the maker can be easily detected in the anatomical images.

15:00 ***4161***. **Optimizing the Visibility of a Carbon Fiber Cannula in Spin Echo Sequences Using Currents Induced by Gradient Switching in an Attached Copper Loop: A Feasibility Study**

Hanne Wojtczyk[1], Hansjoerg Graf[1], Petros Martirosian[1], Anika Klabes[1], Stefan Kegel[1], Verena Ballweg[1], Christoph Thomas[2], Fritz Schick[1]

[1]Section on Experimental Radiology, University Hospital Tuebingen, Tuebingen, Baden-Wuerttemberg, Germany; [2]Department of Diagnostic and Interventional Radiology, University Hospital Tuebingen, Tuebingen, Baden-Wuerttemberg, Germany

Some instruments for interventional MRI procedures, e.g. a carbon fiber cannula, do not produce pronounced signal voids or artifacts. The feasibility of optimizing their visibility by surrounding the object with a loop of thin copper wire was evaluated theoretically and practically: currents induced in the copper loop by gradient switching shall be utilized to create individually controlled gradient echo like artifacts in spin echo sequences. A carbon fiber tube and straws of different lengths were surrounded by loops of copper wire of different diameter and imaged at 1.5 T. The approach works in principle but may be not very practical, however possibly expandable.

Thursday 13:30-15:30 Computer 66

13:30 ***4162***. **Intracoronary 3.0T MRI: An Ex Vivo Feasibility Study in Swine Hearts**

Huidong Gu[1], Feng Zhang[1], Yanfeng Meng[1], Bensheng Qiu[1], Xiaoming Yang[1]

[1]Image-Guided Bio-Molecular Intervention Researchers, Department of Radiology, Institute for Stem Cell and Regenerative Medicine; University of Washington School of Medicine, Seattle, WA, United States

MRI is becoming a useful imaging tool for the diagnosis and treatment atherosclerotic arteries. To date, there are no reports on intracoronary MRI, which requires the placement of a small sized (usually 0.014-inch in diameter) endovascular MR coil into the coronary arteries. This study demonstrates the first attempt on the development of intracoronary 3.0T MRI technology. The combo imaging system with simultaneous use of the 0.014-inch Nitinol loopless antenna and two surface coils can function in a clinical 3.0T MR scanner. These results have established the groundwork towards in vivo intracoronary 3.0T MRI and intracoronary interventions under 3.0T MRI guidance.

14:00 ***4163***. **Technique for Wireless Position Tracking of Intravascular Catheters: Performance Evaluation in a Vessel Phantom**

Harald Busse[1], Gregor Thörmer[1], Nikita Garnov[1], Jürgen Haase[2], Thomas Kahn[1], Michael Moche[1]

[1]Diagnostic and Interventional Radiology, Leipzig University Hospital, Leipzig, Germany; [2]Physics and Earth Sciences, Leipzig University, Leipzig, Germany

A new wireless technique for the tracking of intravascular catheters is presented. The semi-active approach uses a robust morphological image analysis tool to automatically detect the local signals from two small RF coils mounted on a commercial 6F catheter. A fast SSFP sequence at very low flip angles (≈0.3°) provided sufficient marker contrast to reliably localize the catheter in a vessel phantom (≈97% of 1036 trials) within ≈350 ms. Tracking may be realized by continuously superimposing the marker coordinates on a roadmap (≈3 updates/second) or by adjusting the slice geometry of a fast MR scan to the actual catheter orientation.

14:30 ***4164***. **Transmit Power Optimization for Tracking, Wireless Marker and Imaging Applications of a Multi-Mode Endovascular Coil.**

Krishna N. Kurpad[1], Orhan Unal[1,2]
[1]Radiology, University of Wisconsin, Madison, WI, United States; [2]Medical Physics, University of Wisconsin, Madison, WI, United States

The multi-mode intravascular coil consists of a single active device that is connected to the external system via a single coaxial cable and performs three functions: 1) active tip tracking, 2) imaging and 3) inductively coupled wireless marker. The coil behaves as a pseudo transmit coil due to coupling with an external transmit coil. The variable conductor density design of the multi-mode coil results in variable B1 field magnification in its vicinity. This provides an opportunity to adjust transmit power for optimal operation of the multi-mode coil in all three of its functional modes.

15:00 ***4165***. **Phase-Field Dithering for Active Catheter Tracking**

Charles L. Dumoulin[1], Richard P. Mallozzi[2], Robert D. Darrow[3], Ehud J. Schmidt[4]
[1]Imaging Research Center, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States; [2]ONI Medical Systems, Inc., Wilmington, MA, United States; [3]General Electric Global Research, Niskayuna, NY, United States; [4]Radiology, Brigham and Womens Hospital, Boston, MA, United States

An orthogonal gradient pulse is added to an MR tracking pulse sequence to change the phases of the detected MR signals. Since the phase of the signals is unknown in the absence of the orthogonal dephaser, the dephasing gradient can either increase or decrease the strength of the acquired signal. Consequently, the direction of the orthogonal gradient pulse is rotated through a cycle and the data in each cycle is processed to extract the most desired feature (e.g. maximum pixel detection). This approach increases the robustness of MR tracking in low SNR conditions.

Cell Tracking I

Hall B Monday 14:00-16:00 Computer 67

14:00 ***4166***. **Monitoring the Uptake of ^{19}F Nanoparticles and in Vivo Migration of Dendritic Cells Using Magnetic Resonance**

Helmar Waiczies[1,2], Bettina Erdmann[3], Bernd Ittermann[1,2], Frank Seifert[1,2], Thoralf Niendorf,[2,4], Sonia Waiczies,[2,5]
[1]Physikalisch Technische Bundesanstalt, 10587 Berlin, Germany; [2]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, 13125 Berlin, Germany; [3]Electron Microscopy, Max-Delbrueck Center for Molecular Medicine, 13125 Berlin, Germany; [4]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, 13125 Berlin, Germany; [5]Department of Hematology and Oncology, Charité Campus Buch, Humboldt-University, 13125 Berlin, Germany

^{19}F cellular magnetic resonance imaging (MRI) provides signal selectivity during cell tracking and a possibility to overlay ^{19}F-labeled cells with anatomic ^{1}H scans. This work investigates the uptake of nanoparticles containing perfluoro-15-crown-5 ether in dendritic cells and their impact on cell function. ^{19}F MR spectroscopy and electron microscopy showed a rapid and efficient uptake of nanoparticles by DC. The ^{19}F signal intensity in these cells was shown to be directly related to 19F nanoparticle size. ^{19}F/^{1}H MRI showed that DC function was not disturbed following ^{19}F-labeling as demonstrated by an efficient migration of these cells into draining popliteal lymph nodes.

14:30 ***4167***. **Long Term Evaluation of the 1.28 Ppm After Transplantation of Purified Neural Progenitor Cells in the Brain**

Chiao-Chi V. Chen[1], Kuan-Chi Mo[1], Ching-Yu Chuang[2], Hung-Chih Kuo[3], Chen Chang[1]
[1]Functional and Micro-magnetic Resonance Imaging Center, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan; [2]Institute of Biotechnology, National Taiwan University, Taipei, Taiwan; [3]Institute of Cellular and Organismic Biology, Academia Sinica, Taipei, Taiwan

The present study aimed to use in vivo MRS to track the long term changes and consequences of purified neural progenitor cells (NPCs) in the brain. Following transplantation, there were signal intensity changes over time at the 1.28 ppm along with the NAA signal, which may represent the variations of the functional status of the NPC biomarker.

15:00 ***4168***. **Molecular MR Imaging of Labeled Stem Cells in a Mouse Burn Model in Vivo**

Valeria Righi[1,2], Ali M. Rad[3], Dionyssios Mintzopoulos[1], Alan J. Fischman[4], A Aria Tzika[1,2]
[1]NMR Surgical Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States; [2]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Athinoula A. Martinos Center for Biomedical Imaging, Boston, MA, United States; [3]Division of Burn, Shriners Burn Institute, Harvard Medical School, Boston, MA, United States; [4]Division of Burn, Shriners Burns Institute, Harvard Medical School, Boston, MA, United States

Recently, the interest in noninvasive novel methods for molecular imaging using MRI of clinically relevant mouse models using super-paramagnetic iron-oxide (SPIO) nanoparticles as contrast agents has increased. SPIO nanoparticles are commonly used to label cells for cellular imaging. Several methods to generate positive contrast of magnetically labeled cells have been suggested. The scope

of this study was to track label stem cells in a burn mouse model using noninvasive positive-contrast MRI methods in vivo. The results have direct implications for monitoring labeled stem cells during wound healing.

15:30 ***4169***. **Use of Balanced SSFP MR Microscopy for Imaging Endogenously Labeled Neuroprogenitor Stem Cells with Linear Combination Steady-State Free Precession (LCSSFP) for Artifact Reduction.**

H. Douglas Morris[1], James P. Sumner[2]
[1]NIH Mouse Imaging Facility, National Institues of Health, Bethesda, MD, United States; [2]Laboratory of Functional and Molecular Imaging, National Institues of Health, Bethesda, MD, United States

MRI has become a potent method for tracking cells *in situ* and *in vivo*. Recent techniques can produced endogenously labeled cells that can be for tracking cellular migration. A complication is the presence of a large amount of magnetic particle label, which adversely affects high-efficiency pulse sequences such as balanced SSFP. The worst off-resonance artifacts can be mitigated by using a linear combination of SSFP sequences (LCSSFP), which can reduce the artifacts produced by these label caches while preserving the effect detection of the labeled cells.

Tuesday 13:30-15:30 Computer 67

13:30 ***4170***. **Relaxometry Vs Artefact Volume Measurements for Estimating the Number of Iron-Labelled Macrophages: in Vivo Testing in the Mouse Brain**

Jean-Christophe Brisset[1,2], Monica Olivia Sigovan[1,2], Fabien Chauveau[1,2], Adrien Riou[1,2], Norbert Nighoghossian[1,2], Emmanuelle Canet-Soulas[1,2], Yves Berthezene[1,2], Marlene Wiart[1,2]
[1]University of lyon, Lyon, france, France; [2]Creatis-LRMN, CNRS, UMR 5220; Inserm, U 630; Insa de Lyon, Lyon, France

The aim of this study was to compare 4 quantitative methods for estimating the number of iron-labelled cells injected in the mouse brain: T2, T2* relaxometry, and artefact volume measurement using negative and positive contrasts. Eight mice were stereotaxically injected with [500-7,500] iron-labelled cells and imaged at 4.7T. Bland-Altman and scatterplots were used to compare the T2 and T2*-based estimated number of cells, the artefact volumes, and the actual number of iron-labelled cells. T2 and T2* quantification failed to estimate the number of iron-labelled cell in-vivo, while measurement of the artefact volume gave promising results.

14:00 ***4171***. **Detecting the Migration and Accumulation of Macrophages in an Acute Rejection Model of Heart-Lung Transplantation in Rats by in Vivo MRI Using a New Nano-Sized Iron Oxide Particle**

Haosen Zhang[1], Qing Ye[1], Chih-Lung Chen[2], Kevin Hitchens[1], Wen-Yuan Hsieh[3], Li Liu[1], Yijen Wu[1], Lesley Foley[1], Hsin-Hsin Shen[2], Jassy Wang[2], Chien Ho[1]
[1]NMR Center for Biomedical Research, Carnegie Mellon University, Pittsburgh, PA, United States; [2]Biomedical Engineering Laboratories, Industrial Technology Research Institute, Hsinchu, Taiwan; [3]Material and Chemical Research Laboratories, Industrial Technology Research Institute, Hsinchu, Taiwan

The aim of this study is to detect the migration and accumulation of macrophages by in vivo MRI in a rat heart-lung transplantation model of acute rejection using a sensitive nano-sized iron oxide particle (ITRI-IOP). After infusion of the macrophages labeled in vitro with ITRI-IOP, punctuate spots of hypointensity are observed on the myocardium of the transplant allograft heart 24 hrs later. Ex vivo imaging and immunohistochemistry analysis of the fixed allograft heart shows abundance of punctuated spots of hypointensity that are caused by the iron-loaded macrophages, which is not shown in the native heart of the same rat.

14:30 ***4172***. **1.5T Micro-MRI of Macrophages in Obesity-Associated Inflammation: Feasibility Study**

Marie Poirier-Quinot[1], Alain Luciani[2], Michael Levy[3], Jean-Christophe Ginefri[1], Nathalie Luciani[3], Vanessa Devaux[2], Sylvie Manin[2], Eric Lancelot[4], Luc Darrasse[1], Claire Wilhelm[3], Florence Gazeau[3]
[1]U2R2M - UMR 8081 CNRS/Univ Paris Sud, Orsay, France; [2]INSERM U841, Hôpital Henri Mondor, Créteil, France; [3]UMR 7057 CNRS/Univ Paris - Diderot, France; [4]Guerbet Recherche, Roissy, France

It has been recently shown that obesity-associated inflammation is related to the recruitment of pro-inflammatory macrophages. The present work investigates the feasibility to detect in-vivo macrophages in a murine model of obesity using magnetic resonance microscopy following systemic injection of a new kind of iron-oxide nanoparticles (USPIO). High-resolution 1.5 T MRI combined with a superconducting surface coil and an improved USPIO, for micrometric evaluation of fat tissue, appears to be an efficient way to detect macrophages related to fat inflammation. This approach for the follow-up of animals involved in therapeutic trials aimed at limiting fat inflammation has great potential.

15:00 *4173*. **Magnetic Resonance MicroImaging of Cell Migration in Porous Biomaterial Scaffolds Designed for Tissue Engineering**

Marie Poirier-Quinot[1], Claire Wilhelm[2], Mohammed Derkaoui[3], Jean-Christophe Ginefri[1], Nathalie Luciani[2], Luc Darrasse[1], Didier Letourneur[3], Florence Gazeau[2], Catherine Le Visage[3]
[1]Imagerie par Résonance Magnétique Médicale et Multimodalités (UMR 8081), Univ Paris Sud, CNRS, Orsay, France; [2]UMR 7057 CNRS/Univ Paris - Diderot, France; [3]Inserm U698, CHU X. Bichat Paris, France

Polymeric scaffolds, involved in tissue engineering, for cell seeded migration and proliferation, are often extremely sensitive. Therefore 3D non-invasive imaging methods are needed to study tissue-engineered constructs. This work has demonstrated the efficiency of high resolution imaging, using a superconducting surface coil at 1.5 T, with efficient medium and cellular contrast agents, for 3D visualization of tissue-engineered constructs. The labeled cell presence was quantified within the entire structure and their spatial distribution was assessed along the privileged orientation of the pores. According to these results, spatial distribution of cells is easily monitored through the complex microstructure of scaffolds.

Wednesday 13:30-15:30 Computer 67

13:30 *4174*. **Application of Ultra-Short Echo Time Imaging for Visualization of SPIO-Loaded Tumor Cells in Brain**

Yuanxin Chen[1], Jian-Xiong Wang[2], Lisa M. Gazdzinski[1], Paula J. Foster[1], Brian K. Rutt[3]
[1]Imaging Research Laboratories, Robarts Research Institute, London, Ontario, Canada; [2]Applied Science Laboratory, GE HEALTHCARE, London, Ontario, Canada; [3]Department of Radiology, Stanford University, Stanford, CA, United States

There has been increased interest in positive-contrast MRI methods to visualize cells labeled with superparamagnetic iron oxide (SPIO) nanoparticles. Here, we applied the 3D Cones technique for ultra-short echo time (UTE) imaging of SPIO-labelled tumour cells in mouse brain. An intracranial tumour model was created by injection of SPIO labeled GL261 mouse glioma cells into the striata of C57/Bl6 mice. Short-T2-selective UTE imaging with a 3D Cones sequence on a 1.5T MR scanner was accomplished through the subtraction of interleaved, alternating-TE data acquired in an RF-TE1-RF-TE2 scheme. This work shows the feasibility of selectively tracking SPIO-labeled cells with positive-contrast.

14:00 *4175*. **Immunomodulation and Magnetic Resonance Tracking of Transplanted Human Glial-Restricted Precursor Cells in a Mouse Model of Multiple Sclerosis**

Heechul Kim[1,2], Piotr Walczak[1,2], Naser Muja[1,2], James T. Campanelli[3], Jeff W.M. Bulte[1,2]
[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Cellular Imaging Section, Institute for Cell Engineering, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [3]Q Therapeutics, Inc., Salt Lake City, UT, United States

Magnetically labeled human glial restricted precursor (hGRP) cells were transplanted and tracked in a mouse model of multiple sclerosis. The clinical severity of EAE was attenuated in hGRP-transplanted mice compared with controls. Hypointense MRI signals were detected primarily in the ventricles after transplantation. hGRP cell-treated mice showed a significant decrease in antigen-specific T cell proliferation in response to MOG and concanavalin A, compared to control mice. Based on the above results, we postulate that the signals generated from transplanted GRP cells in the ventricle modulate the systemic immune response.

14:30 *4176*. **Cellular MRI Assessment of Magnetic Fluorescent Bead Labeled Macrophage Accumulation Following High Intensity Focused Ultrasound (HIFU) Induced Damage in a Murine Model**

Hilary Hancock[1], Eric M. Gold[1], Bobbi K. Lewis[1], Melissa Smith[1], Victor Frenkel[1], Joseph A. Frank[1,2]
[1]Radiology and Imaging Sciences, NIH, Bethesda, MD, United States; [2]National Institute of Biomedical Imaging and Bioengineering, NIH, Bethesda, MD, United States

This study investigated in vivo labeling of monocytes with SPIO/fluorescent 40nm beads followed by Cellular MRI and fluorescent microscopy to determine the effects of ablative or pulsed high intensity focused ultrasound (HIFU) in a murine model. Pulsed HIFU exposures exhibited smaller regions of edema and hypointense regions, confined to superficial muscle and dermis, on T2*W images with smaller amounts of immune response within tissues compared to ablated tissues.

15:00 *4177*. **^{19}F MRI Tracking of Dendritic Cells in a Novel Migration Assay**

Fernando Bonetto[1], Mangala Srinivas[1], Bettina Weigelin[2], Luis Cruz Ricondo[1], Arend Heerschap[3], Carl Figdor[1], I.J. de Vries[1]
[1]Tumor Immunology, Nijmegen Centre for Molecular Life Sciences, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [2]Cell Biology, Nijmegen Centre for Molecular Life Sciences, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [3]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Dendritic cell migration is monitored and quantified by using ^{19}F-Chemical Shift Spectroscoypic imaging (CSI) in a novel migration assay. 3D scaffolds specially designed to mimic biological tissue are used in this assay. The particular layered structure of the assay allows to assess cell migration and to perform the control experiment simultaneously. Cells were labeled with a perfluorocarbon

compound. Our results demonstrate that ^{19}F-CSI at 7T is suitable to track cell migration in this type of opaque assays. The migration rates obtained in this way are comparable to clinical results suggesting that the proposed migration assays properly mimics in-vivo conditions.

Thursday 13:30-15:30 Computer 67

13:30 ***4178*. ^{19}F Imaging Assessment of Labeled Macrophage Accumulation in a Mouse Brain Following Experimental Traumatic Brain Injury**

Lesley May Foley[1], T Kevin Hitchens[2,3], John A. Melick[4], Chien Ho[2,3], Patrick M. Kochanek[4,5]

[1]Pittsburgh NMR Center for Biomedical Research , Carnegie Mellon University, Pittsburgh, PA, United States; [2]Pittsburgh NMR Center for Biomedical Research, Carnegie Mellon University, Pittsburgh, PA, United States; [3]Department of Biology, Carnegie Mellon University, Pittsburgh, PA, United States; [4]Safar Center for Resuscitation Research, University of Pittsburgh School of Medicine, Pittsburgh, PA, United States; [5]Departments of Critical Care Medicine, Pediatrics and Anesthesiolgy, University of Pittsburgh School of Medicine, Pittsburgh, PA, United States

Macrophages may play a role in mediating both early detrimental and delayed beneficial effects of inflammation. Therefore, the ability to detect the macrophage response in vivo after traumatic brain injury (TBI) may lead to a greater understanding of both secondary injury and repair. Here we report the use of an MRI 19F tracer agent that is taken up by macrophages in vivo to detect the response to experimentally induced TBI in a mouse model. Preliminary results indicate presumptive ^{19}F-labeled macrophage infiltration at the site of injury in the brain which corroborated findings from a recent study using iron oxide-labeled macrophages.

14:00 ***4179*. A Membrane Labeling Agent for MR Tracking of Transplanted Pancreatic Islets**

Emily Alexandria Waters[1], Ellen Kretzschmar Kohlmeir[2], Daniel J. Mastarone[1], Ling-Jia Wang[3], Dixon Blake Kaufman[3], Thomas J. Meade[1,2]

[1]Chemistry, Northwestern University, Evanston, IL, United States; [2]Biochemistry, Molecular Biology, and Cellular Biology, Northwestern University, Evanston, IL, United States; [3]Surgery, Northwestern University Feinberg School of Medicine, Chicago, IL, United States

Pancreatic islet transplant is a promising treatment for diabetes, but little is known about the fate of islets after transplant. We have developed a multimeric MR contrast agent with three macrocyclic Gd(III) chelates attached to a scaffold, with a branched alkyne chain installed to anchor the agent in cellular membranes. This agent effectively labels islets in a time- and concentration-dependent fashion. Islets can be detected with MRI after a 4h incubation with 30 μM agent. Minimal leaching occurs over a 24h period after incubation. Labeling of islets does not affect cell viability or alter islet morphology.

14:30 ***4180*. MRI of Vascular Cells Labeled with SPIO-PLL Complexes for Heart Valve Tissue Engineering Studies**

Paul A. Schornack[1], Sharan Ramaswamy

[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States

Noninvasive & nondestructive monitoring of the cellular function within the developing valvular tissue is a critical aspect of implant success. In-depth study on the longitudinal (temporal) position & migration patterns of cells during the tissue development process. This can be achieved through cellular MRI (cMRI) techniques such as with the labeling of cells with superparamagnetic iron oxide (SPIO) particles. Immediate goal – Conduct efficient, non-toxic, endosomal uptake studies of SPIO particles in endothelial cells (ECs) & smooth muscle cells (SMCs)

15:00 ***4181*. Pro-Survival Cocktail Improves Bone Marrow Stromal Cells (BMSC) Survival and Homing to Flank Tumors as Demonstrated by Cellular MRI**

Aneeka Chaudhry[1], Edyta Pawelczyk[2], Eric Gold[1], Bobbi K. Lewis[1], Melissa Brown[1], Arun Balakumaran[3], Joseph A. Frank[1,4]

[1]Clinical Center, NIH, Bethesda, MD, United States; [2]Federal Drug Administration, Bethesda, MD, United States; [3]National Institute of Dental and Craniofacial Research, NIH, Bethesda, MD, United States; [4]National Institute of Biomedical Imaging and Bioengineering, NIH, Bethesda, MD, United States

In-vivo loss of implanted or infused cells is detrimental to stem cell therapies, as it undermines cell homing and therapeutic efficacy. This study aims to improve the homing and survival of FePro labeled bone marrow stromal cells via incubation with a cocktail of pro-survival and growth factors.

Cell Tracking II

Hall B Monday 14:00-16:00 Computer 68

14:00 ***4182*. Efficient Labeling of Multiple Cell Lines with a New SPIO Agent for Cell Tracking by MRI**

Catherine Ramsay[1], Christiane Mallett[1], Paula Foster[1]
[1]Imaging, Robarts Research Institute, London, ON, Canada

The purpose of this study was to test a new commercially available SPIO which has a colloidal size of 50 nm, a zeta potential of +31 mV and which is cross-linked with a rhodamine B label. Here we show that a variety of cell lines (lymphocytes, cancer and stem cells) can be labeled with this agent (MoldayION Rhodamine B, BioPal Inc), by simple co-incubation, without the use of transfection agents, at a level that permits their detection by MRI and without affecting cell viability. This is illustrated using iron staining of cells, fluorescence microscopy, electron microscopy and cellular MRI.

14:30 ***4183*. Complexation of MPIO with Poly-L-Lysine Greatly Enhances Magnetic Cell Labeling Efficiency**

Kevin S. Tang[1], Erik M. Shapiro[2]
[1]Department of Biomedical Engineering, Yale University, New Haven, CT, United States; [2]Department of Diagnostic Radiology, Yale University School of Medicine, New Haven, CT, United States

Magnetic cell labeling with MPIOs is well established, however, current protocols employ long labeling times. Incubation of negatively charged iron oxide nanoparticles with positively charged transfection agents, such as poly-l-lysine (PLL) increases labeling efficiency. Therefore, it was hypothesized that pre-incubating MPIOs with various quantities of PLL would similarly enhance the rate of magnetic cell labeling. Indeed, it was discovered that MPIO complexation with PLL yielded positive zeta potential. Furthermore, cells labeled with MPIO:PLL complexes were fully labeled after only two hours incubation, whereas negatively charged MPIOs labeled only 20%, even after four hours.

15:00 ***4184*. Fluorinated Cyclodextrin as a Novel ^{19}F Contrast Agent for Labeling Cells**

Florian Schmid[1], Maria Becker[2], Marc Hotfilder[3], Bart-Jan Ravoo[2], Cornelius Faber[1]
[1]Department for Clinical Radiology, University Hospital Münster, Münster, Germany; [2]Organic Chemistry Institute of the Westfälische Wilhelms-Universität Münster, Münster, Germany; [3]Department of Pediatric Hematology and Oncology, University Children's Hospital Münster, Münster, Germany

Fluorinated Cyclodextrins are interesting candidates for novel MR contrast agents for cell labelling as they are soluble in water and contain lots of ^{19}F atoms that contribute to a single spectral line. Results from first cell labeling experiments performed on Ewing's sarcoma cells are presented; ^{19}F MR images acquired on a clinical 3T MRI scanner are shown.

15:30 ***4185*. In Vivo MRI Multicontrast Kinetic Analysis of the Uptake and Intracellular Trafficking of Paramagnetically Labeled Liposomes**

Daniela Delli Castelli[1], Enzo Terreno[1], Walter Dastrù[1], Evelina Cittadino[1], Francesco Mainini[1], Elena Torres[1], Michela Spadaro[1], Silvio Aime[1]
[1]University of Torino, Turin, Italy

The multi-contrast ability of paramagnetically loaded liposomes have been exploited to get a better understanding of their uptake and intracellular trafficking in vivo in a tumor environment.In order to account for the observed MRI data, a kinetic model able to describe the underlying biological processes has been developed. The fit of the data provides a rough estimate of the kinetic constants for each process considered in the model.

Tuesday 13:30-15:30 Computer 68

13:30 ***4186*. Animal Imaging Using L1-Regularized Quantitative Susceptibility Mapping**

Ildar Khalidov[1], Tian Liu[1], Xiaoyue Chen[2], Moonso Jin[2], Ali S. Arbab[3], Quan Jiang[3], Martin Prince[1], Yi Wang[1]
[1]Radiology, Weill Cornell Medical College, NYC, NY, United States; [2]Biomedical Engineering, Cornell University, Ithaca, NY, United States; [3]Neurology, Henry Ford Hospital, Detroit, MI, United States

Quantitative susceptibility mapping (QSM) is a technique that uses phase data from an MRI image to estimate the susceptibility distribution in the object. It has been demonstrated that QSM is able to correctly estimate the magnetic moment of specimen differing in susceptibility to the surrounding tissue [1]. We would like to exploit this ability to perform quantitative imaging of biomarkers in animal imaging. However, animal imaging presents additional challenges: the need for higher resolution suggests lower SNR; mixes of several tissues can create significant artifacts that impede quantification. In this work, we estimated the susceptibility change induced by SPIO nanoparticles that are targeted to specific cells. In experiment (1), we scan a rat brain after stroke injected with neural progenitor cells (NPCs) incubated in a solution containing a suspension of ferumoxide-protamine sulfate. In experiment (2), we image a mouse injected with SPIO nanoparticles that target the intercellular adhesion molecule ICAM-1, which is induced in response to inflammation. We use total-variation based regularization to circumvent the problems with low SNR and the streaking artifacts.

14:00 ***4187*. A Dose Dependent Inflammatory Cell Tracking by Micrometer-Sized Iron Oxide Particles-Enhanced MRI in Murine Myocardial Infarction Model**

Yidong Yang[1,2], Jimei Liu[1], Yuhui Yang[1], Tom C.-C. Hu[1,2]
[1]Department of Radiology, Medical College of Georgia, Augusta, GA, United States; [2]Medical Physics Program, Georgia Institute of Technology, Atlanta, GA, United States

Inflammation plays a pivotal role in the cardiac remodeling process following myocardial infarction. Recently, it has been shown that inflammatory cells such as macrophages can be labeled with micrometer-sized iron oxide particles (MPIO) via systemic injection. After myocardial infarction, MPIO-labeled inflammatory-cell infiltration at MI sites can be monitored using T2*-weighted MRI. The purpose of this study is to investigate the relationship between the injected MPIO dose and the signal attenuation therefore to identify an optimal dose. This study will provide a valuable method to track inflammatory cells, which can be applied in either inflammation-related disease monitoring or drug development.

14:30 ***4188*. Dual Contrast Cellular MRI**

Rohan Dharmakumar[1], Zhuoli Zhang[1], Ioannis Koktzoglou[2], Sotirios A. Tsaftaris[1,3], Debiao Li[1,4]
[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Radiology, NorthShore University HealthSystem, Evanston, IL, United States; [3]Electrical Engineering and Computer Science, Northwestern University, Evanston, IL, United States; [4]Biomedical Engineering, Northwestern University, Evanston, IL, United States

Negative contrast methods utilizing local magnetic susceptibility shifting agents have become one of the most important approaches in cellular imaging research. However, visualizing and tracking labeled cells on the basis of negative contrast is often met with limited specificity and/or sensitivity. Here we report on a cellular MRI method that generates a new contrast with a distinct topology for identifying labeled cells permitting significant improvement in sensitivity and specificity.

15:00 ***4189*. Cellular Uptake and Imaging Studies of Gadolinium-Loaded Single-Walled Carbon Nanotubes**

Annie M. Tang[1,2], Jeyarama S. Ananta[3], Hong Zhao[1], Brandon T. Cisneros[3], Edmund Y. Lam[4], Stephen T. Wong[1], Lon J. Wilson[3], Kelvin K. Wong[1,5]
[1]The Center for Bioengineering and Informatics and Department of Radiology, The Methodist Hospital Research Institute, Weill Cornell Medical College, Houston, TX, United States; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, Hong Kong; [3]Department of Chemistry, Rice University, Houston, TX, United States; [4]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong,, Hong Kong, Hong Kong; [5]Texas Children Small Animal Imaging Facility, Texas Children Hospital, Houston, TX, United States

Single-walled carbon nanotubes (SWCNTs) have recently been proposed as vehicles for efficient delivery of biomolecules such as drugs and genes into targeting sites for therapeutic purposes. In order to monitor the delivery location and efficiency, visualization of these SWCNTs is crucial. In this study, we investigate the intracellular uptake of gadonolimum-loaded ultra-short carbon nanotubes (gadonanotubes) with MRI and demonstrated single cell visualization in a sparsely distributed cell agarose phantom.

Wednesday 13:30-15:30 Computer 68

13:30 ***4190*. Poly-L-Lactic Acid (PLLA) Iron Loaded Nanoparticles for MRI Cell Labelling**

Gerlinde Schmidtke-Schrezenmeier[1], Markus Urban[2], Sonu Sharma[3], Katharina Landfester[2], Hubert Schrezenmeier[1], Volker Rasche[3]
[1]Institute for Transfusion Medicine, University Hospital of Ulm, Ulm, Germany; [2]Max-Planck-Institute for Polymer Research, Mainz, Germany; [3]Department of Internal Medicine II, University Hospital Ulm, Ulm, Germany

Different iron-loaded nanocapusles (diameter 110nm to 135nm, zeta-potential -28mV to -55mV) were synthesized by the mini-emulsion process and applied for efficient labeling of MSCs. The MRI efficiency (T2 and T2* relaxation) and kinetics of the particles regarding cell uptake and release as well as its impact on the cell properties were investigated. The visibility of the labeled cells was investigated over a time period of 14days in an agarose gel phantom.

14:00 ***4191*. In-Vivo Positive Contrast Tracking of Bone Marrow Stem Cells Labeled with IODEX-TAT-FITC Nanoparticles**

Philip Lee[1], Bingwen Zheng[1], George Radda[1], Parasuraman Padmanabhan[1], Kishore Bhakoo[1]
[1]Singapore Bioimaging Consortium, Biomedical Sciences Institute, Singapore, Singapore

In vivo tracking with MRI has become standard in modern therapeutic cell studies. Typically, cells loaded heavily with iron-oxide nanoparticles, are identified as signal voids in T2*-weighted imaging. This raises two issues, namely the detrimental effect of high iron load in terms of cellular function and viability as well as interpretation ambiguities associated with partial volume artifacts and local magnetic field inhomogeneities. TAT-IODEX-FITC nanoparticles offer dual modality detection (MRI and optical) without adverse impact on cellular biology. By utilizing a multiple-echo ultra-short echo-time pulse sequence, we obtain high positive contrast of labeled bone marrow stem cells injected into rats' striatum in vivo.

14:30 ***4192***. **Quantification of Cell Density of SPIO-Labelled Cell Populations**

Bernhard Neumayer[1], Clemens Diwoky[1], Andreas Reinisch[2], Dirk Strunk[2], Rudolf Stollberger[1]

[1]Institute of Medical Engineering, Graz University of Technology, Graz, Austria; [2]Stem Cell Research Unit, Dept. of Hematology, Univ. Clinic of Internal Medicine, Medical University of Graz, Graz, Austria

The use of intracellular contrast agent suffers from quenching effects due to compartmentalization of the contrast medium inside the cell. These effects impede the correct quantification of cell populations. This study presents a simple way to quantify cell density by using inversion recovery measurements and biexponential fitting routines.

15:00 ***4193***. **Magnetic Resonance Imaging of Stem Cells Labeled with Micrometer-Sized Iron Oxide Particles: Applications to Musculoskeletal Tissue Engineering**

Karl Saldanha[1,2], Kimberly Loo[1], Sharmila Majumdar[1,2]

[1]Department of Radiology, UCSF, San Francisco, CA, United States; [2]Joint Graduate Group in Bioengineering, UC Berkeley/UCSF, San Francisco, CA, United States

To aid in the development and implementation of clinically viable stem cell-based tissue engineering therapies, a technique is needed to monitor implanted cells throughout the course of treatment. Labeling of stem cells with an iron oxide contrast agent prior to implantation has the potential to allow for longitudinal non-invasive in vivo assessment of the bio-distribution of transplanted cells via magnetic resonance imaging (MRI). This study aims to investigate labeling of stem cells with micrometer-sized iron oxide particles to enable MRI detection, and its applications in longitudinal monitoring of stem cell-based musculoskeletal tissue engineering.

Thursday 13:30-15:30 Computer 68

13:30 ***4194***. **Characterization of MPIO Labeled Primary Murine Bone Marrow Derived Macrophages**

Kevin S. Tang[1], Erik M. Shapiro, [1,2]

[1]Department of Biomedical Engineering, Yale University, New Haven, CT, United States; [2]Department of Diagnostic Radiology, Yale University School of Medicine, New Haven, CT, United States

Macrophages are key players in the innate immune response and important markers of local inflammation. Here, we evaluated the effects of MPIO labeling on macrophage functions: cytokine secretion, maintained phagocytosis, and cell migration. Labeling with MPIOs did not, on its own, stimulate the cells to produce TNF-á and IL-12, two important inflammatory cytokines. Furthermore, MPIO labeling did not inhibit macrophages to secrete these cytokines upon activation with LPS. Fluorescence microscopy demonstrates the ability to continue phagocytosis after labeling. Lastly, transwell migration assays showed migration from both unlabeled and labeled macrophages, suggesting no effect on migratory ability by MPIOs.

14:00 ***4195***. **Nanoparticle-Loaded Stem Cells for MR Imaging and Hyperthermia**

Lyubov Ostrovska[1], Mohammad Hedayati[2], Christine Cornejo[2], Yoshinori Kato[1], Dmitri Artemov[1], Theodore L. DeWeese[2], Robert Ivkov[2]

[1]The Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Department of Radiation Oncology & Molecular Radiation Sciences, The Johns Hopkins University School of Medicine

The goal of this study is to sensitize tumors to radiation therapy with heat generated by magnetic bionized nanoferrite (BNF)-nanoparticles within stem cells that home to hypoxic areas in tumors. Previously, we demonstrated that in mouse models of prostate cancer intravenously injected mesenchymal stem cells migrate to tumors, home to hypoxic areas, and participate in tumor neovasculogenesis. It was also demonstrated that heating of tumor-bearing mice injected with BNF-particles resulted in tumor size reduction and delayed tumor growth. We aim to develop methods for stem cell-based delivery of BNF-nanoparticles to hypoxic areas in tumors for hyperthermic sensitization to irradiation.

14:30 ***4196***. **Differentiation of Multiple Stem Cells Types Labeled with MPIOs Down Multiple Lineages Is Identical to Unlabeled Cells**

Cicely Williams[1], Dorit Granot[2], Teodor Leahu[1], Erin B. Lavik[3], Erik M. Shapiro, [1,2]

[1]Department of Biomedical Engineering, Yale University, New Haven, CT, United States; [2]Department of Diagnostic Radiology, Yale University School of Medicine, New Haven, CT, United States; [3]Center for Translational Neuroscience, Case Western Reserve University, Cleveland, OH, United States

Critical to the use of magnetic particles for MRI-based cell tracking is that particles not interfere with cellular processes. This is especially the case with stem cells. In this work, we investigated the effect of magnetic cell labeling with various sized MPIOs on differentiation of mesenchymal stem cells and neural progenitor cells, down multiple cell lineages. Neural progenitor cells labeled with MPIOs differentiated into neurons and glia identically to unlabeled cells. Similarly, mesenchymal stem cells labeled with MPIOs were able to differentiate into adipocytes and osteocytes identically to unlabeled cells. Importantly, MPIOs remained intracellular during differentiation.

15:00 ***4197***. **Differences in Clearance of Ferucarbotran and Ferumoxide from the Liver Using Gradient Echo MRI and T2 Measurement in Rat.**

Lindsey Alexandra Crowe[1], Frederic Ris[2], Matthieu Lepetit-Coiffé[1], Christian Toso[2], Thierry Berney[2], Jean-Paul Vallée[1]

[1]Department of Radiology, Geneva University Hospital, University of Geneva, Faculty of Medicine, Geneva, Switzerland; [2]Cell Isolation and Transplant Center, Department of Surgery, Geneva University Hospital, Geneva, Switzerland

The clearance of two injected iron oxide contrast agents was followed by GRE MRI and T2 decay at 1.5T. Ferucarbotran (Resovist®) was found to clear from the rat liver significantly faster than ferumoxide (Endorem®). The rate of clearance will affect the choice of contrast agent for serial cell labeling studies where the iron signal from a rejected cell should be cleared as fast as possible after cell death. T1- and T2- weighted images and T2 decay curves return to normal within 10 days for ferucarbotran, but ferumoxide still has a significant effect on the liver after more than 100 days.

Recent Advances in Molecular Imaging

Hall B Monday 14:00-16:00 Computer 69

14:00 ***4198***. **Hollow Structured Mesoporous Silica Coated MnO Nanoparticles as Highly Efficient T1 Contrast Agents and Their Applications in MR Tracking of Transplanted Mesenchymal Stem Cells**

Taeho Kim[1,2], Eric Momin[3], Jonghoon Choi[1,4], Hasan Zaidi[3], Jaeyun Kim[1,2], Mihyun Park[2], Michael T. McMahon[1,5], Taeghwan Hyeon[2], Alfredo Quinones-Hinojosa[3], Jeff W. M. Bulte[1], Assaf A. Gilad[1]

[1]Department of Radiology, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Chemical & Biological Engineering, Seoul National University, Seoul, Korea, Republic of; [3]Department of Neurological Surgery, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [4]CSTL, National Institute of Standards and Technology, Gaithersburg, MD, United States; [5]F. M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States

New MnO nanoparticles, which have "hollow" structures in a mesoporous silica coating were designed and successfully synthesized. We have demonstrated improved T1 and T2 contrast with these nanoparticles. These nanoparticles showed high cellular uptake with the use of electroporation and were detected with magnetic resonance imaging (MRI) both in vivo and in vitro. Thus, these novel MnO nanoparticles represent an efficient alternative to label and track transplanted cells with MRI.

14:30 ***4199***. **In Vivo Tracking of Gastric Stem Cell by MRI Using a Newly Synthesized Iron-Based Contrast Agent, $MnFe_2O_4$-PEG**

Chiao-Yun Chen[1,2], Gin-Chung Liu[3,4], Deng-Chyang Wu[5,6], Yun-Ming Wang[7], Pei-I Liu[8], Ting-Jung Chen, [23], Twei-Shiun Jaw[3,4], Yu-Ting Kuo[3,4]

[1]Department of Medical Imaging, Kaohsiung Medical University Hospital , Kaohsiung, Taiwan; [2]Kaohsiung Medical University, Kaohsiung, Taiwan; [3]Department of Medical Imaging, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan; [4]Kaohsiung Medical University , Kaohsiung, Taiwan; [5] Division of Gastroenterology, Department of Internal Medicine, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan; [6]Department of Internal Medicine, Faculty of Medicine, College of Medicine, Kaohsiung Medical University , Kaohsiung, Taiwan; [7]Department of Biological Science and Technology, National Chiao Tung University, Hsinchu, Taiwan; [8]Department of Radiology, Pingtung Pao Chien Hospital, Pingtung, Taiwan

We have successfully synthesized and characterized a novel iron-based MR contrast agent, MnFe2O4-PEG, for labeling gastric stem cell, CS12, in vitro. Its carcinogenetic potential was well preserved following MR contrast labeling. In addition, tumor growth from the labeled CS12 cell and the T2* effect can be efficiently detected over three weeks with in vivo MRI. We believe that this molecular imaging technique may contribute further understanding of carcinogenesis induced by gastric stem cell and it may be also beneficial to help gene or cellular therapy in the future.

15:00 ***4200***. **Alternative Labels for Visualization of Pancreatic Islets**

Vít Herynek[1,2], Zuzana Berková[3], Daniel Horák[4], Michal Babic[4], Daniel Jirák[1,2], František Saudek[3], Milan Hájek[1]

[1]MR-Unit, Department of Radiodiagnostic and Interventional Radiology, Institute for Clinical and Experimental Medicine, Prague, Czech Republic; [2]Center for Cell Therapy and Tissue Repair, Second Medical Faculty, Charles University, Prague, Czech Republic; [3]Pancreatic Islet Laboratory, Diabetology Clinic, Institute for Clinical and Experimental Medicine, Prague, Czech Republic; [4]Institute of Macromolecular Chemistry, Czech Republic

Visualization of transplanted islets using MRI requires labeling of islets by a suitable contrast agent. We successfully tested alternative superparamagnetic iron oxide nanoparticles with improved biological and physical properties, which represent alternative to commercially available dextran coated contrast agents. Modified coating of the nanoparticles ensures higher efficiency at lower concentrations and no adverse effects on islet viability or insulin secretion.

15:30 **4201. Characterisation of a Liposomal Contrast Agent for Delivery of SiRNA**

Gavin David Kenny[1], Leigh Pauline Brody[1], Nazila Kamaly[1,2], Tammy Louise Kalber[1], Andrew David Miller[2], Jimmy David Bell[1]

[1]Metabolic and Molecular Imaging Group, Imperial College, London, United Kingdom; [2]Genetic Therapies Centre, Imperial College, London, United Kingdom

This studies aim was to characterise the ability of a liposome encapsulating siRNA to act as a contrast agent for MRI. Liposomes were formed with and without encapsulation of siRNA and size, encapsulation percentage and r1 determined. Encapsulation of siRNA in liposomes had no effect on the size or r1 of the liposomes and was found to be stable for approximately 5 days. This shows that encapsulation of siRNA has no effect on the ability to act as a contrast agent and that liposomes should be used within 5 days, meaning liposomes can be tested without wasting expensive siRNA.

Tuesday 13:30-15:30 Computer 69

13:30 **4202. Detection of Spontaneously Occuring Amyloid Plaques in a Primate Model of Alzheimer's Disease**

Anne Bertrand[1], Adrien Pasquier[1], Alexandra Petiet[1,2], Christopher Wiggins[2], Sebastien Meriaux[2], Audrey Kraska[1], Olene Dorieux[1,3], Nelly Joseph-Mathurin[1], Philippe Hantraye[1], Fabienne Aujard[3], Nadine Mestre-Frances[4], Marc Dhenain[1,2]

[1]CEA, I2BM, MIRCen-URA2210, Fontenay aux Roses, France; [2]CEA, I2BM, Neurospin, Gif-sur-Yvette, France; [3]UMR CNRS/MNHN 7179, Brunoy, France; [4]INSERM U710- EPHE- Université Montpellier 2, Montpellier, France

Amyloid deposits are one of the characteristic lesions of Alzheimer's disease. Their sizes range from 50 µm to 200 µm. These lesions can be detected in transgenic mouse model of Alzheimer's disease by MRI, however, amyloid deposits in mice are very different than those occurring spontaneously in aged primates or humans with Alzheimer's disease. Here, we show that a protocol based on the staining of amyloid plaques with a non targeted Gadolinium contrast agent allows to detect spontaneously occurring amyloid plaques in aged mouse lemur Primates.

14:00 **4203. Acoustic Relaxation Enhancement in MRI**

Christian Höhl[1], Nouri Elmiladi[1], Fahimeh Jahanbakhsh[1], Felix Repp[1], Peter Wolf[1], Karl Maier[1]

[1]Helmholtz-Institut für Strahlen- und Kernphysik (HISKP), Rheinische Friedrich-Wilhelms-Universität, Bonn, Germany

A contrast mechanism which is selective to the binding of a magnetic nanoparticle has been successfully observed in an NMR spectrometer. There are, however, difficulties to achieve compatibility with a standard MRI device. We present first experiments on how to realize this contrast mechanism in an open tomography system.

14:30 **4204. Paramagnetic PH Sensitive Liposomes with Improved MRI Properties**

Elena Torres[1], Enzo Terreno[1], Roberta Cavalli[2], Franco Fedeli[3], Francesco Mainini[1], Roberta Napolitano[1], Silvio Aime[1]

[1]Department of Chemistry and Molecular Imaging Center, University of Torino, Torino, Italy; [2]Department of Drug Science and Technology, University of Torino, Italy; [3]Bioindustry Park of Canavese, Italy

Liposomes occupy a leading role in biomedical field being successfully used since a long time as drug-delivery systems. These nanovesicles can be properly formulated in order to release the entrapped material as a consequence of a specific endogenous stimulus (e.g. acidification, change in redox potential or concentration of specific enzymes) that characterizes the early asymptomatic stage of many diseases. In this contribution, a novel class of paramagnetic pH sensitive liposomes with improved formulations are presented and their basic MRI properties evaluated both in vitro and in vivo on tumor animal model on mice.

15:00 **4205. Gadolinium Chelate Functionalized Gold Nanoparticles for Targeted NIR Laser Heating**

Steve Huntz Fung[1,2], Edward S. Hui[1], Feng Li[1], Guoting Qin[1], Diana U. Lo[1], Rongmin Xia[1], Zheng X. Li[1,2], Brian E. O'Neill[1,2], King C. Li[1,2]

[1]Department of Radiology, The Methodist Hospital, Houston, TX, United States; [2]Department of Radiology, Weill Cornell Medical College, New York, United States

We have developed gadolinium-chelate functionalized gold nanoparticles (Gd-Au NP) as theranostic agents that can be detected by MRI to guide NIR laser therapy. By tuning the optical properties of Gd-Au NP to absorb in NIR, where tissue penetration of light is optimal, one can selectively heat tumor tissue that contain nanoparticles. We have taken into consideration expected spectral shift of surface plasmon resonance (SPR)-associated absorption from surface functionalization, and designed a good NIR absorber that doubles as a very good T1-contrast agent. In the design process, a new Gd-DTPA-based chelate-linker for conjugation to Au NP is proposed that has two thiol-Au binding sites and a longer linker segment than ones proposed in existing literature, which should allow for better immobilization and increased number of Gd-chelate conjugation to Au NP for better T1-relaxivity. MR relaxivity, UV-visible-NIR spectroscopy, and NIR laser heating data are presented.

Wednesday 13:30-15:30 Computer 69

13:30 ***4206*. NMR Relaxation of Mn0.5Zn0.5GdxFe(2-X)O4 Hyperthermia Nanoparticles: Effects of Coating**

Bashar Issa[1], Ihab M. Obaidat[1], Shahnaz Qadri[2], Basil al-Ramadi[3], Yousef Haik[2,4]
[1]Physics, UAE University, Al-Ain, Abu Dhabi, United Arab Emirates; [2]Mechanical Eng., UAE University, Al-Ain, Abu Dhabi, United Arab Emirates; [3]Medicine, UAE University, Al-Ain, Abu Dhabi, United Arab Emirates; [4]Center of Research Excellence in Nanobiosciences, Univ. of North Carolina-Greensboro, United States

We studied the of 1/T1 and 1/T2 behaviour and effect of PEG coating for a new class of magnetic nanoparticles (MNPs) Mn0.5Zn0.5GdxFe(2-x)O4 with Gd concentration x = 0.02. MNPs were dispersed in gel with a range of concentrations (in mM of Fe per kg) from 0.0 to 0.3. At 1.5 T, T1 and T2 were measured at temperatures 26 oC. The measured 1/T1 and 1/T2 show linear dependence on concentrations. Variation of R1,2 with concentration is larger for the uncoated than for the coated particles due to smaller distance separating the protons from MNPs. These nanoparticles have already been used as hyperthermia agents and we are investigating the extension of their use as MRI contrast agents.

14:00 ***4207*. Dual MR-PET Probe for Quantitative, Noninvasive High Resolution PH Mapping**

Luca Frullano[1], Ciprian Catana[1], Thomas Benner[1], A. Dean Sherry[2,3], Peter Caravan[1,4]
[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Chemistry, University of Texas at Dallas, Dallas, TX, United States; [3]Advanced Imaging Research Center, UT Southwestern, Dallas, TX, United States; [4]Radiology, Harvard Medical School, Charlestown, MA, United States

In vivo application of activatable contrast agents is limited by the inability to determine both probe concentration and relaxivity. One approach to this problem is simultaneous MR-PET using a dual MR-PET probe, where PET provides quantification of probe concentration and MR signal can then be related to relaxivity. We describe synthesis and characterization of a fluorine-18 labeled, gadolinium-based probe with pH dependent relaxivity. Simultaneous MR-PET imaging indicates a strong correspondence between pH calculated from the joint image analysis and pH measured by electrode.

14:30 ***4208*. Nuclear Magnetic Relaxation Dispersion Studies of MR Sensor Agents for Myeloperoxidase Imaging**

Yuanxin Chen[1], John A. Ronald[2], Elisenda Rodriguez[3], John W. Chen[3], Kem A. Rogers[4], Brian K. Rutt[2]
[1]Imaging Research Laboratories, Robarts Research Institute, London, Ontario, Canada; [2]Department of Radiology, Stanford University, Stanford, CA, United States; [3]Center for Systems Biology and Department of Radiology, Massachusetts General Hospital, Boston, United States; [4]Department of Anatomy and Cell Biology, University of Western Ontario, London, Ontario, Canada

Bis-5-hydroxytryptamide-diethylenetriamine-pentaacetate gadolinium [bis-5HT-DTPA(Gd)] is a highly sensitive and specific magnetic resonance reporter of myeloperoxidase (MPO) activity in vivo. In this study, we measured water proton T1 nuclear magnetic relaxation dispersion (NMRD) profiles for bis-5HT-DTPA(Gd) solutions and of the aortic specimen excised from atherosclerotic rabbits 2 hours after injection of bis-5HT-DTPA(Gd). When activated by MPO, bis-5HT-DTPA(Gd) exhibits a significant relaxivity increase over the entire range of magnetic fields up to 0.93 T. Similarly, the NMRD profiles of atherosclerotic aorta showed increased relaxivity enhancement compared to aortic specimen from control rabbits. This supports our in vivo MRI results that bis-5HT-DTPA(Gd) targets of MPO and identifies active inflammation in experimental atherosclerosis.

15:00 ***4209*. Quantitative CEST with BIRDS**

Daniel Coman[1,2], Garry Kiefer[3], Douglas L. Rothman, [2,4], Dean A. Sherry[5,6], Fahmeed Hyder, [2,4]
[1]Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Quantitative Neuroscience with Magnetic Resonance (QNMR), Yale University, New Haven, CT, United States; [3]Macrocyclics, Dallas, TX, United States; [4]Diagnostic Radiology and Biomedical Engineering, Yale University, New Haven, CT, United States; [5]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [6]Radiology and Chemistry, University of Texas Southwestern Medical Center, Dallas, TX, United States

***B**iosensor **I**maging of **R**edundant **D**eviation of **S**hifts* (BIRDS) represents another alternative to CEST imaging, using resonances from paramagnetic lanthanide-based contrast agents (CAs). Although spatial resolution is high, CEST data are qualitative because the signal attenuation remains relative unless the CA concentration, temperature and pH are known. A typical BIRDS experiment uses high-speed CSI because of favorable relaxation times for CAs. A europium-based CA, EuDOTA-(gly)$_4^-$, exhibits enhanced CEST characteristics while still retaining high sensitivity to temperature variations specific to BIRDS. Here, we illustrate the principles of combining CEST and BIRDS to obtain optimal temperature measurements with improved spatial resolution.

Thursday 13:30-15:30 Computer 69

13:30 *4210*. **Controlling the Dissolution of MnO Nanocrystals for Time-Dependent T_1 MRI Contrast Agents**

Yi-Cheng Lee[1], Der-Yow Chen[2], Stephen J. Dodd[2], Nadia Bouraoud[2], Alan P. Koretsky[2], Kannan M. Krishnan[1]
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Manganese based nanoparticles have potential as agents that can be "activated" when taken into cells. It would be advantageous to be able to control the rate of dissolution of Mn based nanoparticles to control T_1 contrast signals, in vivo with time. To this end, five different coatings on MnO nanocrystals have been tested to study the release rate of the Mn^{2+} ions and change in relaxivity at pH 7 compared to pH 5. The MnO@SiO_2 particles show the best potential for delaying the release of MRI contrast until specific biological processes have occurred, such as endocytosis.

14:00 *4211*. **Reduced Glutathion Concentration Limits the Reduction Rate of Nitoimidazol Derivatives *in Vitro***

Jesus Pacheco-Torres[1], Paloma Ballesteros[2], Pilar Lopez-Larrubia[1], Sebastian Cerdan[1]
[1]Instituto de Investigaciones Biomédicas "Alberto Sols" - CSIC, Madrid, Spain; [2]Laboratory of Organic Synthesis and Molecular Imaging, UNED, Madrid, Spain

We investigate the mechanism of reduction of commercially available misonizazol or pimonidazol and the newly synthesized NIMAC hypoxia probe. We followed by in vitro ^{1}H NMR the P-450 reductase dependent reduction of solutions containing NADPH and the different hypoxia probes in the presence or not of reduced glutathione, either under the air oxygen tension or under anoxic conditions. We found that the oxygen content of the solution had only a small effect of the different reduction rates, the rate limiting step being in all cases the presence or not of reduced glutathione, independently of the oxygen tension achieved.

14:30 *4212*. **MRI Probes for Sensing the Extracellular Redox State**

Giuseppe Digilio[1], Valeria Menchise[2], Eliana Gianolio[3], Franco Fedeli[3], Concetta Gringeri[1], Roberta Napolitano[3], Carla Carrera[3], Valeria Catanzaro[3], Silvio Aime[3]
[1]DISAV, University of Eastern Piedmont, Alessandria, AL, Italy; [2]Institute for Bioimages and Biostructures, CNR, Naples, Italy; [3]Department of Chemistry IFM, University of Turin, Turin, Italy

Exofacial protein thiols exposed on the cell surface are responsive to the redox state of the extracellular milieu. They can be exploited as anchorage points for suitably designed Gd-based MRI probes, allowing for the visualization of hypoxic tumor regions.

15:00 *4213*. **Integrating MR with 3D Gene Expression Data in the Mouse Brain**

Christopher Lau[1], Lydia Ng[1], Chihchau Kuan[1], Changkyu Lee[1], Mallar Chakravarty[1], Allan Jones[1], George Allan Johnson[2], Michael Hawrylycz[1]
[1]Allen Institute for Brain Science, Seattle, WA, United States; [2]Center for In Vivo Microscopy, Duke University

The Allen Brain Atlas (ABA) adult C56BL/6J mouse brain database of over 20,000 in situ gene expression patterns was registered with a set of multispectral 21.5 micron resolution target MR volumes (T1, T2, and T2*). We developed a 3D viewing application that enables comparison of gene expression patterns with MR data. The application can search for genes expressing in regions of interest defined in MR images, and co-visualize gene expression or histology with MR. This application forms a bridge between the transcriptome and MR data in the mouse brain.

Contrast Agents

Hall B Monday 14:00-16:00 Computer 70

14:00 *4214*. **Validation of Optical Tomography in Vivo**

Yuting Lin[1], Mehmet B. Unlu[1], Brian Grimmond[2], Anup Sood[2], Egidijus E. Uzgiris[3], David Thayer[1], Han Yan[1], Orhan Nalcioglu[1], Gultekin Gulsen[1]
[1]Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]GE Gobal Research, Niskayuna, NY, United States; [3]Rensselaer Polytechnic Institute,, Troy, NY, United States

Multi-modality imaging is becoming a trend in developing new generation in vivo imaging techniques for diagnosis. Recently, our group has developed a high temporal resolution dynamic MRI/DOT multi-modality imaging system. In such a multi-modality system, each modality measures a different parameter set, which make it difficult to cross-validate the parameters measured by different modalities. An alternative solution is using a bi-functional contrast agent that provides contrast for both optical and MRI simultaneously. Here, our in vivo small animal study is the first to validate a true multi-modality system with a true multi-modality contrast agent.

14:30 *4215*. **Novel Cross-Linked Liposomal Chemical Saturation Transfer or CEST Agents**

Aristarchos Papagiannaros[1], Valeria Righi[1,2], George Dai[2], A Aria Tzika[1,2]
[1]NMR Surgical Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States; [2]Department of Radiology, Massachusetts

General Hospital, Harvard Medical School, Athinoula A. Martinos Center of Biomedical Imaging, Boston, MA, United States

Liposomal CEST agents are a novel class of contrast agents that demonstrate excellent imaging capacity in phantoms and ex vivo, but their instability is preventing their use in imaging inflammation or cancer. We present cross-linked liposomal CEST agents that efficiently separated the bulk water from the intra-liposomal water signal, while offer increased stability for in vivo applications.

15:00 ***4216*.** **Novel Metalloporphyrins as Molecular MR Contrast Agents**

Talaignair Venkatraman[1], Ines Batinic-Haberle[2], Vladimir Mouraviev[2], Haichen Wang[2], Chris lascola[2]

[1]Radiology, Duke University Medical Center, Durham, NC, United States; [2]Duke University Medical cener

We have investigated a new class of therapeutic metalloporphyrins for their potential as molecular MR imaging probes for prostate cancer detection. Mn(III)TE-2-Pyp5+ (meso-tetrakis(N-ethyl-2-prydil)porphyrin) and Mn(III)TnHex-2-PYP5+ (meso-terakis(N-n-hexyl-2-pyridyl)porphyrin are powerful superoxide dismutase mimics with low toxicity and antineoplastic activity. In phantom experiments, we observe unusually high T1 relaxivity. In vivo, we observe selective accumulation of these probes in prostate tumor xenografts following a single dose of either compound. Relaxation changes in prostate tumors is 10-11 fold greater than in normal prostate gland, suggesting these compounds may be particularly effective at detecting multifocal disease in situ.

15:30 ***4217*.** **Controlled-Release and Magnetic Resonance Imaging of Doxorubicin-Conjugated Magnetic Nanoparticles from 3D Poly(Propylene Fumarate) Scaffolds**

Jonghoon Choi[1,2], Kyobum Kim[3], Taeho Kim[4], Taeghwan Hyeon[4], Mike T. McMahon[1], Jeff WM Bulte[1], John P. Fisher[3,5], Assaf A. Gilad[1]

[1]Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Biochemical Science, National Institute of Standard and Technology, Gaithersburg, MD, United States; [3]Chemical and Biomolecular Engineering, University of Maryland, College Park, MD, United States; [4]Chemical Engineering, Seoul National University, Seoul, Korea, Republic of; [5]Fischell Department of Bioengineering, University of Maryland, College Park, MD, United States

Three-dimensional PPF (poly(propylene fumarate)) scaffolds carrying cancer drug-coated nanoparticles showed controlled release of drug nanoparticles and bimodal imaging (fluorescence and magnetic resonance) capabilities. This novel biopolymer matrix could be used for many biomedical applications, including MR-guided implantation, as a drug-carrying vehicle, and as a tumor treatment because of the persistent release of drugs in the vicinity of a malignancy.

Tuesday 13:30-15:30 Computer 70

13:30 ***4218*.** **Transition to MRI – Guided Interventions: First Multimodal Embolization Particles Being Visible in MRI and X-Ray/CT**

Sönke H. Bartling[1], Johannes Budjan[1], Hagit Aviv[2], Henrik J. Michaely[1], Wolfhard Semmler[3], Stefan O. Schönberg[1], Steffen Diehl[1], Shlomo Margel[2], Maliha Sadick[1]

[1]Clinical Radiology and Nuclear Medicine, University Medical Center, Mannheim, Baden-Württemberg, Germany; [2]Dept. of Chemistry, Bar-Ilan University, Ramat-Gan, Israel; [3]Dept. of Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

MRI guidance of interventions is a goal. Current embolization particles cannot be detected by an imaging modality (clinical) or only by CT/X-ray (research). Here, we developed and tested the first multimodal embolization particles being visible within MRI and CT/x-ray. An animal model was used. Post embolization imaging confirmed dual-modality contrast as embolized areas could be detected by CT and MRI. Histology confirmed results. The particles consist of two clinically approved substances: polymerized Iodine and USPIO. Once introduced into clinical routine, improvements of embolization therapy can be expected, because both CT and MRI could be used for treatment control.

14:00 ***4219*.** **On the Effect of Contrast Agent Internalization in a Two Compartment Diffusion Model**

Thomas Kampf[1], Christian Herbert Ziener[1], Peter Michael Jakob[1,2], Wolfgang Rudolf Bauer[3]

[1]Experimental Physics 5, University of Wuerzburg, Wuerzburg, Bavaria, Germany; [2]Research Center for Magnetic Resonance Bavaria (MRB), Wuerzburg, Bavaria, Germany; [3]Medical Clinic and Polyclinic 1, University of Wuerzburg, Wuerzburg, Bavaria, Germany

Contrast agents (CA) are commonly used to alter the contrast in MR data. Thus, profound knowledge of the CAs influence on the MR signal is important. In this work the effect of CA internalization is studied numerically. The simulations show that the simple linear relationship between the concentration of the CA and the relaxation rate is not preserved if the CA is internalized in a small part of the volume. This leads to a decreased apparent relaxivity. Furthermore an upper limit for the averaged relaxation rate was observed for a given volume fraction and size of the CA containing compartment.

14:30 **4220. Prolonged and Homogenous Delivery of Gd Chelates to the Rat Brain with an Osmotic Pump**

Paul A. Schornack[1]
[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States

The purpose of this study is to demonstrate the very prolonged, chronic delivery of neutral & negatively charged Gd-chelates, in addition to the positively charged Mn2+ ion, directly to rat brain interstitium by direct infusion into CSF of the lateral ventricles using an osmostic pump. The main goal of this work is to develop a framework for delivering molecular imaging agents of interest, such as pH reporting agents, to the brain in a consistent & predictable manner.

15:00 **4221. Indirect Sensitive MR Detection of Aβ Plaques with USPIO in Alzheimer Transgenic Mice**

Jean-Sebastien Raynaud[1], *Gaelle Louin*[1], *Olivier Rousseaux*[1], *Isabelle Raynal*[1], *Claire Corot*[1]
[1]Research, Guerbet, Roissy CdG Cedex, France

The aim was to evaluate the potentiality of an USPIO to increase the sensitivity to indirectly detect, via microglial phagocytic activity, Ab plaques, in Alzheimer transgenic mice. P904-Rhodamine was iv administrated in trangenic mice. MRI was performed at 2.35T and 7T. Microglia (CD45), iron (Perl's), Ab (Congo Red) and Rhodamine were analyzed on histological slices. Post P904 injection, several susceptibility artefacts were observed as focal spots all over the mouse brain. Iron, microglia, amyloid plaques et fluorescence were colocalized. These results suggest that P904 could be a very sensitive tool for Alzheimer disease diagnostic and prognostic.

Wednesday 13:30-15:30 Computer 70

13:30 **4222. Gadolinium-Stained Brains Reveal Amyloid Plaques in Live Alzheimer's Transgenic Mice**

Alexandra Petiet[1,2], *Anne Bertrand*[2,3], *Christopher J. Wiggins*[3], *Fanny Petit*[2], *Diane Houitte*[2], *Thomas Debeir*[1], *Thomas Rooney*[1], *Philippe Hantraye*[2], *Marc Dhenain*[2,3]
[1]CNS, sanofi-aventis, Vitry-sur-Seine, France; [2]MIRCen, CEA-CNRS URA 2210, Fontenay-aux-Roses, France; [3]DSV/I2BM/Neurospin, CEA, Gif-sur-Yvette, France

Beta-amyloid (Aβ) plaques, one of the hallmarks of Alzheimer's disease (AD), are the targets of many pharmacological trials. MRI can be used to image these microscopic lesions (50–200µm) in mouse models but their in vivo detection is very challenging. We propose here a protocol based on the use of a gadolinium contrast agent injected directly in the brain of live mice to detect amyloid plaques. We show that Aβ plaques can be identified in APP/PS1 mice aged from 6 to 20 months and that the plaque load measured with MR correlates with histological measurements.

14:00 **4223. Targeting of Tumor Cells with Glutamine Containing Carriers**

Simonetta Geninatti-Crich[1], *Rachele Stefania*[1], *Lorenzo Tei*[2], *Alessandro Barge*[1], *Ibolya Szabo*[1], *Stefania Lanzardo*[1], *Carlotta Bianco*[1], *Silvio Aime*[1]
[1]University of Torino, Torino, Italy; [2]University of piemonte orientale, Alessandria, Italy

Efficient routes to accumulate imaging probes in tumor cells may be found by exploiting the up-regulation of trans-membrane transporting systems. In fact, rapidly growing tumors require an increased and continuous supply of aminoacids and other nutrients. Glutamine appears an interesting candidate as it is considered the main source of nitrogen for tumor cells. Thus tumor cells have been targeted with MR imaging probes bearing glutamine residues as targeting vectors.

14:30 **4224. ^{19}F MRI of Trifluoroacetic Acid Encapsulated Into Liposomes**

Mirko Meißner[1], *Germaine Loredana Truisi*[2], *Constantin von zur Mühlen*[2], *Gerhard Pütz*[3], *Dominik von Elverfeldt*[1]
[1]Dept. of Diagnostic Radiology / Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Dept. of Cardiology and Angiology, University Hospital Freiburg, Freiburg, Germany; [3]Dept. of Clinical Chemistry, University Hospital Freiburg, Freiburg, Germany

Gd-liposomes had been synthesized with a novel dual asymmetric centrifugation technique. Using MRI we examined the in vitro T_1-Relaxivity at 9.4 T and could show the influence of the internal Gd-concentration on the in vitro relaxivity of liposome encapsulated Gd-DTPA.

15:00 **4225. Fluorinated Contrast Agents with Cation Depending T1 Sensitivity**

Markus Plaumann[1], *Dieter Leibfritz*[1]
[1]Institute of Organic Chemistry, University of Bremen, Bremen, Germany

The synthesis of metal ion sensitive MR-contrast agents is important for many medical studies, i.e. neuronal processes. Eight fluorinated Gd^{3+} complexes were synthesized to study the effect of different metal ions to the relaxation time. ^{1}H-T_1 measurements of the synthesized complexes show a strong dependence of relaxivity in presence of diamagnetic metal ions (i.e. Na^+, K^+, Ca^{2+}, Mg^{2+}) and additionally M^{n+}-concentration. Furthermore, relaxation times depend on temperature and pH-value. The molecular structure and length of the side chain of the synthesized complexes is very important for sensitivity to metal ions and changes in T_1 times.

Thursday 13:30-15:30 Computer 70

13:30 *4226*. **Positive Contrast and Quantitative Imaging of Magnetic Nanoparticles and Cancer Cells with Biomarker Targeted RGD-Nanoparticle Conjugates Using T_1 Weighted Ultrashort Echo Time (UTE) Imaging**

Xiaodong Zhong[1], Longjiang Zhang[2,3], Liya Wang[2], Hongwei Chen[2], Julie Yeh[2], Andrew Wang[4], Hui Mao[2]
[1]MR R&D Collaborations, Siemens Healthcare, Atlanta, GA, United States; [2]Department of Radiology, Center for Systems Imaging, Emory University, Atlanta, GA, United States; [3]Department of Radiology, Jinling Hospital, Nanjing University College of Clinical Medicine, Nanjing, Jiangsu, China; [4]Ocean NanoTech, LLC, Springdale, AR, United States

Negative contrast of magnetic nanoparticles (MNPs) on conventional T_2 weighted images may suffer from poor contrast to noise ratio (CNR). This study demonstrated that positive T_1 contrast from MNPs can be obtained using ultrashort echo time (UTE) imaging, resulting higher CNR than that of conventional T_2 weighted imaging. Signal intensity of MNPs in UTE images has a linear correlation with core size and concentration of MNPs used in this study. Cell imaging with the UTE method also demonstrated potential applications of UTE imaging of biomarker targeted MNPs with contrast enhancement associated to the binding of cell targeted MNP.

14:00 *4227*. **MR Lymphography with Fe3O4 Nanoparticles in Rabbits: In Vivo Investigation of Metabolism of Fe3O4 Nanoprobes**

Rong Rong[1], Wang Ruixue[2], Wang Xiaoying[1], Zhang Jue[2], Song Yujun[2]
[1]Department of Radiology, 1st Hospital of Peking University, Beijing, China; [2]Department of Biomedicine, Peking University, Beijing, China

The metabolism of magnetic nanoprobes for MRI was investigated in vivo in order to determinate optimized diagnosis time for the most contrast imaging and to discover nidus. After injection of these nanoprobes into rabbits, a significant darkening effect on the liver epithelial net lymph tissue was observed in 20 min, with about 20% reduce of the spin-spin relaxation time T2. The metabolism study on these nanoparticles indicated that they did not show any weak toxicity to organs detected and finally entered into the hematopoietic organ ¨C spleen without obvious retention in any related organs after recycling for 3 days.

14:30 *4228*. **Ultrasmall Particle of Iron Oxide – RGD Peptidomimetic Conjugate as Novel MRI Contrast Agent**

Sophie Laurent[1], Carmen Burtéa[1], Vincent Rerat[2], Jacqueline Marchand-Brynaert[2], Luce Vander Elst[1], Robert N. Muller[1]
[1]Université de Mons, Mons, Belgium; [2]Université catholique de Louvain, Louvain-la-Neuve , Belgium

In this work, we describe the grafting of a home-made RGD peptidomimetic on ultrasmall particles of iron oxide (USPIO) coated with 3,3’-bis(phosphonate)propionic acid, and the determination of the grafting rates by X-ray photoelectron spectroscopy (XPS). The USPIO-g-Mimic have been characterized by photon correlation spectroscopy (PCS); their magnetometric and relaxometric profiles, and their capacity to target leukemic cells were also analyzed.

15:00 *4229*. **Cracked Iron Oxide Nanoprticles as T2 Contrast Agents for Magnetic Resonance Imaging**

Sung Lan Jeon[1], Min Kyung Chae, Eun Ju Jang, Jee-Hyun Cho, Kwan Soo Hong, Gyunggoo Cho, Chulhyun Lee
[1]Korea Basic Science Institute, Cheongwon-gun, Chungcheongbuk-do, Korea, Republic of

Nanoparticles with small size and large surface provide magnetic resonance image with high sensitivity and specificity at low imaging-agent concentration. Metal oxide nanoparticles with hollow spheres can incorporate therapeutic agents into their payloads, enabling simultaneous MRI diagnosis and delivery of drugs to targeted sites. Herein, we report a facile synthesis of nontoxic cracked iron oxide nanoparticles (CIONPs) from hydrophobic FeO nanoparticles (HIONPs) via 3 steps. With complex surface structure, CIONPs showed improved r2 relaxivities compared to hydrophobic FeO nanoparticles (HIONPs). We expect that CIONPs have the potential application as a drug or chemical delivery vehicle because of their cracked spheres. In addition, cellular and in vivo MR imaging study with CIONPs will be tested.

Advanced Imaging of Spine

Hall B Monday 14:00-16:00 Computer 71

14:00 *4230*. **Magnetization Transfer MRI Measurements of Cervical Spinal Cord Abnormalities in Patients with Neuromyelitis Optica**

Mina Kim[1], Aaron Chan[1], Henry Mak[1], Queenie Chan[2], Koon Ho Chan[3]
[1]Department of Diagnostic Radiology, The University of Hong Kong, Pokfulam, Hong Kong, China; [2]Philips Healthcare, Hong Kong; [3]Department of Medicine, The University of Hong Kong, Hong Kong

Diagnosing neuromyelitis optica (NMO) in the early stages is crucial in order to provide the proper treatment as it involves aggressive and severe attacks of blindness and paralysis. However, current diagnostic criteria in routine practice using conventional techniques

are not sensitive to early abnormalities in NMO. In the present work, we conducted magnetization transfer (MT) imaging for NMO patients. Our results show that it is feasible to assess NMO cervical cord damage of normal appearing tissues using the quantitative capability of MT imaging, which may lead to a better understanding of the clinical manifestations in NMO.

14:30 ***4231*.** **Diffusional Kurtosis Imaging of the Cervical Spinal Cord in Multiple Sclerosis Patients**

Maxim Bester[1,2], Eric Sigmund[1], Ali Tabesh[1], Hina Jaggi[1], Matilde Inglese[3,4], Robin Mitnick[1]

[1]Radiology, New York University, New York, NY, United States; [2]Neuroradiology, Eppendorf-Hamburg University, Hamburg, Germany; [3]Radiology , New York University, New York, NY, United States; [4]Neurology, New York University, New York, NY, United States

Spinal cord (SC) is a frequent and clinically relevant site of pathology in multiple sclerosis (MS). Diffusion kurtosis imaging (DKI) measures non-Gaussian water diffusion and DKI-derived mean kurtosis (MK) is an index of tissue microstructural complexity. Using a moderately expanded diffusion sampling scheme, MK can be obtained simultaneously with DTI metrics. The aim of this study was to investigate global and regional structural abnormalities in the cervical SC of MS patients using both DKI and DTI. Compared to controls, fractional anisotropy and MK were significantly decreased and mean diffusivity was increased in patients. MK was significantly associated to disability.

15:00 ***4232*.** **Radial Fractional Anisotropy Mean and Radial Mean Diffusivity Mean: New Metric in the Study of Spinal Cord Tissue**

Arturo Cardenas-Blanco[1,2], Eve Chung Tsai[3,4]

[1]Radiology, Ottawa Hospital Research Institute, Ottawa, Ontario, Canada; [2]Cellular and Molecular Medicine, University of Ottawa, Ottawa, Ontario, Canada; [3]Neurosurgery, The Ottawa Hospital, Ottawa, Ontario, Canada; [4]Cellular and Molecular medicine, University of Ottawa, Ottawa, Ontario, Canada

Diffusion Tensor Imaging (DTI) and its ability to delineate the motion of water molecules and subsequently white matter tracts has become more important during the last years in the study of spinal cord. Nevertheless, due to the lack of resolution and the poor signal to noise ratio, it is still one of the big challenges in clinical MR research. In this abstract a new approach to quantitatively assess SC tissue is presented. This new approach is based in the combination of quantitative information obtained from DTI; Fractional Anisotropy (FA) and Mean Diffusivity (MD); taking advantage of the singular geometry of the SC.

15:30 ***4233*.** **T1 and T2 Mapping of the Human Cervical Spinal Cord at 3 Tesla**

Maxim Bester[1,2], Matilde Inglese[1], Lazar Fleysher[1]

[1]Radiology and Neurology, New York University, New York, NY, United States; [2]Eppendorf-Hamburg University, Hamburg, Germany

The cervical spinal cord (SC) is a frequent site of pathology in several neurological diseases. We measured the T1 and T2 relaxation times of the human SC using a 3-point GRE T1 mapping method with built-in B1-correction and spin-echo sequence with protocol optimization based on 2-point measurements of T2s respectively. The T1 relaxation times measured in our study were lower and the T2 relaxation values were higher than those reported previously. The latter might be explained by the fact that undesired diffusion weighting may be introduced by use of the TSE sequence leading to a decrease in T2 values.

Tuesday 13:30-15:30 Computer 71

13:30 ***4234*.** **Novel Assessment of the Effects of Spinal Cord Injury in Patients by Means of Spinal FMRI**

Patrick W. Stroman[1,2], Randi L. Beazer[1], Christopher Kidd[1], Rachael Bosma[1], Karen Smith[3,4], Ronald Pokrupa[5,6], Omar Islam, [2,7], Nomusa Mngoma[4], David Cadotte[8,9], David Mikulis[8,10], Michael G. Fehlings[8,9]

[1]Centre for Neuroscience Studies, Queen's University, Kingston, Ontario, Canada; [2]Diagnostic Radiology, Queen's University, Kingston, Ontario, Canada; [3]Physical Medicine and Rehabilitation, Queen's University, Kingston, Ontario, Canada; [4]Providence Care, St Mary's of the Lake, Kingston, Ontario, Canada; [5]Neurosurgery, Kingston General Hospital, Kingston, Ontario, Canada; [6]Neurosurgery, Queen's University, Kingston, Ontario, Canada; [7]Radiology, Kingston General Hospital, Kingston, Ontario, Canada; [8]Neurosurgery, University of Toronto, Toronto, Ontario, Canada; [9]Surgery, Toronto Western Hospital, Toronto, Ontario, Canada; [10]Medical Imaging, Toronto Western Hospital, Toronto, Ontario, Canada

Clinical applications of functional MRI of the spinal cord, in order to assess the effects of spinal cord trauma or disease, must provide sensitive and reliable results, even in the presence of fixation devices to stabilize the spine, and must meet practical time limitations while providing enough information to be diagnostic. Here we demonstrate detailed functional maps in response to stimulation on the right and left sides of the body, at spinal cord segmental levels above and below the level of injury, in spinal cord injured patients. The method is almost fully automated, and takes under 7 minutes.

14:00 ***4235*.** **High-Resolution CINE MRI for the Visualization of Arachnoid Adhesions**

Andreas Gottschalk[1], Axel Bornstedt[2], Uwe Maurer[3], Silke Steinhoff[1], Bernd Schmitz[4], Volker Rasche[2]

[1]Department of Radiology, Armed Forces Hospital, Ulm, Germany; [2]Department of Internal Medicine II, University Hospital Ulm, Ulm, Germany; [3]Department of Neurosurgery, Armed Forces Hospital, Ulm,

Germany; [4]Department for Diagnostic and Interventional Radiology, University Hospital Ulm, Ulm, Baden Wuerttemberg, Germany

The application of high-resolution cardiac phase resolved MRI (CINE) to directly visualize arachnoid adhesions for improved intervention planning in syringomyelia was investigated. It could be shown that high-spatial resolution (250µmx500µmx2mm) combined with 30 cardiac phases enabled direct visualization and quantification of the arachnoid adhesions. The position of the adhesions was verified during the intervention and post-interventional MRI was performed for assessment of the structure of the arachnoid adhesion after the microsurgical adhesiolysis procedure.

14:30 ***4236*. Preoperation MRI Analysis in 149 Patients with Adolescent Idiopathic Scoliosis**

Zhengguang Chen[1], Lifeng Lao[2], Jianxiong Shen[3], Xiaozhen Li[4]
[1]Department of Radiology, First Hospital of Tsinghua University, Beijing, China; [2]Department of Orthopaedic, Renji Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai, China; [3]Department of Orthopedics, Peking Union Medical College Hospital, Peking Union Medical College, Beijing, China; [4]Department of Radiology, Peking Union Medical College Hospital, Peking Union Medical College, Beijing, China

Adolescent Idiopathic Scoliosis (AIS) is defined as a lateral spinal curvature greater than 10° accompanied by vertebral rotation and has no clear underlying causes. Traditionally AIS was evaluated using standing radiographs of the full spine to assess lateral curvature with the Cobb method, but it is on 2D coronal plane-only evaluating system, ignoring the 3D nature of AIS. MRI and computer-generated 3D images is a noninvasive procedure which could be used to assess the functional morphology in spine. To validate the hypothesis of disproportional growth between neural and skeletal system a MRI study was performed in 149 AIS patients and 41 age-matched controls.

15:00 ***4237*. Mean Displacement Map of Spine and Spinal Cord Disorders Using High B-Value Q-Space Imaging; Feasibility Study.**

Masaaki Hori[1,2], Utaro Motosugi[1], Fatima Zareen[1], Keiichi Ishigame[1], Hiroshi Kumagai[1], Toshiyuki Onodera[3], Kazuo Yagi[3], Shigeki Aoki[2], Tsutomu Araki[1]
[1]Radiology, University of Yamanashi, Chuou, Yamanashi, Japan; [2]Radiology, School of Medicine, Juntendo University, Bunkyo, Tokyo, Japan; [3]Tokyo Metropolitan University, Tokyo, Japan

Purpose of this study is to investigate the use of high b-value q-space imaging (QSI) to evaluate spine and spinal cord lesions in vivo, with the use of mean displacement (MD) maps, as feasibility study. In results, various MD values were measured in the lesions. Moreover, MD maps were not apparently well correlated with corresponding apparent diffusion coefficient maps of DWI with b-values of 1000 s/mm2. This technique has potential to provide new information in addition to conventional sequences in routine clinical study.

Wednesday 13:30-15:30 Computer 71

13:30 ***4238*. Fully Automated Straightening of the Spinal Cord Using Fiber Tractography**

Demian Wassermann[1], Julien Cohen-Hadad[2,3], Stephane Lehericy[4], Habib Benali[5], Serge Rossignol[6], Rachid Deriche[1]
[1]INRIA, Sophia-Antipolis, PACA, France, Metropolitan; [2]Athinoula A. Martinos Center for Biomedical Imaging, MGH, Harvard Medical School, Charlestown, MA,, Charleston, MA, United States; [3]UMRS 678, Laboratoire d'Imagerie Fonctionnelle, Inserm, UPMC Univ Paris 06, Paris, Ile-de-France, France, Metropolitan; [4]Center for NeuroImaging Research, Pitie Salpetriere Hospital, UPMC Univ Paris 06, Paris, Ile-de-France, France; [5]Inserm, UPMC Univ Paris 06, UMRS 678, Laboratoire d'Imagerie Fonctionnelle, Paris, Ile-de-France, France; [6]Groupe de recherche sur le Système Nerveux Central, Département de Physiologie, Université de Montréal, Montreal, Quebec, Canada

Spinal Cord MRI (SC-MRI) is a challenging research field with numerous important clinical and basic research applications. Some of the SC-MRI applications strongly need to deal with a well straightened spinal cord either for appropriate methodological developments, for better visualization or diagnostic purposes. In this article, we develop an efficient and automatic method to straighten the spinal cord image and fibres. Diffusion Tensor MRI is first used to recover by tractography the bundles of fibres related to the spinal cord. An efficient Gaussian process framework is then used to automatically recover in a robust way the most representative fibre which is used to interpolate and straighten the spinal cord image and fibres. Our method is successfully tested on real images of one cat with partial spinal cord injury and two healthy volunteers. This capability to reliably reconstruct straightened animal and human spinal cord opens new opportunities for SC-MRI applications.

14:00 ***4239*. Susceptibility Weighted Imaging: A New Tool in Detecting Hemorrhage in Spinal Cord Injury**

Meiyun Wang[1], Yongming Dai[2], Qing Lin, Yanhong Han, Man Wang, E Mark Haacke[3], Zhen Wu, Dapeng Shi
[1]Department of Radiology, Henan Provincial People's Hospital, Zhengzhou, Henan, China; [2]MRI, Siemens Healthcare, Shanghai; [3]Biomedical Engineering, McMaster University

We aimed to evaluate the role of SWI in detecting hemorrhage in spinal cord injury (SCI). Eighteen patients with a history of acute cervical spine trauma and 20 volunteers were enrolled in this study. SWI showed hemorrhage in 4 patients, which was not demonstrated on conventional MRI; 4 of 18 had intramedullary hemorrhage, which was proved by SWI and neurosugery. So we conclude SWI is an invaluable tool for visualizing hemorrhage in SCI compared to conventional MRI methods.

14:30 **_4240_. DCE-MRI and DW-MRI in Characterization of Spinal Metastasis**

David H. Gultekin[1,2], Hebert A. Vargas Alvarez[3], Cecilia Wassberg[4], Jason A. Koutcher[1], Yoshiya Yamada[5], Eric Lis[2], Sasan Karimi[2], Lawrence H. Schwartz[2]

[1]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, United States; [2]Radiology, Memorial Sloan-Kettering Cancer Center, New York, United States; [3]Radiology, Sloan-Kettering Institute, New York, United States; [4]Sloan-Kettering Institute, Memorial Sloan-Kettering Cancer C, New York, United States; [5]Radiation Oncology, Memorial Sloan-Kettering Cancer Center, New York, United States

The combination of DCE-MRI and DW-MRI in the assessment of metastatic cancer of various primaries (breast, prostate, melanoma, colorectal, papillary thyroid, RCC and NSCLC) in the spine has been evaluated for treatment response monitoring in patients undergoing radiotherapy.

15:00 **_4241_. Fast Spin-Echo Triple Echo Dixon: Initial Clinical Experience with a Novel Pulse Sequence for Simultaneous Fat Suppressed and Non Fat Suppressed T2-Weighted Spine Mr Imaging**

Russell Norman Low[1,2], Matthew J. Austin[3], Jingfei Ma[4]

[1]Sharp and Children's MRI Center, San Diego, CA, United States; [2]San Diego Imaging, San Diego, CA, United States; [3]Radiology, Univeristy of California at San Diego, San Diego, CA, United States; [4]Department of Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States

We evaluate a novel Dixon based FSE sequence (fTED) for spine imaging that efficiently provides T2 weighted imaging with and without fat suppression in a single acquisition. Compared to STIR images the fTED water images showed equal homogeneity of fat suppression with less motion artifact, sharper anatomic detail, and less susceptibility artifact. The T2 fTED images without fat suppression were equivalent to T2 FRFSE images for lesion detection. FTED provides T2 imaging of the spine with and without fat suppression with a 56% savings in scan time compared to STIR and T2 FRFSE imaging.

Advanced Imaging of Dementia & Neurodegenerative Disease, Part I

Hall B Monday 14:00-16:00 Computer 72

14:00 **_4242_. BOLD Signal Fractal Dimension Mapping in AD Demonstrates Increase Microvascular Activity and Metabolism When Combined with Spectroscopy**

Mohammed Warsi[1], D William Molloy[2], Tim Standish[2], Graeme Wardlaw[3], Michael D. Noseworthy[4]

[1]School of Biomedical Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada; [2]Medicine, St. Peters Hospital, Hamilton, Ontario, Canada; [3]Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, Ontario, Canada; [4]Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

We present a BOLD signal fractal dimension (FD) mapping approach to assess the tissue microvascular environment in Alzheimer's dementia. The periodicity or temporal complexity can be quantified using this method thus allow insight into the underlying microvascular processes. Alzheimer's Disease (AD) is associated with regional hypermicrovascularity, especially in the deep grey matter. Furthermore our BOLD FD was inversely correlated to our MRS measures of total creatine.

14:30 **_4243_. Automatic Segmentation of Hippocampal Subfields in T2-Weighted in Vivo MRI**

Hongzhi Wang[1], John B. Pluta[2], Brian B. Avants[1], Sandhitsu R. Das[1], Caryne Craige[1], Murat Altinay[1], Michael W. Weiner[3], Susanne Mueller[3], Paul A. Yushkevich[1]

[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States; [3]Center for Imaging of Neurodegenerative Diseases, VA Medical Center, San Francisco, CA, United States

To be added

15:00 **_4244_. A Diffusion Tensor Imaging Study of Cross-Sectional and Longitudinal White Matter Alterations in Frontotemporal Lobar Degeneration**

Yu Zhang[1,2], Maria Carmela Tartaglia[2], Norbert Schuff[1,2], Gloria Chiang[1,2], Christopher Ching[1,2], Howard J. Rosen[2], Bruce L. Miller[2], Michael W. Weiner[1,2]

[1]CIND VA Medical Center, San Francisco, CA, United States; [2]UC San Francisco, San Francisco, CA, United States

Behavioral variant frontotemporal dementia (bvFTD), semantic dementia (SD) and progressive nonfluent aphasia (PNFA) are three major clinical subtypes of frontotemporal lobar degeneration (FTLD). In this study, cross-sectional and a preliminary longitudinal diffusion tensor imaging (DTI) analyses were performed in 12 bvFTD, 6 SD, 6 PNFA, and 19 healthy control (CN) subjects. Cross-sectional analysis revealed bvFTD is associated with a characteristic pattern of fractional anisotropy (FA) reductions in the frontal and temporal regions, SD predominantly affects the uncinate fasciculus, and PNFA affects the left arcuate fasciculus. Preliminary longitudinal analysis suggests that DTI captures disease progression in FTLD.

15:30 **4245. Automated Segmentation of Cortical and Subcortical Gray Matter Structures for Evaluation of Alzheimer's Disease and Fronto-Temporal Dementia**

Emil Malucelli[1], David Neil Manners[1], Claudia Testa[2], Caterina Tonon[2], Giovanni Rizzo[2], Roberto Poda[3], Federico Oppi[3], Michelangelo Stanzani Maserati[3], Luisa Sambati[3], Bruno Barbiroli[2], Roberto Gallassi[3], Raffaele Lodi[2]

[1]Department of Internal Medicine, Aging and Nephrology , University of Bologna, Bologna, Italy; [2]Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Italy; [3]Department of Neurological Sciences, University of Bologna, Bologna, Italy

Objectives: To assess the ability of combined MR cortical structure volumetry and DTI to automatically detect regional brain changes in patients with Alzheimer disease (AD) and Frontotemporal dementia (FTD). Methods: 9 AD patients, 7 FTD patients and 7 controls were studied by 3D volumetric and DW MR imaging. An automated registration/segmentation pipeline defined cortical and subcortical regions of interest, yielding structure volumes and mean diffusivity. Results. Diffuse volume reductions and MD increases were found in both patient groups compared to controls. Conclusions: the protocol described has the potential to identify in vivo surrogate markers for brain pathologic changes in neurodegeneration.

Tuesday 13:30-15:30 Computer 72

13:30 **4246. DTI Measurements of Neurodegeneration in Early Alzheimer's Disease: A Corpus Callosum Study**

Julio Acosta-Cabronero[1,2], Guy B. Williams[1], George Pengas[2], Peter J. Nestor[2]

[1]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Neurology Unit, Department of Clinical Neurosciences, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom

The splenium and genu of the corpus callosum (CC), which contain millions of inter-hemispheric fibres, were found to be abnormal in early AD. In this study, we analysed the behaviour of several DTI measures in the subregions of the midline CC and assessed their relationship with global cognitive data. We found that in both splenium and genu, axial and mean diffusion were better predictors of the disease, whereas radial diffusion and particularly, fractional anisotropy exhibited strong correlations with cognitive performance in the splenium only. The results suggest that the neurodegenerative processes affecting the splenium are different than in the genu.

14:00 **4247. Functional Connectivity and Psychometrics as Early Biomarkers for Alzheimer's Disease**

Partick Rich[1], Huiling Peng[2], Jewell Thomas[2], Joseph Mettenburg[3], Tammie Benzinger[3], John Morris[2], David Balota[4], Beau Ances[5]

[1]Psychology, Grinnell College, Grinnell, IO, United States; [2]Neurology, Washington University in St. Louis, St. Louis, MO, United States; [3]Radiology, Washington University in St. Louis, St. Louis, MO, United States; [4]Psychology, Washington University in St. Louis, St. Louis, United States; [5]Neurology, Washingotn University in St. Louis, St. Louis, MO, United States

This project investigated early biomarkers of Alzheimer's disease (AD). In particular, we studied the relationship between psychometrics (the Stroop task) and blood oxygen level dependent resting state functional connectivity magnetic resonance imaging (BOLD-fcMRI). We observed significant differences in BOLD-fcMRI correlations between subjects with high and low COV subjects within the default mode network (DMN). Our results suggest that psychometric changes are associated with alterations in the DMN with both being early markers for individuals at risk for AD.

14:30 **4248. Structural and White Matter Changes in Patients with Dementia: Comparative FDG-PET and MRI Studies**

Elena Gerasimovitch Steffensen[1], Vineet Prakash[2], Simon Fristed Eskildsen[3], Karsten Vestergård[4], Victor Vishwanath Iyer[2], Elna-Marie Larsson[5]

[1]Department of Radiology, Aalborg Hospital/Århus University Hospital, Aalborg, Denmark; [2]Department of Nuclear Medicine, Aalborg Hospital/Århus University Hospital, Aalborg, Denmark; [3]Department of Health Science and Technology, Aalborg University, Aalborg, Denmark; [4]Department of Neurology, Aalborg Hospital/Århus University Hospital, Aalborg, Denmark; [5]Department of Radiology, Uppsala University Hospital, Uppsala, Sweden

Introduction: Volumetry and evaluation of WM damage is used to characterization of dementia. Purpose: To investigate whether cortical/hippocampal volumetry; measurement of mI- and NAA-concentration or FA and ADC is preferable in classification of dementia. Method: 3T protocol: 3D T1-weighted imaging; 1H-spectroscopy and DTI in 34 patients. 18FDG-PET: 9 FTD patients; 9-AD, 2- normal PET. Results: Thinner cortex and higher ratio of mI/NAA was seen in posterior cingulate cortex (PCC) for AD ($p<0.05$). FA was lower and ADC higher in FTD. Conclusion: WM abnormalities have a potential to facilitate classification of dementia. PCC may be chosen as a region of investigation.

15:00 **_4250_. **

15:00 ***4249*. Are Behavioural Symptoms of Alzheimer'S Disease Directly Associated to Neurodegeneration?**

Laura Serra[1], Roberta Perri[2], Mara Cercignani[1], Barbara Spanò[1,3], Lucia Fadda[2,4], Camillo Marra[5], Giovanni Augusto Carlesimo[2,4], Carlo Caltagirone[2,4], Marco Bozzali[1]

[1]Neuroimaging laboratory, Fondazione IRCCS Santa Lucia, Roma, Italy; [2]Department of Clinical and Behavioural Neurology, Fondazione IRCCS Santa Lucia, Roma, Italy; [3]Direzione Scientifica, , IRCCS Centro Neurolesi 'Bonino-Pulejo', Messina, Italy; [4]Department of Neuroscience, University of Rome 'Tor Vergata', Roma, Italy; [5]Institute of Neurology, Università Cattolica, Roma, Italy

Psychiatric symptoms (BPSD) are frequently observed in the clinical course of Alzheimer's disease (AD). We used voxel-based morphometry to identify, in a large cohort patients with AD at different clinical stages, which BPSD are more significantly associated with regional gray matter degeneration. Correlation analyses showed an association between disinhibition and GM volumes in the cingulate gyrus bilaterally, and in the right middle frontal gyrus, and between delusions and GM volume of the right hippocampus and parahippocampal gyrus, and of the right middle frontal gyrus. These findings indicate that BPSD are likely part of the clinical features of AD.

Wednesday 13:30-15:30 Computer 72

13:30 ***4250*. Retrospective Distortion Correction Using the ADNI Phantom to Salvage Unusable Exams**

Bogdan Dzyubak[1], Jeffrey L. Gunter[1], Edward Brian Welch[2], Ron J. Killiany[3], Clifford R. Jack[1], Matt A. Bernstein[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States; [2]Philips Healthcare, Highland Heights, OH, United States; [3]Boston University School of Medicine, Boston, MA, United States

During the Alzheimer's Disease Neuroimaging Initiative (ADNI) multicenter study, a laser alignment light was mis-calibrated on one scanner, leading to a displacement error in the isocenter location used during image reconstruction. Consequently, the standard gradient distortion correction was inaccurate and the resulting data were unusable for longitudinally tracking brain changes. Off-line processing was used to remove the aberrant distortion correction from ADNI phantom data, then those images were shifted by a variable displacement, and finally the images were re-corrected for gradient distortion. The actual displacement error was determined by this method and the subject data could be re-corrected and salvaged.

14:00 ***4251*. Findings of Nonlinear Behaviors of Log-Signal Intensities on DTI in Patients with Alzheimer¡¯s Disease**

Geon-Ho Jahng[1], Songfan Xu[2], Chang-Woo Ryu[1], Dal-Mo Yang[1], Dong-Wook Sung[3], Dong Ho Lee[3], Seungjoon Park[4]

[1]Radiology, East West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; [2]Biomedical Science, Graduate School of Medicine, Kyung Hee University, Seoul, Korea, Republic of; [3]Radiology, KHU Hospital, Kyung Hee University, Seoul, Korea, Republic of; [4]Pharmacology and and Biomedical Science, School of Medicine, Kyung Hee University, Seoul, Korea, Republic of

Proposing Calculation of Voxel-based B-values on DTI in Patients with Alzheimer's Disease

14:30 ***4252*. Early and Late Onset Alzheimer's Disease Patients Have Distinct Patterns of White Matter Damage**

Elisa Canu[1], Federica Agosta[1], Michela Pievani[1,2], Giovanni B. Frisoni[3], Massimo Filippi[1]

[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]LENITEM, IRCCS S.Giovanni di Dio, Fatebenefratelli, Brescia, Italy; [3]LENITEM, IRCCS Centro San Giovanni di Dio - FatebenefratelliIRCCS Centro San Giovanni di Dio, Fatebenefratell, Brescia, Italy

SPM5 and the DARTEL method were used to perform a VBM analysis to assess WM differences in 14 early onset AD (EOAD) and 15 late onset AD (LOAD) vs. age- and gender-matched healthy controls (HC). Compared to HC, in EOAD patients, WM loss was mapped mainly to the posterior regions such as the posterior cingulum and the lateral parietal regions, bilaterally. In LOAD patients, WM loss was confined to the medial temporal lobe in the parahippocampal regions. Our findings indicate that EOAD and LOAD patients differ in the topography of WM damage, which reflects the pattern of cortical loss.

15:00 ***4253*. The Diffusivity Pattern of White Matter Degeneration in Semantic Dementia Is Spatially and Qualitatively Different from Alzheimer's Disease**

Julio Acosta-Cabronero[1], George Pengas[2], Guy B. Williams[1], Peter J. Nestor[2]

[1]Wolfson Brain Imaging Centre, Department of Clinical Neurosciences, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Neurology Unit, Department of Clinical Neurosciences, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom

The diffusion profile in semantic dementia (SD) was studied to examine the profile of connection changes. Tract-based spatial statistics in SD patients provided compelling evidence that the network is distinct to that of Alzheimer's disease (AD), and indicated that the key abnormality exiting the temporal lobe was in the uncinate fasciculus projection to the orbital frontal lobe. The tensor behaviours also indicated that the nature of the neurodegenerative in SD differs qualitatively from that seen in AD.

Thursday 13:30-15:30 Computer 72

13:30 ***4254*. MRI-Derived, ROI-Based Whole-Brain Comparison of FDG- And PIB-PET in Prodromal and Mild Alzheimer's Disease**

David S. Karow[1], Linda K. McEvoy[1], Christine Fennema-Notestine[2], Donald J. Hagler, Jr. [1], James B. Brewer, [1,3], Carl K. Hoh[1], Anders M. Dale, [1,3]
[1]Radiology, University of California, San Diego, La Jolla, CA, United States; [2]Psychiatry, University of California, San Diego, La Jolla, CA, United States; [3]Neurosciences, University of California, San Diego, La Jolla, CA, United States

Evaluation of metabolism and amyloid plaque burden in prodromal and mild Alzheimer's Disease using MRI-derived, subject-specific, semi-automated procedures.

14:00 ***4255*. Lateral Ventricle Segmentation Based on Fusion of Expert Priors in AD.**

Vladimir S. Fonov[1], Sridar Narayanan[1], Douglas L. Arnold[1], D. Louis Collins[1]
[1]McConnell Brain Imaging Centre, Montreal Neurological Institute, Montreal, QC, Canada

Measurement of lateral ventricular volume is often used for measuring the progression of neurodegenerative diseases. Existing techniques for ventricle segmentation have been extensively validated for the normal population, but may be suboptimal for the patients with Alzheimer's Disease (AD), for example. We propose an automated method which uses information from expert manual segmentation combined with a population-specific atlas. Experiments were completed with a group of 271 elderly patients from an ongoing clinical trial, using manual segmentations as a gold standard. We found that proposed algorithm yields accurate results with a median kappa of 0.962.

14:30 ***4256*. Assessment of White Matter Tract Damage in Mild Cognitive Impairment and Alzheimer's Disease**

Michela Pievani[1,2], Federica Agosta[1], Elisabetta Pagani[1], Elisa Canu[3], Stefania Sala[1], Martina Absinta[1], Cristina Geroldi[3], Rossana Ganzola[3], Giovanni B. Frisoni[3], Massimo Filippi[1]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]IRCCS Centro San Giovanni di Dio - Fatebenefratelli, Brescia, Italy; [3]IRCCS Centro San Giovanni di Dio - FatebenefratelliIRCCS Centro San Giovanni di Dio - Fatebenefratel, Brescia, Italy

DT-MRI tractography was used to investigate MD, FA, axial (DA) and radial (DR) diffusivities changes in limbic and cortico-cortical (CCT) WM tracts in 25 patients with Alzheimer's disease (AD), 19 with amnestic mild cognitive impairment (aMCI), and 15 controls. AD showed increased MD in CCT and cingulum, and reduced FA in fornix. Both patient groups showed increased DA in CCT and DR in the fornix. In AD and aMCI, limbic tracts showed a greater increase in DR vs. DA. Hippocampal volumes correlated with fornix DA. This study suggests different pattern of WM involvement in the limbic and CCT in AD.

15:00 ***4257*. 2D L-COSY MR Spectroscopy Detects Very Early Changes in the Brain of Alzheimer Mouse**

S van Duijn[1], F Kara[2], N Braakman[2,3], S G. van Duinen[1], R Natté[1], M A. van Buchem[4], A Alia[2]
[1]Department of Pathology, Leiden University Medical Center, Leiden, Netherlands; [2]Leiden Institute of Chemistry, Leiden University, Leiden, Netherlands; [3]Catharina hospital, Eindhoven, Netherlands; [4]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands

Proton magnetic resonance spectroscopy (MRS) provides a non-invasive way to investigate in vivo neurochemical abnormalities of many brain disorders. However, its role in finding very early and specific metabolic changes as biomarkers for Alzheimer's disease (AD) has not yet been established. In the present study we employed, for the first time, localized 2D L-COSY MRS in young wild-type and transgenic APP/PS1 mouse model of AD to probe specific early metabolic changes during AD. Our results provide an important indication of early neurochemical changes that take place before Aâ plaque formation in these transgenic mice.

Advanced Imaging of Dementia & Neurodegenerative Diseases, Part II

Hall B Monday 14:00-16:00 Computer 73

14:00 ***4258*. Echo Planar Spectroscopic Imaging in Patients with Amyotrophic Lateral Sclerosis**

Sanjeev Chawla[1], Sumei Wang[1], Sulaiman Sheriff[2], John H. Woo[1], Lauren Elman[3], Leo F. McCluskey[3], Murray Grossman[3], Elias R. Melhem[1], Andrew Maudsley[2], Harish Poptani[1]
[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Radiology, University of Miami, Miami, FL, United States; [3]Neurology, University of Pennsylvania, Philadelphia, PA, United States

The purpose of this study was to evaluate the potential of echoplanar spectroscopic imaging (EPSI) in assessing metabolic alterations beyond the motor cortex of ALS patients. NAA/Cr and Cho/Cr were measured from the precentral gyrus (PreCG), postcentral gyrus (postCG) and internal capsule (IC) and compared to Occipital region (OR) as an internal control. Significant reductions in NAA/Cr were observed from the preCG and IC from both the hemispheres. Significantly higher Cho/Cr ratios were also observed from the preCG, postCG and IC regions indicating that metabolic abnormalities in ALS extend beyond the motor cortex that can be observed using EPSI.

14:30 ***4259***. **Study on Gray and White Matter Changes in ALS with Voxle-Based Morphometry Using DARTEL**

Lin Ma[1], Zhiye Chen[1]
[1]Department of Radiology, PLA General Hospital, Beijing, China

Standard VBM (VBM-STANDARD) has demonstrated gray and white matter loss in ALS. In order to evaluate the efficacy of VBM with DARTEL algorithm (VBM-DARTEL), both VBM-DARTEL and VBM-STANDARD were performed in ALS. High resolution images were acquired from 30 ALS patients and 30 controls. ALS was subclassified into ALS/MCI and ALS/CN, and ALS/Bulbar and ALS/Limb. VBM-DARTEL revealed more gray and white matter deficits than VBM-STANDARD. With VBM-DARTEL, gray matter loss was also detected in ALS/MCI compared with ALS/CN, and gray and white matter deficits in ALS/Limb compared with ALS/Bulbar. VBM-DARTEL was more accurate than VBM-STANDARD in performing volumetric studies.

15:00 ***4260***. **Whole-Brain Proton MRSI in ALS: Changes in the Distribution of Metabolites by Brain Lobes and Tissue Types**

Varan Govind[1], Khema R. Sharma[2], Sulaiman Sheriff[1], Andrew A. Maudsley[1]
[1]Radiology, University of Miami, Miami, FL, United States; [2]Neurology, University of Miami, Miami, FL, United States

Whole-brain proton MRSI data acquired at 3T from groups of definite-ALS and control subjects were analyzed by brain hemispheric lobes and parenchymal constituent tissue-types (white matter and gray matter). The metabolite ratios, NAA/Cr and Cho/NAA, in the white matter showed significant and widespread alterations throughout the brain of ALS patients. In the gray matter of the ALS group, significant differences were found in the left frontal- and left parietal lobes for NAA/Cr, and bilateral frontal lobe for Cho/NAA.

15:30 ***4261***. **Brain DT MRI Predicts the Long-Term Clinical Evolution in Amyotrophic Lateral Sclerosis: A 3.4 Year Follow Up Study**

Federica Agosta[1], Elisabetta Pagani[1], Melissa Petrolini[1], Maria Pia Sormani[2], Domenico Caputo[3], Michele Perini[4], Alessandro Prelle[5], Fabrizio Salvi[6], Massimo Filippi[1]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Unit of Biostatistics, DISSAL, University of Genoa, Genoa, Italy; [3]Department of Neurology, Scientific Institute Fondazione Don Gnocchi, Milan, Italy; [4]Department of Neurology, Ospedale di Gallarate, Gallarate, Italy; [5]Dino Ferrari Center, Department of Neuroscience, University of Milan, Milan, Italy; [6]Department of Neurology, Ospedale di Bellaria, University of Bologna, Bologna, Italy

We investigated whether corticospinal tract (CST) DT-MRI changes contribute to the prediction of long-term clinical evolution in patients with amyotrophic laterals sclerosis (ALS). Conventional and DT-MRI were obtained in 24 ALS patients, who were followed prospectively for 3.4 years. Compared with controls, ALS patients showed increased MD and decreased FA of the CST. Shorter disease duration and lower CST FA were associated with disability worsening. Bulbar-onset and CST FA were independent predictors of time to death in ALS patients. More severe DT-MRI abnormalities in the CST predicted a poorer clinical outcome after a 3.4 year follow up in ALS patients.

Tuesday 13:30-15:30 Computer 73

13:30 ***4262***. **Altered Functional Connectivity of the Motor Network in Multiple System Atrophy**

Feng Feng[1], Hui You[1], Han Wang[2], Fuling Zheng[1], Chunling Meng[1], Jue Wang[3], Yufeng Zang[3]
[1]Radiology, Peking Union Medical College Hospital, Beijing, China; [2]Neurology, Peking Union Medical College Hospital, Beijing, China; [3]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China

MSA is mainly a sporadic neurodegenerative disease. Besides abnormalities of nigrostriatal pathway, the typical pathological findings were also described in primary motor and supplementary motor cortices. We hypothesize that there is associated disturbance of functional connectivity of the motor cortex in MSA patients. To test the hypothesis, resting-state functional MRI was used to measure the coherent spontaneous fluctuations in the blood oxygenation level¨Cdependent signal. Our results showed regional homogeneity changes in left precentral gyrus, right precuneus, supramarginal gyrus and middle frontal gyrus, indicating functional connectivity disturbance of motor-related circuits and left-sided predominance of primary motor cortex involvement.

14:00 *4263*. **The Topographical Distribution of White Matter Damage in Parkinson's Disease and Progressive Supranuclear Palsy**

Federica Agosta[1], Sebastiano Galantucci[1], T Stojkovic[2], A. Tomic[2], Igor Petrovic[2], Giulia Longoni[1], Vladimir Kostic[2], Massimo Filippi[1]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Department of Neurology, School of Medicine, University of Belgrade, Belgrade, Yugoslavia

Using TBSS, we investigated WM changes in 39 Parkinson's disease (PD) patients, 20 progressive supranuclear palsy (PSP) patients (10 Richardson's syndrome [PSP-RS] and 10 PSP-Parkinsonism [PSP-P]), and 26 controls. PSP-RS showed the most pronounced pattern of decreased FA, including both infratentorial and supratentorial regions, vs. controls and other patient groups. A similar pattern of FA decrease (except for superior cerebellar peduncle) was found in PSP-P vs. controls and PD (only at a lower significance). Impaired WM integrity was found in PSP but not in PD. The less prominent WM involvement in PSP-P might be associated to its favorable clinical status.

14:30 *4264*. **The In-Vivo Topographical Distribution of Brain Tissue Loss Associated with Depression in Parkinson's Disease: A Voxel-Based Morphometry Study**

Massimo Filippi[1], Federica Agosta[1], Igor Petrovic[2], Sebastiano Galantucci[1], Vladana Spica[2], Milica Jecmenica[2], Vladimir Kostic[2]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Department of Neurology, School of Medicine, University of Belgrade, Belgrade, Yugoslavia

VBM was used to investigate whether specific patterns of gray (GM) and white matter (WM) loss are associated with depression in 40 patients with Parkinson's disease (PD). Twenty-four PD were diagnosed as non-depressed (PD-NDep), and 16 as having depression (PD-Dep). Compared with PD-NDep, PD-NDep showed WM loss in the right anterior cingulum and inferior orbitofrontal (OF) region. In PD patients, Hamilton rating scale for depression score correlated significantly with right inferior OF WM. The pattern of brain atrophy in PD-Dep overlaps with the key regions involved in major depressive disorders, suggesting an increased vulnerability of this neural circuit in PD.

15:00 *4265*. **1H and 31P Spectroscopy: High Energy Metabolism in Idiopathic Parkinson Syndrome**

Elke Hattingen[1], Ruediger Hilker[2], Joerg Magerkurth[1], Carola Seifried[2], Ulrich Pilatus[1]
[1]Institute of Neuroradiology, University Hospital, Goethe University, Frankfurt, Germany; [2]Department of Neurology, University Hospital, Goethe University, Frankfurt, Germany

Combined 31P and 1H spectroscopic imaging was used to study changes in midbrain energy metabolism of patients with Parkinsons disease. Compared to healthy volunteers there is a decrease in high energy phospahtes (ATP an phosphocreatine). The effect is more pronounced in the hemisphere contralateral to the clinacal more affected side. The results corroborate the hypothesis of a potential role of mitochondrial dysfunction in Parkinsons disease.

Wednesday 13:30-15:30 Computer 73

13:30 *4266*. **Proinflammatory Cytokines Correlate with Diffusion Tensor Imaging Derived Metrics in Patients with Acute and Acute-On-Chronic Liver Failure**

Santosh Kumar Yadav[1], R Murali[2], Vivek A. Saraswat[2], R KS Rathore[3], A Yadav[1], K N. Prasad[4], M A. Thomas[5], Rakesh Kumar Gupta[1]
[1]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [2]Gastroenterology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [3]Mathematics and Statistics, Indian Institute of technology Kanpur, Kanpur, Uttar Pradesh, India; [4]Microbiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [5]Radiological Sciences, UCLA School of Medicine, Los Angeles, CA, Los Angeles, CA, United States

Fourteen patients with ALF, 17 with ACLF and 8 age/sex matched controls were included in this study. MRI, 1H-MR spectroscopy and serum proinflammatory cytokines measurements were done in all the patients and controls. Serum proinflammatory molecules were significantly increased in both conditions as compared to controls. A significant positive correlation of CS with IL-6 and TNF-α was observed in ALF while, CS correlated only to IL-6 in ACLF. A significant negative correlation was observed between MD values and IL-6 in both conditions. A significant positive correlation was also observed among Glx/Cr, IL-6 and TNF-α in both conditions. These observations suggest that proinflammatory cytokines may contribute in the development of CE in these patients.

14:00 *4267*. **Absolute Quantification of Human Brain Metabolites in Gulf War Syndrome Using Proton MR Spectroscopy at 3T**

Hyeon-Man Baek[1], Sergey Cheshkov[1,2], Audrey Chang[1], Sandeep Ganji[1], Evelyn Babcock[1], Richard Briggs[1,2], Robert Haley[2]
[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States; [2]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States

In the present study, metabolic concentrations of three distinct Gulf War (GW) syndromes (e.g., Syndrome-I is described as "impaired cognition;" syndrome-II, "confusion-ataxia; syndrome-III, "central pain") were calculated and compared the findings with those for healthy GW veterans. The main observation in this work was the significant reduction of NAA (Syndrome-I, -8%; Syndrome-II, -11%; Syndrome-III, -4%) concentration in left BG and (Syndrome-I, -7%; Syndrome-II, -8%; Syndrome-III, -9%) in right BG of GW syndrome subjects compared to healthy control subjects. The present study demonstrated that quantitative in vivo 1H-MRS can be used to detect the brain abnormalities in GW illness veterans, which may have relevance for the mechanisms of Gulf War syndrome.

14:30 *4268*. **Brain Diffusion-Weighted Imaging in Friedreich's Ataxia**

Giovanni Rizzo[1,2], Caterina Tonon[1], Maria Lucia Valentino[2], David Neil Manners[1], Filippo Fortuna[1,2], Cinzia Gellera[3], Antonella Pini[4], Sandro Ghezzo[4], Agostino Baruzzi[2], Claudia Testa[1], emil Malucelli[1], Bruno Barbiroli[1], Valerio Carelli[2], Raffaele Lodi[1]
[1]MR Spectroscopy Unit, Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, BO, Italy; [2]Neurological Sciences, University of Bologna, Bologna, BO, Italy; [3]U.O. Biochemistry and Genetics, Fondazione IRCCS-Istituto Neurologico Nazionale "Carlo Besta", Milano, MI, Italy; [4]Neuropsichiatric Unit, Ospedale Maggiore, Bologna, BO, Italy

Objectives. To define the extent of the brain damage in FRDA and to identify in vivo markers of neurodegeneration, using DWI. Methods. MD maps from 27 FRDA patients and 21 healthy volunteers were generated. ROI and histogram analysis was performed. Results. MD values of patients were higher than controls in medulla, pons, MCP, SCP, pyramidal tracts, and OR, as well as in whole brainstem, cerebellar hemispheres, cerebellar vermis and sovratentorial compartment, and correlated with genetic and clinical data. Conclusions. Neurodegeneration in FRDA is more extensive than previously reported, and DWI is a suitable technique to provide biomarkers of disease progression.

15:00 *4269*. **Decreased Brain Glx Levels in HIV Dementia: A 3 Tesla MR Spectroscopy Study**

Mona Adel Mohamed[1,2], Peter B. Barker[1,2], Richard L. Skolasky[3], Richard T. Moxley[3], Martin G. Pomper[1], Ned C. Sacktor[3]
[1]Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Kennedy Krieger Institute, FM Kirby Center for Functional Brain Imaging, Baltimore, MD, United States; [3]Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, United States

The major finding of the current study is that brain MRS performed at 3T reveals decreased levels of Glx in the frontal white matter (FWM) of patients with HIV-associated dementia (HAD) compared to those without dementia. FWM Glx decreases were also associated with poorer cognitive function, specifically impaired executive and fine motor functioning in HAD. 3T MRS measurements of Glx may be a useful indicator of neuronal loss or dysfunction in patients with HIV infection.

Thursday 13:30-15:30 Computer 73

13:30 *4270*. **Widespread and Different Distribution of Extrafocal NAA/(Cr+Cho) Reductions in Mesial Temporal Lobe Epilepsy (TLE) with and Without Mesial Temporal Sclerosis**

Susanne G. Mueller[1], Andreas Ebel[1], Jerome Barakos[2], Cathy Scanlon[1], Ian Cheong[1], Daniel Finaly[1], Paul Garcia[3], Michael W. Weiner[1], Kenneth D. Laxer[2]
[1]Dept. of Radiology and Biomedical Imaging, UCSF, Center for Imaging of Neurodegenerative Diseases, San Francisco, CA, United States; [2]Pacific Epilepsy Program, Califronia Pacific Medical Center; [3]Department of Neurology, UCSF

14 TLE with mesial temporal lobe sclerosis (TLE-MTS)and 14 TLE with normal appearing hippocampi (TLE-no) and 18 healthy volunteers were studied with a whole brain 3D EPSI at 4T. Widespread NAA/(Cr+Cho) reductions showing a considerable intersubject variability were found in both groups. The distribution of these abnormalities was different in the two TLE groups. These findings indicate that TLE-MTS and TLE-no are metabolically heterogeneous and might even represent different TLE entities.

14:00 *4271*. **Voxel-Based Analysis of Magnetisation Transfer Ratio as a Potential Biomarker in Prion Diseases.**

Harpreet Hyare[1], Enrico De Vita[2], Gerard Ridgway[3], Rachael Scahill[4], Durrenajaf Siddique[1], Simon Mead[1], Peter Rudge[1], Tarek Yousry[2], John Collinge[1], John Thornton[5]
[1]MRC Prion Unit, UCL Institute of Neurology, London, United Kingdom; [2]National Hospital for Neurology and Neurosurgery; [3]Dementia Research Centre, UCL Institute of Neurology; [4]Department of Neurodegenerative Diseases, UCL Institute of Neurology; [5]National Hospital for Neurology and Neurosurgery, London, United Kingdom

Voxel based morphometry in inherited prion diseases demonstrates regionally specific atrophy in the basal ganglia, cerebellum and posterior cortical areas but no significant differences in the white matter compared to controls. Voxel-based analysis of magnetisation transfer ratio (MTR) demonstrates decreased MTR in the same grey matter regions but for the same threshold ($p<0.001$), there is activation of more voxels including white matter voxels. The findings suggesting that MTR may be more sensitive to microstructural changes and offers potential as a neuroimaging biomarker in prion diseases.

14:30 *4272*. **Cerebral White Matter Disruption in Creutzfeldt-Jakob Disease**

Hedok Lee[1], Chen Hoffmann[2], Oren S. Cohen[3], Peter B. Kingsley[4], Isak Prohovnik[1,5]
[1]Psychiatry, Mount Sinai School of Medicine, New York, United States; [2]Radiology, Sheba Medical Center, Tel Aviv, Israel; [3]Neurology, Sheba Medical Center, Tel Aviv, Israel; [4]Radiology, North Shore University Hospital, Manhasset, NY, United States; [5]Radiology, Mount Sinai School of Medicine, New York, United States

To test the sensitivity of DTI to detect white matter integrity in Creutzfeldt-Jakob disease (CJD), we scanned 21 CJD patients and 19 healthy controls, computed fractional anisotropy (FA), mean diffusivity, radial diffusivity (RD), and axial diffusivity, and quantitatively compared the results in voxel-level analyses of tract-based spatial statistics (TBSS). In CJD patients, significant FA reductions in distinct and functionally relevant white matter (WM) pathways correlated with disease duration and reflected an elevation of RD, suggesting augmented permeability of axonal membranes. Our findings demonstrate involvement of WM pathways connecting structural landmarks that are known to be involved in the disease.

15:00 *4273*. **In Vivo Longitudinal Monitoring of Blood Flow Alterations in TG2576 Mouse Model of Alzheimer's Disease**

F Kara[1], N Braakman[1], M A. van Buchem[2], H JM de Groot[1], R Schliebs[3], A Alia[1]
[1]Leiden Institute of Chemistry, Leiden University, Leiden, Netherlands; [2]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; [3]Department of Neurochemistry, University of Leipzig, Leiden, Netherlands

In this study we longitudinally monitored, the blood flow alterations in TG2576 mouse model of Alzheimer's disease using MR angiography. Blood flow alterations were clearly increased in transgenic mice over time. Flow defects in middle cerebral artery were seen already at the age of 8 month when there was no cerebral amyloid angiopathy (CAA) was observed. In anterior cerebral artery the flow alterations were visible at the age of 19 months and were correlated with CAA as well as with high plaque deposition in the brain tissues. Our results show that blood flow defects are present long before vascular deposition of Aβ takes place in this mouse model.

Advanced Imaging of Dementias & Neurodegenerative Diseases, Part III

Hall B Thursday 14:00-16:00 Computer 71

14:00 *4274*. **Excitatory Neurotransmitter Dysfunction Is Induced in Frontal Brain After Excitatory Drug Abuse**

Napapon Sailasuta[1], Osama Abulseoud[2], Martha Hernandez[2,3], Thao T. Tran[1,3], Brian D. Ross[1,3]
[1]Clinical MR Spectroscopy, Huntington Medical Research Institutes, Pasadena, CA, United States; [2]University of Southern California, Keck School of Medicine, Los Angeles, CA, United States; [3]Rudi Schulte Research Institute, Santa Barbara , CA, United States

Does excitatory drug abuse, specifically of methamphetamine, have the expected effect on the major excitatory neurotransmitter, glutamate? Using TE-Average at 3 Tesla, and examining frontal white matter, site of the major neuropsychological deficits in this patient population, we describe a 20% increase in brain glutamate. This is accompanied by the previously described 15% reduction in the neuronal marker NAA. The two neurochemical changes are statistically correlated ($P<0.003$) inviting the question whether the one is causative of the other. The hypothesis linking excitatory drug use with excitatory neurotransmitter excess is confirmed. Longitudinal studies are in progress to answer that new question.

14:30 *4275*. **Anatomical Connectivity Mapping Quantifies Neuroplastic Activity of Anticholinesterase Treatments in Patients with Ad**

Marco Bozzali[1], Tommaso Gili[2,3], Laura Serra[1], Bruno Maraviglia[1,3], Carlo Caltagirone[4,5], Karl Embleton[6], Geoff J. M. Parker[7], Mara Cercignani[1]
[1]Neuorimaging Laboratory, Santa Lucia Foundation, Rome, Italy; [2]MarbiLab, Enrico Fermi Centre, Rome, Italy; [3]Dept of Physics, University of Rome "La Sapienza", Rome, Italy; [4]Department of Clinical and Behavioural Neurology, Santa Lucia Foundation, Rome, Italy; [5]Dept of Neuroscience, University of Rome "Tor

Vergata"; [6]Cognition and Cognitive Neuroscience Group, School of Psychological Sciences, University of Manchester, United Kingdom; [7]Imaging Science & Biomedical Engineering and the Biomedical Imaging Institute, University of Manchester, United Kingdom

This study assesses WM structural connectivity based on an index derived from diffusion MRI in a group of patients with Alzheimer's disease (AD), in a group of patients with amnestic mild cognitive impairment and in a group of healthy control, in order to investigate whether structural connectivity is altered in AD. The unexpected finding of increased anatomical connectivity in several subcortical areas of patients with AD but not in those with mild cognitive impairment might be explained by the neurotrophic and neurorestorative properties of the cholinesterase inhibitors assumed by these patients, although more investigations are needed.

15:00 ***4276*.** **Differences Between Patients with Parkinson's Disease and Healthy Controls Detected by High Spatial Resolution 3D-MRSI at 3 T**

Adriane Groeger[1], Grzegorz Chadzynski[2], Kathrin Brockmann[1], Karin Srulijes[1], Daniela Berg[1], Uwe Klose[2]

[1]Department of Neurodegeneration, Hertie Institute for Clinical Brain Research, University of Tuebingen, Tuebingen, Germany; [2]Department for Diagnostic and Interventional Neuroradiology, Section for Experimental Magnetic Resonance of Central Nervous System, University of Tuebingen, Tuebingen, Germany

We developed an optimized 3D-MRSI protocol with high spatial resolution at 3T to evaluate a method for assessing the characteristic loss of neurons inside the substantia nigra in patients with Parkinson's disease. Nine PD patients and eight age-matched healthy controls were examined. A voxel size of 0.252 ml yielded reproducible values for the NAA/Cr ratios in all subjects. Our results show clear differences between the intra-individual NAA/Cr ratios in the SN of PD patients compared to controls and suggest that aspects of the pathophysiological process at the SN can be assessed by 3D-MRSI with high spatial resolution at 3T.

15:30 ***4277*.** **Diffusion Tensor Imaging Detection of Early White Matter Changes in an Accelerated SIV Primate Model of NeuroAIDS**

Eva-Maria Ratai[1,2], Vadim Villarroel[3], Julian He[1,2], Reza Hakimelahi[1,2], Robert Fell[1], Chan-Gyu Joo[1,2], Jeffrey Bombardier[1], Susan Westmoreland, [2,4], Kenneth Williams[5], Ramon Gilberto Gonzalez[1,2]

[1]Department of Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Harvard Medical School, Boston, MA, United States; [3]Johns Hopkins School of Medicine, Baltimore, MD, United States; [4]Division of Comparative Pathology, New England Primate Research Center, Southborough, MA, United States; [5]Biology Department, Boston College, Boston, MA, United States

A significant number of HIV-infected patients develop neurological symptoms which are thought to be a result of injury to neurons in the CNS. Our objective was to use DTI to detect abnormalities in white matter in a SIV-infected, CD8-depleted macaque model of neuroAIDS. MRS and DTI were conducted before and at 2 and 4 weeks post infection. White matter in the corpus callosum showed a trend towards decreased FA at 2 wpi. Correlation analyses demonstrated a significant association between white matter damage in the splenium and increases in choline. FA showed a negative correlation with viral load in the CSF.

Clinical Brain Tumor Imaging

Hall B Monday 14:00-16:00 Computer 74

14:00 ***4278*.** **^{1}H-HRMAS of Small-Molecule-Metabolites in Adult Brain Tumours: Assignment, Quantification and Biomarker Determination.**

Alan Wright[1], Greg A. Fellows[2], John R. Griffiths[3], Martin Wilson[4,5], B Anthony Bell[2], Franklyn Arron Howe[2]

[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [2]St George's University of London, United Kingdom; [3]CRUK Cambridge Research Institute, United Kingdom; [4]University of Birmingham, United Kingdom; [5]Birmingham Children's Hospital NHS Foundation Trust, United Kingdom

MRS has the potential to provide diagnostic and prognostic biomarkers for brain tumours *in vivo*. We have used the *ex vivo* technique of ^{1}H HRMAS NMR spectroscopy of brain tumour samples to identify the "NMR visible" metabolites in the common adult brain tumours. This has lead to the identification of 29 small molecule metabolites observable in spectra from a set of 65 tumours including grade II astrocytomas, grade III gliomas, GBMs, lymphomas, metastases and meningiomas. We have also identified some novel-potential biomarkers for binary brain-tumour diagnostic comparisons. These include hypotaurine as a marker for GBM when compared to metastases or histidine as a positive marker for gliomas when compared to metastases or meningioma.

14:30 *4279*. **Radiation Toxicity to the Normal Brain Detected by Echoplanar Spectroscopic Imaging in Patients with Brain Metastases Treated with Whole Brain Radiation Therapy**

Sanjeev Chawla[1], Sumei Wang[1], Sulaiman Sheriff[2], Lisa Desiderio[1], Alexander Lin[3], Harry Quon[3], Ramesh Rengan[3], Elias R. Melhem[1], Andrew Maudsley[2], Harish Poptani[1]
[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Radiology, University of Miami, Miami, FL, United States; [3]Radiation Oncology, University of Pennsylvania, Philadelphia, PA, United States

Echoplanar spectroscopic imaging (EPSI) was performed serially in patients with brain metastasis undergoing whole brain radiation therapy to assess metabolic alterations in the normal brain. NAA/Cr and Cho/Cr ratios were measured from dorsolateral-prefrontal-cortex, cingulate-gyrus, thalamus, hippocampus and basal ganglia. In general, a decrease in NAA/Cr was noted from several regions while the Cho/Cr ratio decreased in some regions with a concomitant increase in other regions probably due to neurodegenerative effects of whole brain radiation. These results suggest that EPSI may be used for detecting radiation toxicity to the normal brain in patients with brain metastases treated with radiation therapy.

15:00 *4280*. **Using MR Spectroscopy to Track Metabolic Changes in Glioblastoma After One Dose of Cediranib**

Heisoog Kim[1,2], Ciprian Catana[1], Eva-Maria Ratai[1], Wei-Ting Zhang[1], Ovidiu C. Andronesi[1], Tracy T. Batcheolor[3], Rakesh K. Jain[4], Alma Gregory Sorensen[1]
[1]A.A.Martinos center, Massachusetts General Hospital, Charlestown, MA, United States; [2]NSE/HST, Massachusetts Institute of Technology, Cambridge, MA, United States; [3]Neurology, Massachusetts General Hospital, Boston, MA, United States; [4]Radiology, Massachusetts General Hospital, Boston, MA, United States

This study investigated early changes in predominant metabolites for assessment of tumor response to anti-angiogenic agents in rGBM using 1H-MRS. After one dose, NAA/norCre in ET showed a significant increase in good-OS patients (12/19) and no such increase in poor-OS. NAA/Cho increased in good-OS, while decreasing in poor-OS. There were no significant changes in norCre or MRI parameters, including T1, FLAIR, and ADC. The change in NAA/norCre after one dose suggests a revival of neuronal activity as well as a recovery of metabolite concentrations due to reduction of edema. NAA/Cho changes also seem to correlate well with overall survival.

15:30 *4281*. **Combining High Resolution Magic Angle Spinning H1 NMR and Molecular Genomics Predicts Survival in Brain Tumor Patients Better Than Either Methodology Alone**

Loukas G. Astrakas[1,2], Konstantinos D. Blekas[3], Ovidiu C. Andronesi[1,4], Michael N. Mindrinos[5], Peter M. Black[6], Laurence G. Rahme[7], A Aria Tzika[1,4]
[1]NMR Surgical Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States; [2]Department of Medical Physics, University of Ioannina, Ioannina, Greece; [3]Department of Computer Science, University of Ioannina, Ioannina, Greece; [4]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Athinoula A. Martinos Center of Biomedical Imaging, Boston, MA, United States; [5]Stanford Genome Technology Center, Department of Biochemistry, Stanford University School of Medicine, Palo Alto, CA, United States; [6]Neurosurgery, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States; [7]Molecular Surgery Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burn Institute, Harvard Medical School, Boston, MA, United States

Our aim was to develop a novel approach that combines high-resolution magic angle spinning (HRMAS) H1 NMR and genomics in the same biopsies to improve prognostication of brain tumors. We employed a linear Support Vector Machine combined with the robust minimum redundancy – maximum relevance feature selection scheme, and applied our algorithm to combined HRMAS 1H MRS and microarray data of the same adult brain tumor biopsies. Our results demonstrate that we are able to produce accurate and meaningful data and introduce a novel classification scheme that predicts a clinically meaningful parameter such as survival better than either method alone.

Tuesday 13:30-15:30 Computer 74

13:30 *4282*. **Correlation Between Diffusion Tensor and Perfusion Imaging in Segmented Enhancing Lesion with High Grade Glioma**

Naomi Morita[1,2], Masafumi Harada[1], Eva Zacharaki[2], Priyanka Bhatt[2], Sanjeev Chawla[2], Elias R. Melhem[2], Hiromu Nishitani[1]
[1]Radiology, Tokushima University Hospital, Tokushima, Japan; [2]Radiology, University of Pennsylvania, Philadelphia, PA, United States

Knowledge about microvascularity, angiogenesis or tumor cellularity is important in determing tumor grade. The purpose of this study was to determine whether there are any correlations between ADC, FA and rTBV value in segmented enhancing lesion within tumor. Thirty three brain tumor patients with contrast enhancement on MRI underwent DTI and PWI. FA, ADC and rTBV values were measured in the segmented enhancing area within tumor. FA and rTBV had a negative correlation ($p<0.05$). This study indicates that damage of fiber and tumor progression may have any relationships in the course of tumor progression.

14:00 *4283*. **Differentiation of Radiation-Injuries and Tumor Recurrence Using Perfusion-Weighted Imaging**

Yu Lin Wang[1], Lin Ma[2]
[1]department of radiology,PLA gerneral hospital, China; [2]department of radiology,PLA gerneral hospital, beijing, China

PWI made it possible to obtain measurements of vascularity within brain lesions. The vascularity of malignant tumor differs dramatically from that of radiation necrosis. Thus, tumor recurrence within irradiated lesions may be differentiated from regions of radiation necrosis with PWI. 15 patients were prospectively entered into the study on the basis of the following criteria: previous treatment with radiation therapy after surgical resection for intraaxial tumors; new development of enhancing lesions within the radiation field. The final determination of the new development of enhancing lesions was decided either histologically or clinicoradiologically.

14:30 *4284*. **Non-Negative Matrix Factorization for Differentiation of Brain Metastasis and Glioblastoma Multiforme, and Visualization of Tumor Infiltration**

Jan Luts[1], Teresa Laudadio, [1,2], M. Carmen Martinez-Bisbal[3,4], Sofie Van Cauter[1], Enrique Molla[5], Jose Piquer[5], Johan Suykens[1], Uwe Himmelreich[1], Bernardo Celda[3,4], Sabine Van Huffel[1]
[1]Katholieke Universiteit Leuven, Leuven, Belgium; [2]Istituto Applicazioni Calcolo, CNR, Bari, Italy; [3]University of Valencia, Valencia, Spain; [4]Networking Research Center on Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Valencia, Spain; [5]Hospital de La Ribera, Valencia, Spain

This study focuses on the differentiation between solitary brain metastasis and glioblastoma multiforme based on conventional magnetic resonance imaging (MRI) and long TE two-dimensional turbo spectroscopic imaging (2D-TSI) data. Fifteen patients with a brain tumor, nine affected by glioblastoma multiforme and six by metastasis, were considered. Non-negative matrix factorization (NNMF) results in a clear separation of glioblastomas and metastases. The methods allows visualizing the abundances of the normal tissue component, which indicate tumor infiltration. In conclusion, automated processing with NNMF of 2D-TSI enables to visualize metabolic differences between glioblastomas and metastases and enables to visualize tumor infiltration.

15:00 *4285*. **The Effect of Bevacizumab on Normal Appearing White Matter Fibers: A Diffusion Tensor Imaging (Dti) Study**

Moran Artzi[1,2], Deborah T. Blumenthal[3,4], Felix Bokstein[3,4], Benjamin W. Corn, [4,5], Palmon Mika[1], Orna Aizenstein[6], Dafna Ben Bashat[1]
[1]The Wohl Institute for Advanced Imaging, Brain Imaging Center, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [2]Sackler Faculty of Medicine, Tel-Aviv University , Tel-Aviv, Israel; [3]Neuro-Oncology Service, Oncology Division, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [4]Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel; [5]Radiation Oncology Unit, Oncology Division, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [6]Department of Radiology, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel

Combined chemo-radiation therapy (RT) is the standard first-line treatment for glioblastoma (GB). Recently, antiangiogenic-drugs such as bevacizumab have become routine second-line-therapy for patients with recurrent-GB; however the effects of this agent on the normal appearing white-matter (NAWM) are yet unknown. In this work we scanned patients with primary brain tumors before and after RT and during bevacizumab therapy. DTI was used to evaluate NAWM changes compared to healthy controls. Changes in diffusivity values were detected following RT but not during bevacizumab-therapy. Those results support that post-radiation changes occur, without evidence for additional WM toxicity from bevacizumab-therapy.

Wednesday 13:30-15:30 Computer 74

13:30 *4286*. **Support Vector Machines in DSC-Based Glioma Imaging – Suggestions for Optimal Characterization**

Frank G. Zöllner[1], Kyrre Eeg Emblem[2], Lothar R. Schad[1]
[1]Heidelberg University, Mannheim, Germany; [2]Oslo University Hospital, Oslo, Norway

Dynamic susceptibility contrast magnetic resonance perfusion imaging (DSC-MRI) is a method of choice to characterize gliomas. Recently, support vector machines (SVM) have been introduced as means to prospectively characterize new patients based on information from previous patients. Based on features derived from automatically segmented tumor volumes from 101 DSC-MR examinations, four different SVM models were compared. All SVM models achieved high prediction accuracies (>82%) after rebalancing the training data sets to equal amounts of samples per class. Best discrimination were obtained using a SVM model with a radial basis function kernel allowing for a correct prediction of low-grade glioma at 83% and high-grade glioma at 91%.

14:00 **4287. Differentiation Between Glioblastomas, Brain Metastases and Primary Cerebral Lymphomas Using Diffusion and Perfusion Weighted Imaging**

Sumei Wang[1], Sungheon Kim[2], Sanjeev Chawla[1], Ronald L. Wolf[1], David Knipp[1], Arastoo Vossough[1], Donald M. O'Rourke[3], Kevin D. Judy[3], Elias R. Melhem[1], Harish Poptani[1]

[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Radiology, New York University School of Medicine, New York, NY, United States; [3]Neurosurgery, University of Pennsylvania, Philadelphia, PA, United States

Twenty-six glioblastomas, 25 brain metastases and 16 cerebral lymphomas underwent DTI and DSC studies. FA, ADC, CL, CP, CS and rCBV were measured from the enhancing part of the tumor. Elevated FA, CL, CP and decreased CS were observed in glioblastomas compared with both metastases and lymphomas, whereas ADC and rCBV values from glioblastomas were significantly higher than lymphomas. FA and ADC was the best predictor for differentiation of glioblastomas from non-glioblastomas, whereas ADC, CS and rCBV were the best model for distinguishing lymphomas from metastases. Our study indicates that DTI metrics along with rCBV measurement may be helpful in tumor classification.

14:30 **4288. Initial RCBV Predicts Response to Bevacizumab in Patients with High-Grade Gliomas**

Kathleen M. Schmainda[1,2], Devyani Bedekar[1,2], Scott D. Rand[1,2], Jennifer Connelly, [23], Mark Malkin, [23]

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The prognosis for patients diagnosed with brain tumors has been dismal. Now there is hope with improved time to progression and survival noted for patients treated with anti-angiogenic drugs such as bevacizumab. Yet, many questions remain regarding the appropriate selection of patients most likely to respond. These questions are important from both a clinical and economic perspective and therefore speak to the need for ways to efficiently and reliably predict response. Here we demonstrate the potential of DSC-measures of rCBV, obtained just prior to treatment with bevacizumab, to predict outcomes in patients with both new and recurrent GBM.

15:00 **4289. Using Cerebrovascular Response to Hyperoxia for Assessing Treatment Resonse in Glioblastoma**

Heisoog Kim[1,2], Ciprian Catana[1], Grace Kim[1], Ovidiu C. Andronesi[1], Dominique L. Jennings[1], Divya S. Bolar[1,3], Elizabeth R. Gerstner[4], Tracy T. Batchelor[4], Rakesh K. Jain[5], Alma Gregory Sorensen[1]

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This study quantitatively investigated BOLD responses to pure oxygen in glioblastoma (GBM) throughout the course of the treatment with chemoradiation and an anti-angiogenic drug. BOLD signal changes dropped significantly at the beginning of the treatment in tumor and gradually recovered afterwards. Conversely, in contralateral normal tissue a slight increase was observed at the early time points. Interestingly, no difference was observed between values in both regions after 35 days. Our preliminary findings suggest that assessing the oxygenation status before and after treatment might be useful for both prognostic and diagnostic assessment in GBM patients.

Thursday 13:30-15:30 Computer 74

13:30 **4290. Correlation Between Imaging Findings of Magnetic Susceptibility Weighted Images and MIB-1 Labeling Index.**

Kazuchika Hagiwara[1], Akira Kunimatsu[1], Wataru Gonoi[1], Harushi Mori[1], Osamu Abe[1], Kuni Ohtomo[1], Hiroyuki Kabasawa[2]

[1]Radiology, Tokyo University Hospital, Bunkyouku, Tokyoto, Japan; [2]GE Healthcare Japan

The purpose of this study was to examine with or without of association between findings in phase sensitive imaging (PSI) that is a susceptibility weighted imaging method and MIB-1 Labeling Index (LI) that is a marker of malignancy of human brain tumors. Forty brain tumors were studied with 3 T MRI and properties of intratumoral dark spots in PSI were graded on scale of 1 to 4 subjectively depending on area proportions of dark spots within tumors. Statistically significant difference of MIB-1 LI was found between low and high grade tumor groups.

14:00 ***4291***. **Influence of Combined FMRI and MR Tractography on Operative Planning of Brain Tumors: Initial Experience in a Histopathologically Variable Subset of Tumors**

Hossam Moussa Sakr[1], Mona Adel Mohamed[2], Hasan Mohamed Jalalod'din[3], Yasser Abd El Aziem Abbas[1]

[1]radiology, Ain Shams University, Cairo, Egypt; [2]radiology, Johns Hopkins University School of Medicine, Baltimore, United States; [3]neurosurgery, Ain Shams University, Cairo, Egypt

Functional MRI and tractography are two non invasive methods to assess the relation of and possible affection of eloquent cortical brain centers as well as white matter tracts by brain tumors, in this study we show that adding functional and tractography data to the conventional MR data modify the decision of therapy aiming to avoid or minimize post operative deficit.

14:30 ***4292***. **Breath-Hold Regulated Blood Oxygenation-Level Dependent MRI and Vascular Space Occupancy MRI of Brain Tumors**

Yuan-Yu Hsu[1,2], Wan-Chun Kwan[3], Kun-Eng Lim[1,2], Ho-Ling Liu[4,5]

[1]Dept. of Medical Imaging, Buddhist Tzu Chi General Hospital-Taipei Branch, Xindian, Taipei, Taiwan; [2]School of Medicine, Tzu Chi University, Hualien, Taiwan; [3]Dept. of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan; [4]Graduate Institute of Medical Physics and Imaging Science, Chang Gung University, Taoyuan, Taiwan; [5]MRI center, Chang Gung Memorial Hospital, Taoyuan, Taiwan

To evaluate the cerebrovascular response of normal tissues and cerebral tumors under breath-holding challenges by using 3-T blood oxygenation-level dependent (BOLD) and vascular space occupancy (VASO) MRI. Six normal adults and 14 patients with brain tumors were studied. There were significant BOLD signal increases and VASO signal decreases in normal appearing gray matter of normal subjects and patients, but not in the tumors. Interestingly, there were BOLD signal decreases or VASO signal increases in two meningiomas. Both 3-T BOLD and VASO MRI can detect breath-hold regulated cerebrovascular changes, with a higher sensitivity for signal detection of BOLD technique.

15:00 ***4293***. **T1 CUBE Compared to Fast Spin Echo T1 Weighted and BRAVO in Post Contrast Enhanced Brain MRI at 3T**

David W. Stanley[1], Amy L. Kotsenas[2], Timothy J. Kaufmann[2], Heidi A. Edmonson[2], Dan W. Rettmann[3], Eric T. Han[4]

[1]MR, GE Healthcare, Proctor, MN, United States; [2]Dept. of Radiology, Mayo Clinic, Rochester, MN, United States; [3]Applied Science Laboratory, GE Healthcare, Rochester, MN, United States; [4]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States

3T MR scanners have become increasingly useful in medical imaging with their increased SNR capabilities and potential of higher resolution images. However, with some existing pulse sequences, mediocre lesion contrast enhancement, image artifacts, excessive vascular enhancement, and increased signal from white matter pose challenges to the assessment of small and subtle enhancing lesions at 3T. The purpose of this study was to compare the quality of imaging and contrast enhancing lesion conspicuity of 3D fast spin echo-based T1 CUBE with a T1 weighted 2D FSE and 3D volumetric T1-weighted IR prepared 3D GRE (BRAVO) in contrast enhanced 3T brain MRI.

Clinical Brain Tumor or Head & Neck Imaging

Hall B Monday 14:00-16:00 Computer 75

14:00 ***4294***. **Tracer Kinetic Parameters Derived from Quantitative Dynamic Contrast-Enhanced MRI Correlate with VEGF Expression in Head-And-Neck Tumours**

Stephanie B. Donaldson[1,2], Guy Betts[3], Suzie C. Bonington[4], Catharine M.L West[3], Lucy E. Kershaw[2], David L. Buckley, [2,5]

[1]North Western Medical Physics, Christie Hospital NHS Trust, Manchester, United Kingdom; [2]Imaging Science and Biomedical Engineering, University of Manchester, Manchester, United Kingdom; [3]Academic Department of Radiation Oncology, University of Manchester, Manchester, United Kingdom; [4]Department of Radiology, Christie Hospital NHS Trust, Manchester, United Kingdom; [5]Division of Medical Physics, University of Leeds, Leeds, United Kingdom

Dynamic contrast-enhanced (DCE-) MRI using a two-compartment exchange model (2CXM) can provide estimates of perfusion (F_b), microvessel permeability-surface area (PS), interstitial volume (v_e) and blood volume (v_b). DCE-MRI parameters correlate with VEGF expression, an initiator of angiogenesis and prognostic indicator, in a variety of tumours. Eight patients with head-and-neck cancer underwent high temporal-resolution DCE-MRI before surgery. Whole-tumour concentration-time curves were analysed using the 2CXM to estimate F_b, PS, v_e, v_b and plasma mean transit time. VEGF mRNA expression was measured at surgery. F_b, v_e and PS correlated significantly with VEGF expression suggesting that DCE-MRI parameters may be indicative of angiogenesis.

14:30 ***4295***. **MRI of Head and Neck Patients in the Radiotherapy Treatment Position**

Scott Hanvey[1], John Foster[2]
[1]Radiotherapy Physics, Beatson West of Scotland Cancer Centre, Glasgow, Lanarkshire, United Kingdom; [2]MRI Physics, Beatson West of Scotland Cancer Centre, Glasgow, United Kingdom

Accurate localisation of the planning target volume (PTV) is vitally important in radiotherapy. The excellent soft tissue contrast of MRI makes it an ideal imaging modality for radiotherapy of the head and neck. Registration of MRI with CT can be problematic since patients are not positioned in the same way. The following study compared the accuracy of the registration of MRI with CT in 20 head and neck patients receiving an MRI in the typical curved table and within an immobilisation device. It also measured the PTVs of patients in the normal and radiotherapy position in MRI.

15:00 ***4296***. **Prognostic Value of Minimum Apparent Diffusion Coefficient for Patients with Hypopharyngeal Cancer**

Yu-Chun Lin[1,2], Su-Hang Ng[1], Yau-Yau Wai[1], You-Hsuan Tsai[3], Jiun-Jie Wang[3]
[1]Department of Diagnostic Radiology, ChangGung Memorial Hospital, KweiShan, Taoyuan, Taiwan; [2]Department of Electrical Engineering, ChangGung University, KweiShan, Taoyuan, Taiwan; [3]Department of Medical Imaging and Radiological Science, ChangGung University, KweiShan, Taoyuan, Taiwan

The minimum ADC reflects the highest cellularity within the tumor. In this study we proposed to assess the survival rates for patients with hypopharyngeal cancer using minimum ADC, mean ADC and the tumor volume, which is the conventional standard. The Kaplan-Meier survival analysis revealed that the minimum ADC can successfully predict the 16-month overall survival with a optimal threshold of 6.94¡Ñ10-3 mm2/sec. Thus, the minimum ADC could serve as a biomarker for the prognosis in patients with hypopharyngeal cancer.

15:30 ***4297***. **MRI Sialolithography: Direct Visualization of Calculi in the Submandibular Gland Using SWI at 3T**

Ali Fatemi[1], Colm Boylan[2], Judith Coret-Simon[2], Michael D. Noseworthy, [23]
[1]Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, Ontario, Canada; [2]Diagnostic Imaging, St. Joseph's Healthcare, Hamilton, Ontario, Canada; [3]Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

A technique is presented that allows for the specific identification and localization of calculi within glandular tissues or ducts using MRI. The technique is based on positive phase filtered SWI, and does not require ionizing radiation or the use of sialogogue.

Tuesday 13:30-15:30 Computer 75

13:30 ***4298***. **T1 and T2 Relaxation Time Histograms of Mandibular Bone Marrow: A Monomodal Distribution in Sickle Cell Disease**

Joseph Liao[1], Nekou Nowrouzi[1], Elliott Elias[1], Hernan Jara[1], Osamu Sakai[1]
[1]Boston Medical Center, Boston University School of Medicine, Boston, MA, United States

Purpose: To characterize sickle-cell disease-related changes in the mandibular bone marrow using qMRI relaxometry. Materials and Methods: 13 SCD patients (19.8-43 years old) and 17 age-matched controls (23-64 years old) were imaged with the mixed turbo spin-echo pulse sequence. The mandible was manually segmented. T1 and T2 relaxation time histograms were created. Results: 15 of the 17 controls exhibited bimodal peaks in T1; all controls exhibited bimodal peaks in T2. In contrast, all SCD patients exhibited monomodal peaks in both T1 and T2 sequences. Conclusion: qMRI relaxometry reveals a monomodal histogram distribution in the bone marrow in SCD patients.

14:00 ***4299***. **Quantitative MRI Analysis of Lacrimal Glands in Patients with Sickle Cell Disease**

Elliott Elias[1], Joseph Liao[1], Memi Watanabe[1], Naoko Saito[1], Hernan Jara[1], Osamu Sakai[1]
[1]Boston Medical Center, Boston University School of Medicine, Boston, MA, United States

Purpose: To analyze MR relaxometric and volumetric changes in lacrimal glands in sickle cell disease (SCD) as motivated by a recent case report on lacrimal gland pathology. Materials and Methods: 15 SCD patients (19.8-43.6 yrs) and 23 control subjects (23-64 yrs) were imaged by mixed-TSE sequence at 1.5T. T1, T2, and secular-T2 relaxation time histograms and volumes were analyzed. Results: T2 and secular-T2 relaxation times were significantly shortened in SCD patients, and glandular volumes were increased. No significant differences were observed in T1. Conclusion: Disease specific relaxometric and volumetric were observed in the lacrimal glands of SCD patients.

14:30 ***4300***. **Quantitative MRI Analysis of Craniofacial Bone Marrow in Patients with Sickle Cell Disease**

Elliott Elias[1], Joseph Liao[1], Memi Watanabe[1], Yu Sakai[1], Kaan Erbay[1], Naoko Saito[1], Hernan Jara[1], Osamu Sakai[1]
[1]Boston Medical Center, Boston University School of Medicine, Boston, MA, United States

Purpose: To analyze MR relaxometric and volumetric changes in craniofacial bone marrow in sickle-cell disease (SCD). Materials and Methods: 15 SCD patients (19.8-43.6 yrs) and 23 controls (23-64 yrs) were imaged by mixed-TSE sequence at 1.5T. Craniofacial bones were manually segmented, and T1, T2, and secular-T2 relaxation time histograms and volumes were analyzed. Results: T2 and

secular-T2 peaks revealed significant shortening in SCD patients. Only the first T1 peak showed significant increase. Significant increase in marrow volume was observed in SCD patients. Conclusion: Disease specific relaxometric and volumetric changes were observed in the craniofacial bone marrow in SCD patients.

15:00 ***4301*. Susceptibility Weighted Imaging (SWI) for the Assessment of Iron Loading in the Brain of Beta-Thalassemia Major Patients**

Deqiang Qiu[1], Godfrey CF Chan[2], Queenie Chan[3], Sau-Yin Ha[2], Pek-Lan Khong[1]
[1]Diagnostic Radiology, The University of Hong Kong, Hong Kong, China; [2]Pediatric and Adolescent Medcine, The University of Hong Kong, Hong Kong, China; [3]Philips Healthcare Hong Kong, Hong Kong, China

Brain iron loading was evaluated in a group of thalassemia beta-major patients using susceptibility weighted imaging and compared with normal healthy volunteers. Age and gender effects were found in normal subjects. A wide range of iron concentration was indicated in the patient group with some showing higher phase value and some lower phase value in brain regions than normal. Significantly different phase value was found among patients receiving different iron chelation agents. SWI is sensitive in measuring iron concentration in the brain and provide a valuable tool for iron assessment both for clinical trials and for individual evaluation.

Wednesday 13:30-15:30 Computer 75

13:30 ***4302*. Imaging Biomarkers in Neurofibromatosis 2-Related Vestibular Schwannomas**

Dominique Louise Jennings[1], Kim Mouridsen[2], Meiyun Wang[2], Harry Miao[3], Langdon Miller[3], Scott R. Plotkin[4], A Gregory Sorensen[2]
[1]Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA , MA, United States; [2]Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, MA, United States; [3]PTC Therapeutics, Inc., South Plainfield, NJ, United States; [4]Department of Neurology and Cancer Center, Massachusetts General Hospital, Boston, MA, United States

This study applied advanced imaging techniques in the evaluation of the tumor heterogeneity in neurofibramatosis type-2 vestibular schwannomas. We aim to develop imaging biomarkers to assess response to anti-angiogenic therapies in this tumor type.

14:00 ***4303*. Differential Diagnosis of Intracranial Ectopic Germinomas at Early Stage and Lacunar Infarction by Susceptibility-Weighted Imaging**

Xin Lou[1], Lin Ma[1], Chenglin Tian[2], Ailian Zhang[1], Yulin Wang[1], Zhiye Chen[1]
[1]Radiology Department, Beijing, China; [2]Neurology Department, Beijing, China

Intracranial germinomas may arise in sites besides pineal and suprasellar regions, which was named intracranial ectopic germinomas (IEGs). Most IEGs at early stage present as lacunar infarct-like or demyelination-like lesions. Because germinomas are highly sensitive to radiotherapy, therefore the early diagnosis is crucial for the treatment. Susceptibility-weighted imaging (SWI) has proved to be more sensitive in detecting early basal ganglia germinoma than conventional MRI. Five patients with early IEGs and six patients with lacunar infarction in basal ganglia were performed SWI and conventional MRI. Our preliminary results revealed SWI is helpful in differentiating early IEGs from lacunar infaction.

14:30 ***4304*. Ex Vivo Metabolic Profiles for the Differential Classification Between Oligodendroglial and GBM Tumours**

Bernardo Celda[1,2], Ruben Ferrer-Luna[1], Horacio Martinetto[3], Jorge Calvar[3], Gustavo Sevlever[3], Vicent Esteve[2], MCarmen Martinez-Bisbal[2]
[1]Physical Chemistry, University of Valencia, Burjassot, Valencia, Spain; [2]Physical Chemistry, CIBER-BBN, Burjassot, Valencia, Spain; [3]FLENI, Buenos Aires, Argentina

Ex vivo metabolic profiles for 5o brain tumours (20 oligodendrogial (OT) and 30 GBM) obtained by HR-MAS were used for a clear classification between OT and GBM.

15:00 ***4305*. r-CBV Changes: Can We Predict Tumor Behavior of Low Grade Gliomas with Rapid Progression from Imaging Features?**

Yoo Jeong Yim[1], Soo Chin Kim[1], Hyo bin Seo[1], Ji Hoon Kim[1], Chul-Ho Sohn[1], Kee Hyun Chang[1]
[1]Radiology, Seoul National University Hospital, Seoul, Korea, Republic of

The purpose of this study was to determine whether r-CBV(relative cerebral blood volume) value in low grade gliomas can be used as an adjunct to pathologic grading. From 2004 to 2009. among 190 pathologically proven low grade glioma(WHO grade II), fifteen patients(7.8%)(4 astrocytomas, 10 oligodendrogliomas, 1 oligoastrocytoma) showed malignant transformation. These tumors included 8 anaplastic oligodendroglioma, 3 anaplastic astrocytoma, 3 anaplastic oligoastrocytoma and 1 glioblastoma. At the initial study, mean r-CBV value was 5.07(range, 2.87-9.32) and 10.4(range,3.25-16.15) at malignant transformation. Cut-off value for r-CBV of low grade glioma at the point of high grade transformation is 5.3(p=0.0005, sensitivity 83.3%, specificity 76.9%). r-CBV values can be used as an accurate adjunct to WHO pathologic grading of low grade gliomas that have a propensity for malignant transformation.

Thursday 13:30-15:30 Computer 75

13:30 ***4306*. Quantitative MRI Analysis of Aging of Human Fat Tissue: Intra-Orbital Versus Extra-Orbital Fat**

Memi Watanabe[1], Osamu Sakai[1], Joseph Liao[1], Hernan Jara[1,2]
[1]Department of Radiology, Boston Medical Center, Boston University School of Medicine, Boston, MA, United States; [2]Department of Biomedical Engineering, Boston University, Boston, MA, United States

Purpose: To study the aging pattern of intra- vs. extra-orbital fat tissue, using multispectral quantitative MR imaging (qMRI). Methods: Forty-two subjects (M:F=21:21, age: 0.5-87 years, average 31.5) were examined with experimental mixed turbo spin echo (mixed-TSE) sequence. Region-of-interest (ROI) measurements of retrobulbar fat, buccal fat and subcutaneous fat tissues were obtained for multispectral qMRI analysis. Results: PD and T1 values of all fat tissues showed similar tissue characteristics and aging patterns, while a decrease in T1 and secular-T2 values was seen in extra-orbital fat with aging. Conclusion: Multispectral qMRI data of aging in intra- and extra-orbital fat tissues were obtained.

14:00 ***4307*. High-Resolution Diffusion-Weighted Imaging of the Orbits Using Readout-Segmented EPI**

Roland Bammer[1], Kristen W. Yeom[1], Samantha J. Holdsworth[1], Stefan T. Skare[1]
[1]Radiology, Stanford University, Stanford, CA, United States

Diffusion-weighted MRI (DWI) of the Orbits bears great diagnostic potential. Its use, however, has been limited due to profound geometric distortions and signal loss related to single-shot EPI. We demonstrate that diffusion-weighted readout-segmented (RS)-EPI with its significant distortion reduction capacity can provide high-resolution DWI and DTI scans that allows one to delineate intra-orbital structures within clinically reasonable scan times. A consecutive series of 35 pediatric patients was enrolled in a comparative evaluation and a 100% superiority of RS-EPI (both in resolution and distortion reduction) over ASSET-enhanced EPI could be demonstrated.

14:30 ***4308*. The Effects of Age, Gender and BMI on Parotid Fat and Parotid ADC Measurements in EPI Based and FSE-PROPELLER Based Diffusion Weighted Imaging**

Hui-Chu Chiu[1,2], Chun-Jung Juan[3], Hing-Chiu Chang[4,5], Hsiao-Wen Chung[3,5], Cheng-Chieh Cheng[3,5], Su-Chin Chiu[3,5], Cheng-Yi Cheng[1], Cheng-Yu Chen[3], Guo-Shu Huang[3]
[1]Department of Nuclear Medicine, Tri-Service General Hospital, Taipei, Taiwan; [2]EMBA in Global Chinese Management, Department of Business Administration, College of Management, Tamkang University, Taipei, Taiwan; [3]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan; [4]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [5]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

The effects of age, gender and body mass index (BMI) on parotid fat content and parotid ADC measurements have never been investigated yet. In this study, we measured parotid ADC values using non-fat-saturated and fat-saturated DWI pulse sequences including fast spin-echo PROPELLER and echoplanar acquisitions. Our results highlight the parotid fat content is influenced by gender and is significantly positively associated with age and BMI. The parotid fat content has a significantly negative effect on parotid ADC values that is most apparent in non-fat-saturated DWI pulse sequence and the effect could not be remedied by any fat-saturated DWI pulse sequence.

15:00 ***4309*. Cortical Activation During Swallowing Rehabilitation Maneuvers: A Functional MRI Study of Healthy Controls**

Kyung K. Peck[1], Ryan Branski, Cathy Lazarus[2], Victoria Cody, Devon Kraus, Samantha Haupage, Cindy Ganz, Andrei Holodny, Dennis Kraus
[1]Medical Physics and Radiology, Memorial Sloan-Kettering Cancer Center, New York, United States; [2]New York University

Both the Effortful and Mendelsohn maneuver are currently used in the clinical setting as a component of a comprehensive rehabilitation of swallowing. However, the brain responses to these tasks and how activation differs from dry swallowing has not been investigated. In this study, we seek to provide preliminary data regarding the neural networks associated with commonly-employed rehabilitation strategies. We hypothesize that with increased understanding of the neural bases behind these maneuvers, factors of peripheral injury as well as the central adaptor response can be considered in order to develop enhanced rehabilitation strategies for this challenging patient population

Multiple Sclerosis I

Hall B Monday 14:00-16:00 Computer 76

14:00 ***4310*. Magnetization Transfer (MT) and Endogenous Chemical Exchange Saturation Transfer (CEST) Effects in Patients with Clinically Isolated Syndrome**

Ali Al-Radaideh[1], Olivier Mougin[1], Su-Yin Lim[2], Christopher Tench[2], Cris Constantinescu[2], Penny Gowland[1]
[1]Sir Peter Mansfield MR Centre, The University Of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Clinical Neurology, The University Of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Magnetization transfer (MT) is an important MRI measure in MS and the MT effect can be assessed qualitatively using magnetization transfer ratio (MTR) maps.A distinctive peak is observed in the z -spectrum of the human brain, at -1.05k Hz offset from the water frequency at 7T. This is caused by endogenous chemical exchange saturation transfer (CEST) between amide (chemical group attached to the peptide bond) and water protons. Here we obtain MTR images for negative (MTR- sensitive to MT + CEST effects) and positive (MTR+ sensitive to just MT effects) frequency offsets of the saturation and compare the distributions of these parameters in NAWM of healthy controls and patients with Clinically Isolated Syndrome (CIS: a condition that is likely to lead to MS).

14:30 ***4311*. Application of CEST Imaging to Study Amide Proton Transfer (APT) in Healthy Controls and Multiple Sclerosis Pathology at 7 Tesla**

Adrienne N. Dula[1,2], Richard D. Dortch[1,2], Bennett A. Landman[2,3], Sid Pawate[4], Patrick J. Lavin[4], Edward B. Welch, [1,5], John C. Gore[1,2], Seth A. Smith[1,2]
[1]Vanderbilt Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Radiology and Radiological Sciences, Vanderbilt Medical Center, Nashville, TN, United States; [3]Electrical Engineering & Computer Science, Vanderbilt University, Nashville, TN, United States; [4]Neurology, Vanderbilt Medical Center, Nashville, TN, United States; [5]3MR Clinical Science, Philips Healthcare, Cleveland, OH, United States

Increased contrast from chemical exchange saturation transfer (CEST) effects in human brain at 7T has been used to study amide proton transfer (APT) and applied in multiple sclerosis (MS). APT imaging is sensitive to the mobile protons associated with proteins and peptides. The increased signal, T1, and spectral dispersion at 7T ameriorate this molecular MRI method. APT asymmetry analysis at 7T was used to examine unique white matter, gray matter contrast in healthy controls as well as an MS patient. Herein, we utilize the Water Spectrum Shift Reference (WASSR) method to correct for B0 inhomogeneities and center the CEST spectra.

15:00 ***4312*. Multimodal High Resolution Magnetization Transfer and T1mapping in NAWM of Patients with Clinically Isolated Syndrome**

Ali Al-Radaideh[1], Olivier Mougin[1], Su-Yin Lim[2], Christopher Tench[2], Cris Constantinescu[2], Penny Gowland[1]
[1]Sir Peter Mansfield MR Centre, The University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Clinical Neurology, The University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Multiple Sclerosis (MS) is known to reduce magnetization transfer ratio (MTR)and increase the longitudinal relaxation time (T1) in the white matter (WM). Here, we measure the distribution of MTR and T1 values in normal appearing white matter (NAWM) at 7T and high spatial resolution, comparing CIS patients with healthy controls.

15:30 ***4313*. Magnetization Transfer Weighted Double Inversion Recovery for an Improved Visualization of Neocortical and Juxtacortical Signal Abnormalities**

Christian Langkammer[1], Christian Enzinger[1], Siegrid Fuchs[1], Franz Fazekas[1], Stefan Ropele[1]
[1]Department of Neurology, Medical University of Graz, Graz, Austria

Signal abnormalities in multiple sclerosis such as neocortical and juxtacortical lesions can be visualized best using a double inversion recovery (DIR) sequence. DIR sequences are based on T1 filtering and aim on suppressing signal from white matter and cerebrospinal fluid. We here investigated, whether the application of additional MT saturation pulses can further improve the contrast between cortex, white matter and embedded lesions. The new sequence was evaluated in the brain of healthy volunteers and multiple sclerosis patients.

Tuesday 13:30-15:30 Computer 76

13:30 ***4314*. Elimination of T_1 Weighting in FLAIR by Optimized Double IR – Could This Be the Only T_2-Weighted Sequence Needed?**

Ananth J. Madhuranthakam[1], Subhendra N. Sarkar[2,3], Reed F. Busse[4], David C. Alsop[2,3]
[1]MR Applied Science Lab, GE Healthcare, Boston, MA, United States; [2]Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States; [3]Harvard Medical School, Boston, MA, United States; [4]MR Applied Science Lab, GE Healthcare, Madison, WI, United States

FLAIR is widely used for its improved conspicuity of long T_2 lesions. However, concerns remain that the IR imparts T_1 weighting that can decrease detectability of some lesions. Frequently, both T_2 and FLAIR are used in clinical protocols to guard against these concerns. Recently, double IR (DIR) has been proposed to highlight some brain lesions by nulling both WM and CSF but produces

even stronger T_1 contrast than FLAIR. Here, we describe an optimization with DIR to produce an image with pure T_2 weighting while simultaneously suppressing CSF and demonstrate results in normal volunteers with a single slab 3D acquisition.

14:00 ***4315*. Diffusional Kurtosis Imaging of Gray Matter in Patients with Multiple Sclerosis**

Maxim Bester[1,2], Jens H. Jensen[1], Ali Tabesh[1], Hina Jaggi[1], Cathy Hu[1], Joseph Herbert[3], Robert I. Grossman[1], Matilde Inglese, [3,4]

[1]Radiology, New York University, New York, NY, United States; [2]Neuroradiology, Eppendorf-Hamburg University, Hamburg, Germany; [3]Neurology, New York University, New York, NY, United States; [4]Radiology , New York University, New York, NY, United States

Diffusion tensor imaging (DTI) is useful to assess subtle pathology in normal-appearing white matter of multiple sclerosis (MS) patients. Diffusional kurtosis imaging (DKI) measures the non-Gaussian water diffusion and mean kurtosis (MK) is sensitive to structural changes in isotropic tissue such as gray matter (GM). The aims of this study were to assess GM in MS patients using DKI and DTI and to investigate the relationship between GM MK and white matter injury. Differences from controls were observed in both GM MK and DTI metrics suggesting that DKI can provide additional complementary information about brain tissue microstructure

14:30 ***4316*. Magnetization Transfer DTI in Multiple Sclerosis**

Alexandru Vlad Avram[1], Arnaud Guidon[1], Jeffrey Petrella, Joel Morgenlander[2], Allen W. Song

[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States; [2]Department of Neurology, Duke University

We present a stimulated echo DTI sequence with magnetization transfer capable of imaging the diffusion anisotropy of myelin water and evaluate its potential for early detection of white matter abnormalities in multiple sclerosis. The observed myelin-specific FA changes clearly indicated the underlying demyelination in MS patients, and the degrees of the FA changes may further characterize the stage of disease progression, which may lead to an early detection of areas undergoing initial myelin microstructural changes before any significant myelin content reduction.

15:00 ***4317*. A Multi Center Longitudinal Study of Diffusion Tensor Mri Changes in Healthy Volunteers and People with Ms**

Elisabetta Pagani[1], Jochen G. Hirsch[2], Petra J.W. Pouwels[3], Mark A. Horsfield[4], Elisabetta Perego[1], Achim Gass[2], Stefan D. Roosendaal[3], Frederik Barkhof[3], Federica Agosta[1], Roberto Vuotto[1], Marco Rovaris[1], Domenico Caputo[5], Antonio Giorgio[6], Jacqueline Palace[6], Stefan Ropele[7], Franz Fazekas[7], Massimo Filippi[8]

[1]Scientific Institute and University Hospital San Raffaele, Italy; [2]University Hospital Basel, Switzerland; [3]VU University Medical Centre, Netherlands; [4]University of Leicester; [5]Scientific Institute Fondazione Don Gnocchi, Italy; [6]University of Oxford, United Kingdom; [7]Medical University of Graz, Austria; [8]Scientific Institute and University Hospital San Raffaele, Milan, Italy

We studied diffusion tensor (DT)-derived metrics acquired at baseline and after 6 months with the aims of assessing: a) longitudinal stability in healthy subjects, and b) sensitivity to tissue damage in multiple sclerosis (MS) patients. Thirty-one healthy subjects and 22 MS patients were studied in 7 MRI centers using a standardized DT-MRI sequence. Mean diffusivity and fractional anisotropy longitudinal changes in healthy subjects ranged from 1% to 3.7%. Neither of these two DT-MRI measures disclosed progressive tissue changes in MS patients, possibly because of the relatively short follow-up period.

Wednesday 13:30-15:30 Computer 76

13:30 ***4318*. Knowledge-Driven Automated Segmentation of Cortical Lesions on MR Brain Images in MS**

Sushmita Datta[1], Jerry S. Wolinsky[2], Ponnada A. Narayana[1]

[1]Diagnostic and Interventional Imaging, The University of Texas Medical School at Houston, Houston, TX, United States; [2]Neurology, The University of Texas Medical School at Houston, Houston, TX, United States

A knowledge-based technique for segmenting cortical lesions in multiple sclerosis (MS) with minimal human intervention is presented. This method relies on double inversion recovery and phase sensitive inversion recovery images combined with morphological operations. To the best of our knowledge, this is the first study that addresses the segmentation of cortical lesions in MS.

14:00 ***4319*. Detecting Multiple Sclerosis Cortical Lesions Post-Mortem Using 7 Tesla Magnetic Resonance Imaging**

Bing Yao[1], Simon Hametner[2], Peter van Gelderen[1], Hellmut Merkle[1], Fredric Cantor[3], Henry McFarland[3], Hans Lassmann[2], Jeff H. Duyn[1], Francesca Bagnato[3]

[1]AMRI, NINDS, National Institutes of Health, Bethesda, MD, United States; [2]Centre for Brain Research, Medical University, Vienna, Austria; [3]NIB, NINDS, National Institutes of Health, Bethesda, MD, United States

Focal cortical grey matter lesions (CLs) are an important component of multiple sclerosis (MS) pathology. However, detecting cortical lesions in MS using MRI poses challenges. MRI at ultra-high field strengths such as 7 Tesla has the potential to superbly enhance MS-induced CLs visibility. In this study, we applied ultra-high resolution R2* maps to detect and evaluate cortical lesions and their subtypes and the MRI results were compared with the pathology analysis.

14:30 **4320. Profile-Based Cortical Parcellation to Detection of Cortical Multiple Sclerosis Lesions**

Christine Lucas Tardif[1], John B. Richardson[2], Claude Lepage[1], D Louis Collins[1], Alan C. Evans[1], G Bruce Pike[1]

[1]McConnell Brain Imaging Centre, Montreal Neurological Institute, Montreal, QC, Canada; [2]Department of Neuropathology, Montreal Neurological Institute/Hospital, Montreal, QC, Canada

Cortical grey matter (GM) multiple sclerosis lesions are difficult to segment in MR images due to poor contrast with normal appearing GM and spatial variation in healthy GM. We propose using an observer-independent profile-based method for cortical parcellation to detect cortical lesions. Following tissue classification and surface extraction, profiles are extended from the white matter surface to the cortical surface. The cortex is parcellated according to profile intensity and shape using a kmeans classifier with squared Euclidean distance. The method is tested on high-resolution MR data from a fixed postmortem MS brain, and validated using myelin basic protein immunohistochemistry.

15:00 **4321. Evidence of Distributed Subpial T2* Signal Changes at 7T in Multiple Sclerosis: An Histogram Based Approach.**

Caterina Mainero[1], Carlos Lima[1], Julien Cohen-Adad[1], Doug Greve[1], Amy Radding[1], Thomas Benner[1], R Philip Kinkel[2], Bruce Fischl[1], Bruce R. Rosen[1]

[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States; [2]Neurology, Beth Israel Deaconess Medical Center, Boston, MA, United States

We investigated whether a histogram-based analysis of 7T T2* signal intensity in the cortex can show distributed subpial cortical changes in 14 patients with multiple sclerosis (MS), as described histopathologically. We hypothesized that this show significantly increased T2* signal intensity in patients vs controls. FLASH-T2* spoiled gradient-echo weighted images acquired at 7T. Pial and white matter surfaces generated by FreeSurfer on a 3T MEMPR were overlaid on the 7T FLASH-T2* images. T2* intensities were normalized to mean CSF intensity (T2*/CSF) and then sampled 1mm inside the pial surface. The histogram-based analysis showed significant, diffuse T2*/CSF signal increases in MS vs matched controls, particularly evident in frontal areas.

Thursday 13:30-15:30 Computer 76

13:30 **4322. Optimisation of 3 T and 7 T T_2^*-Weighted MRI for the Detection of Small Parenchymal Veins in MS Lesions**

Jennifer Elizabeth Dixon[1], Matthew John Brookes[1], Emma C. Tallantyre[2], Nikos Evangelou[2], Peter G. Morris[1]

[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Department of Clinical Neurology, Nottingham University Hospital NHS Trust, Nottingham, Nottinghamshire, United Kingdom

Post-mortem studies of MS lesions show a close spatial relationship to parenchymal veins. In vivo study of this has previously been limited by the difficulties in demonstrating both lesions and veins on a single MR image. Recently, we have shown that T2*-weighted MRI at 7T enables simultaneous visualisation of both structures, and found that 82% of white-matter MS lesions contained a detectable vein. Here, we predict optimal scanning parameters for increasing the sensitivity of vessel detection and reducing the inherent bias towards detection of veins with particular orientations.

14:00 **4323. High Resolution Magnetic Susceptibility Mapping in Patients with Clinically Isolated Syndrome**

Ali Al-Radaideh[1], Samuel Wharton[1], Su-Yin Lim[2], Christopher Tench[2], Cris Constantinescu[2], Richard Bowtell[1], Penny Gowland[1]

[1]Sir Peter Mansfield MR Centre, The University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Clinical Neurology, The University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

Neurodegeneration in MS might be expected to cause an accumulation of iron in deep grey matter (dGM) structures. The aim of this study is to measure the susceptibility of dGm structures in patients with Clinically Isolated Syndrome (CIS), an early manifestation of MS.

14:30 **4324. Iron-Sensitive Quantitative Methods for Multiple Sclerosis: Lesion Evolution and Deep Grey Matter Iron Deposition**

Robert Marc Lebel[1], Amir Eissa[1], Peter Seres[1], Derek J. Emery[2], Gregg Blevins[3], Alan H. Wilman[1]

[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada; [2]Radiology and Diagnostic Imaging, University of Alberta, Edmonton, Alberta, Canada; [3]Neurology, University of Alberta, Edmonton, Alberta, Canada

Three iron-sensitive methods are applied at 4.7T for tracking iron-based changes in the brain of patients with relapsing-remitting multiple sclerosis (MS). The methods are phase susceptibility, R2 and R2* mapping. Each method is applied with special high field adaptations. They are used to track lesion progression as well as deep grey matter changes. Each measure provides unique contrast and its own sensitivity and specificity to iron. Together these methods can provide new insight into MS progression.

15:00 **4325. Abnormal Iron Content in Deep Grey Matter Structures of MS Patients as a Function of Age**

Charbel Abdo Habib[1], James Garbern, [1,2], Manju Liu[1], Ewart Mark Haacke[1]
[1]Radiology, Wayne State University, Detroit, MI, United States; [2]Neurology, Wayne State University, Detroit, MI, United States

Multiple sclerosis (MS) is a disease whose etiology until recently has remained a mystery. A possible explanation for MS has been put forward by Zamboni et al that it is caused by a chronic cerebrospinal venous insufficiency (CCSVI). In this abstract, we show that the iron deposition seen by susceptibility weighted imaging (SWI) in MS patients is abnormal compared to normal controls and appears in areas drained by the medial venous drainage system. This finding is consistent with the CCSVI hypothesis.

Multiple Sclerosis II

Hall B Monday 14:00-16:00 Computer 77

14:00 **4326. Deep Gray Matter Atrophy in a Large Sample of Clinically Isolated Syndrome and Early Relapsing-Remitting Multiple Sclerosis Patients**

Niels Bergsland[1], Michael G. Dwyer[1], Dana Horakova[2], Ondrej Dolezal[1], Zdenek Seidl[3], Manuela Vaneckova[3], Eva Havrdova[2], Robert Zivadinov[4]
[1]University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; [2]Charles University, Department of Neurology, Prague, Czech Republic; [3]Charles University, Department of Radiology, Prague, Czech Republic; [4]Neurology, Buffalo Neuroimaging Analysis Center, Buffalo , NY , United States

To quantify deep gray matter (DGM) atrophy in a large sample of clinically isolated syndrome (CIS) patients, early relapsing-remitting (RR) multiple sclerosis (MS) patients, and healthy controls (HC). To investigate the relationship between DGM atrophy and disability in CIS patients.

14:30 **4327. Exploring the Relations Between Emotional Disability and Subcortical Atrophy in Patients with Multiple Sclerosis**

Francesca Bagnato[1], Clelia Pellicano[1], Fredric Cantor[1], Antonio Gallo[1], Sungyoung Auh[2], Mary Ehrmantraut[1], Iordanis Evangelou[1], Vasiliki Ikonomidou[1], Robert Kane[3], Joan Ohayon[1], Susan Stern[1], Henry McFarland[1]
[1]NIB-NINDS-NIH, Bethesda, MD, United States; [2]Clinical Director Office-NINDS-NIH, Bethesda, MD, United States; [3]VA, Baltimore

Pathophysiological mechanisms underlying the development of depression in patients with multiple sclerosis (MS) remain unknown. We here demonstrate that atrophy of deep grey matter (GM) structures of the limbic circuit, such as thalamus and hippocampus, may explain up to 30% of the variance of depression in MS. The relation between depression and GM atrophy holds significant when the effect of patients' physical disability is taken into account. The results highlight the role of neurodegeneration in specific brain sites as an important factor associated with depression in MS patients.

15:00 **4328. A Five-Year Serial Longitudinal Study of Deep Gray Matter Atrophy in Patients with Multiple Sclerosis**

Robert Zivadinov[1], Dana Horakova[2], Michael G. Dwyer[3], Deepa Ramasamy[3], Eva Havrdova[2], Zdenek Seidl[4], Ondrej Dolezal[3], Sara Hussein[3], Ellen Carl[3], Manuela Vaneckova[4], Niels Bergsland[3]
[1]Neurology, Buffalo Neuroimaging Analysis Center, Buffalo , NY , United States; [2]Charles University, Department of Neurology, Prague, Czech Republic; [3]University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; [4]Charles University, Department of Radiology, Prague, Czech Republic

To compare the evolution of deep gray matter (DGM) atrophy in early relapsing-remitting (RR) multiple sclerosis (MS) patients and in normal controls (NC) over 2 years. To investigate the extent of DGM atrophy progression in MS patients over 5 years.

15:30 **4329. Relation Between Thalamic Atrophy and Long-Term Disability Progression in Multiple Sclerosis: A 8-Year Follow Up Study**

Maria A. Rocca[1], Sarlota Mesaros[1], Elisabetta Pagani[1], Maria Pia Sormani[1,2], Vittorio Martinelli[3], Giancarlo Comi[3], Massimo Filippi[1]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Unit of Biostatistics, DISSAL, University of Genoa, Genoa, Italy; [3]Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy

We assessed the value of thalamic damage (in terms of atrophy and magnetization transfer ratio-MTR), taken in isolation, and its short-term changes in predicting accumulation of disability over an 8-year period in 73 patients with relapse-onset multiple sclerosis (MS). At the end of follow up, 44 patients (60%) showed a significant disability worsening. A multivariable model included baseline thalamic fraction [p=0.01, odds ratio (OR)=0.62], and average lesion MTR percentage change after 12 months (p=0.04, OR=0.90) as

independent predictors of disability worsening at 8 years (r2=0.29) suggesting that thalamic damage predicts the long-term accumulation of disability in MS.

Tuesday 13:30-15:30 Computer 77

13:30 ***4330*. Cortical N-Acetyl Aspartate Predicts Long-Term Clinical Disability in Multiple Sclerosis – a Longitudinal MR Spectroscopic Imaging Study**

Xingchen Wu[1], Lars G. Hanson[1,2], Morten Blinkenberg[3], Arnold Skimminge[1], Per Soelberg Sørensen[3], Olaf Paulson[1,4], Henrik Mathiesen[1,3]
[1]Danish Research Center for Magnetic Resonance, MR Dept., Copenhagen University Hospital Hvidovre, Hvidovre, Denmark; [2]Department of Electrical Engineering, Technical University of Denmark, Denmark; [3]Danish MS Research Center, Neurology Dept., Copenahgen University Hospital Rigshospitalet, Denmark; [4]Dept. Neurology and Neurobiology Research Unit, Copenhagen University Hospital Rigshospitalet, Denmark

MR spectroscopic imaging (MRSI) provides in vivo information about neuronal loss or dysfunction by measuring N-acetyl aspartate (NAA). This aim of this multi-slice echo-planar spectroscopic imaging study was to test the hypothesis that cortical NAA/Creatine (Cr) is a potential predictor of neurological disability in relapsing-remitting multiple sclerosis (RRMS) by serial MRSI once every 6 months for 24 months. Clinical examinations including the Expanded Disability Status Scale (EDSS) were performed at baseline, month 24, and year 7. We found that baseline cortical NAA/Cr ratio was negatively correlated with EDSS at month 24 and year 7. In conclusion, cortical NAA/Cr in early RRMS predicts clinical disability in 7 years.

14:00 ***4331*. The Correlation Between Whole-Brain N-Acetylaspartate Quantification and Multiple Sclerosis Severity Score**

Daniel Rigotti[1], Nissa Perry[1], Joseph Herbert[2], Oded Gonen[1]
[1]Radiology, NYU School of Medicine, New York, NY, United States; [2]Neurology, NYU School of Medicine, New York, NY, United States

Due to its homogeneity, there remains no accurate way to quickly assess current disease status of relapsing-remitting multiple sclerosis (RR-MS). We combine data from the Multiple Sclerosis Severity Scale (MSSS), an EDSS-based marker sensitive to small lesions in eloquent areas, with whol-brain N-acetylaspartate (WBNAA), a marker specific for diffuse neurodegeneration in a large cohort of MS patients (including ~50 clinically-confirmed benign). We show a near unanimous concurrence of the two methods in the benign patients. Additionally, using the confirmed benigns as an internal standard,~20% of non-benigns meet the both definitions of benign, which is similar to the accepted prevalence.

14:30 ***4332*. Serial Whole-Brain N-Acetylaspartate Concentration in Multiple Sclerosis Patients**

Daniel Rigotti[1], Matilde Inglese[1], Nissa Perry[1], James Babb[1], Joseph Herbert[2], Oded Gonen[1]
[1]Radiology, NYU School of Medicine, New York, NY, United States; [2]Neurology, NYU School of Medicine, New York, NY, United States

The irreversible effects of multiple sclerosis are chiefly caused by neuronal loss. The global concentration of the neuron-specific amino-acid derivative N-acetylaspartate (WBNAA1) has been shown to be a sensitive marker for diffuse neurodegeneration in cross-sectional studies. Here we show data from a year-long longitudinal study of nineteen newly-diagnosed MS patients where we detect a significant and biologically relevant serial decline in WBNAA. This is the first time, to our knowledge, that quantifiable changes reflecting ongoing pathogenesis have been measured in MS using WBNAA.

15:00 ***4333*. Classification of Multiple Sclerosis Clinical Forms by 1H Magnetic Ressonance Spectroscopy of Cerebrospinal Fluid**

Francesc Xavier Aymerich[1,2], Julio Alonso[1], Manuel Comabella[3], Miquel E. Cabañas[4], Mar Tintoré[3], Xavier Montalban[3], Alex Rovira[1]
[1]Unitat RM Vall Hebron (IDI), Hospital Vall Hebron, Barcelona, Spain; [2]Enginyeria de Sistemes, Automàtica i Informàtica Industrial, Universitat Politècnica de Catalunya, Barcelona, Spain; [3]Unitat Neuroimmunologia Clínica, CEM Cat, Hospital Vall Hebron, Barcelona, Spain; [4]Servei Ressonància Magnètica Nuclear, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Barcelona, Spain

The purpose was the design of a fuzzy classifier to differentiate among primary progressive multiple sclerosis (MS), relapsing remitting MS and non-MS conditions by 1H-NMR spectroscopy of cerebrospinal fluid. The design considered the fusion of classifiers based on fuzzy decision trees. We considered three different datasets (aliphatic region, aromatic region and the aggregation of both regions). We evaluated for each dataset the classifier performance by means of two classification quality indexes (correctness and robustness). Results showed mean classification correctness and robustness in the intervals [0.92,1] and [0.34,0.50] respectively. The aggregation of aliphatic and aromatic regions provided the best results.

Wednesday 13:30-15:30 Computer 77

13:30 ***4334*. Transversal and Longitudinal Voxelwise Whole Brain Evaluation in the Earliest Stages of Multiple Sclerosis**

Eytan Raz[1], Mara Cercignani[2], Emilia Sbardella[1], Porzia Totaro[1], Carlo Pozzilli[1], Marco Bozzali[2], Patrizia Pantano[1]

[1]Department of Neurological Sciences, Sapienza University of Rome, Rome, Italy; [2]Neuroimaging Laboratory, Santa Lucia Foundation, Rome, Italy

In patients with multiple sclerosis, the relationship between white matter and gray matter damage evolution is not fully understood; we aimed at longitudinally (one-year interval) evaluating the white matter and gray matter damage in the same coohort of clinically isolated syndrome patients recruited at onset. While white matter damage is detectable early and widely involves most tracts, no white matter changes over one year follow-up period are noted; conversely, a significant decrease in cortical and deep gray matter volume is observed at 1 year follow-up evaluation.

14:00 ***4335*. Relationship Between Structural Brain Damage and Functional Cortical Reorganisation in Patients with Benign Multiple Sclerosis**

Antonio Giorgio[1], Emilio Portaccio[2], Maria Laura Stromillo[3], Silvia Marino[3], Valentina Zipoli[2], Gianfranco Siracusa[2], Marco Battaglini[3], Maria Letizia Bartolozzi[4], Anita Blandino[3], Leonello Guidi[4], Sandro Sorbi[2], Antonio Federico[3], Maria Pia Amato[2], Nicola De Stefano[3]

[1]Neurology and Neurometabolic Unit, Dept. of Neurological and Behavioral Sciences, Siena University , Siena, Italy; [2]Dept. of Neurology, University of Florence, Italy; [3]Neurology and Neurometabolic Unit, Dept. of Neurological and Behavioral Sciences, Siena University, Siena, Italy; [4]Neurology Unit, Hospital of Empoli, Italy

It is not currently known whether the favorable clinical status present several years after disease onset in Benign Multiple Sclerosis (B-MS) might be due to the presence of a more efficient functional cortical reorganisation. In 25 right-handed patients with B-MS, different bilateral brain areas, not only those devoted to motor tasks, were recruited during a simple motor task. This widespread functional cortical reorganisation appeared directly related to the integrity of normal appearing brain tissues and inversely associated with focal WM pathology and progressive brain volume loss.

14:30 ***4336*. Patterns of Regional Gray Matter Atrophy and Cognitive Impairment in Multiple Sclerosis Patients with Different Disease Phenotypes**

Gianna Riccitelli[1], Maria A. Rocca[1], Cristina Forn[1], Andrea Falini[2], Elisabetta Pagani[1], Mariaemma Rodegher[3], Monica Falautano[3], Paolo Rossi[3], Giancarlo Comi[3], Massimo Filippi[1]

[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Department of Neuroradiology, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [3]Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy

Using voxel-based morphometry, we found distinct patterns of regional distribution of GM damage associated with cognitive impairment (CI) in MS patients with different clinical phenotypes. CI relapsing-remitting MS patients had GM volume loss in the deep GM nuclei and in several regions in the frontal, parietal and temporal lobes. CI secondary progressive MS patients had GM volume loss in regions of the fronto-temporal lobes, and the hippocampus. CI primary progressive MS patients showed GM volume loss in the cingulum, superior temporal gyrus, inferior frontal gyrus and cerebellum. GM loss in CI MS patients was only partially correlated with T2-visible lesions.

15:00 ***4337*. Variation in Signal Surrounding White Matter Lesions in Primary Progressive Multiple Sclerosis**

Daniel J. Tozer[1], Abdulgabbar Hamid[1], Declan T. Chard[1], David H. Miller[1], Alan J. Thompson[2]

[1]NMR Unit, Department of Neuroinflammation, UCL Institute of Neurology, London, United Kingdom; [2]Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom

It is known that the normal appearing tissue of subjects with multiple sclerosis is abnormal, but not whether this is linked to focal white matter (WM) lesions or more widespread. This work investigates the tissue surrounding lesions for a variety of MRI parameters and compares them to the lesion and distant WM. Up to 9 pixel thick layers were extracted for MTR, T1 and T2 maps. It was found that much of this tissue is different to WM and the lesion. Hypointense and isointense lesions (on T1 weighted images) also behaved differently suggesting different pathological processes occurring at different times.

Thursday 13:30-15:30 Computer 77

13:30 ***4338*. In Vivo Quantitative Evaluation of Brain Tissue Damage in Multiple Sclerosis Using Gradient Echo Plural Contrast Imaging Technique**

Pascal Sati[1,2], Anne H. Cross[3], Charles Hildebolt[1], Dmitriy A. Yablonskiy[4]
[1]Mallinckrodt Institute of Radiology, Department of Radiology , Washington University School of Medicine, St Louis, MO, United States; [2]Translational Neuroradiology Unit, Neuroimmunology Branch, NINDS, National Institutes of Health, Bethesda, MD, United States; [3]Department of Neurology, Washington University School of Medicine, St Louis, MO, United States; [4]Mallinckrodt Institute of Radiology, Department of Radiology, Washington University School of Medicine, St Louis, MO, United States

Conventional MRI based on spin-echo sequences aids in the diagnosis of multiple sclerosis. However, MRI markers derived from these SE sequences provide limited information about tissue damage and correlate poorly with patient disability assessed with clinical tests. In this study, we introduce for the first time a new scoring method for MS evaluation using R2* histograms acquired by means of Gradient Echo Plural Contrast Imaging technique. This method is sensitive not only to lesion load, but also to the degree of tissue damage within the MS lesions thus holding promise for improving the evaluation of MS pathology.

14:00 ***4339*. Quantifying the Permeability of Blood-Brain Barrier in MS Patients Under Conventional Treatment**

saeid Taheri[1], Gary A. Rosenberg[1], Corey Ford[1]
[1]Neurology, University of New Mexico, Albuquerque, NM, United States

We investigated the permeability of Blood-Brain Barrier by employing contrast-enhanced MRI, a reduced dose of Gd-DTPA and a fast T1 mapping technique. A series of T1 images before and after the injection of contrast agent were acquired. By using Patlak modeling technique and a reference for concentration of Gd-DTPA in plasma we were able to build a permeability map corresponding to the permeability of BBB underlying each pixel. We have recruited ten MS patients under the conventional treatment along with 17 controls and compared results. We were able to distinguish between high and low grade activities of BBB in MS.

14:30 ***4340*. Use of Magnetic Resonance Venography for Characterization of Extracranial Venous System in Patients with Multiple Sclerosis and in Normal Controls**

Robert Zivadinov[1], Alexandra S. Lopez[1], Bianca Weinstock-Guttman[2], Claudiu Schirda[1], Christopher Magnano[1], Cheryl Kennedy[1], Christina Brooks[1], Justine Reuther[3], Kristin Hunt[1], Michelle Andrews[1], David Hojnacki[1]
[1]University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; [2]University at Buffalo, The Jacobs Neurological Institute, Buffalo, NY, United States; [3]University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo\, NY, United States

Chronic cerebrospinal venous insufficiency (CCSVI) is a vascular condition characterized by anomalies of the primary veins outside the skull that restrict the normal outflow of blood from the brain in patients with multiple sclerosis (MS). Extracranial venous flow morphology in 57 MS patients and in 21 age- and sex-matched normal controls (NC), was investigated by using magnetic resonance venography (MRV) on a GE 3T scanner. 4D Time Resolved Imaging of Contrast KineticS (TRICKS) and enhanced and unenhanced 3D Time of Flight (TOF) MRI sequences were performed. No extracranial venous flow morphology MRV differences were detected between MS patients and NC.

15:00 ***4341*. Hypoperfusion of Brain Parenchyma Is Strongly Associated with the Severity of Chronic Cerebrospinal Venous Insufficiency in Patients with Multiple Sclerosis**

Paolo Zamboni[1], Erica Menegatti[1], Bianca Weinstock-Guttman[2], Michael G. Dwyer[3], Claudiu V. Schirda[3], Anna M. Malagoni[1], David Hojnacki[2], Cheryl Kennedy[3], Ellen Carl[3], Niels Bergsland[3], Christopher Magnano[3], Ilaria Bartolomei[1], Fabrizio Salvi[1], Robert Zivadinov[4]
[1]University of Ferrera- Bellaria Neurosciences, Vascular Diseases Center, Ferrera, Italy; [2]University at Buffalo, The Jacobs Neurological Institute, Buffalo, NY, United States; [3]University at Buffalo, Buffalo Neuroimaging Analysis Center, Buffalo, NY, United States; [4]University at Buffalo, Buffalo Neuroimaging Analysis Center\, Buffalo, NY, United States

Chronic cerebrospinal venous insufficiency (CCSVI) is a vascular condition described in multiple sclerosis (MS) patients, characterized by stenoses of the main extracranial veins with hampered cerebral venous outflow. We hypothesized that the impaired venous outflow contributes to hypoperfusion of brain parenchyma, as measured by perfusion-weighted imaging. CCSVI was established based on the venous hemodynamic (VH) Doppler criteria. There was a significant strong association between VH criteria and PWI indices in all examined regions of the brain parenchyma in MS patients. This study demonstrates that severity of CCSVI is directly associated with hypoperfusion of the brain parenchyma in MS.

White Matter Diseases

Hall B Monday 14:00-16:00 Computer 78

14:00 ***4342*. Whole-Brain Histograms of the Bound Pool Fraction Reveal Delayed White and Gray Matter Damage After Blast-Induced Mild Traumatic Brain Injury (MTBI)**

Vasily L. Yarnykh[1], Hunter R. Underhill[1], Donna J. Cross[1], K McCraw[2], J Biberston[2], D J. Hoff[2], K Hart[2], Satoshi Minoshima[1], Eric C. Petrie[3,4], Murray A. Raskind[2], Elaine R. Peskind, [23]

[1]Department of Radiology, University of Washington, Seattle, WA, United States; [2]Northwest Network Mental Illness Research, Education, and Clinical Center (MIRECC), Veterans Affairs Puget Sound Health Care System, Seattle, WA, United States; [3]Department of Psychiatry & Behavioral Sciences, University of Washington, Seattle, WA, United States; [4]Northwest Network Mental Illness Research, Education, and Clinical Center (MIRECC) , Veterans Affairs Puget Sound Health Care System, Seattle, WA, United States

Cross-relaxation imaging (CRI) is a new method for quantitative mapping of parameters describing magnetization transfer between mobile water protons (free pool) and macromolecular protons (bound pool) in tissues. The purpose of this study was to test the capability of CRI to identify post-traumatic changes in brain tissues caused by blast-induced mTBI. CRI was performed in groups of military veterans recently exposed to blast trauma and healthy controls. Bound pool fraction (f) maps were reconstructed using a novel modification of the CRI processing algorithm. Histogram analysis revealed a significant decrease of f in both white and gray matter of mTBI patients.

14:30 ***4343*. DTI Parameters Predict Outcome in Severe Traumatic Brain Injury Patients**

Joshua F. Betz[1], Jiachen Zhuo[1], Anindya Roy[2], Kathirkamanthan Shanmuganathan[1], Rao P. Gullapalli[1]

[1]Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States; [2]Department of Mathematics and Statistics, University of Maryland Baltimore County, Baltimore, MD, United States

Patients presenting with Diffuse Axonal Injury (DAI) follow a highly variable clinical course, with initial neurological status frequently discrepant from long-term outcomes.

In this study, we compared Diffusion Tensor Imaging (DTI) parameters in 38 TBI patients with their Glasgow Coma Scale (GCS) at discharge. The DTI parameters ADC and Axial Diffusion are shown to be correlated with the GCS at the time of MRI, and can be used to predict survival better than GCS alone. In addition DTI parameters are able to predict neurological recovery at discharge.

15:00 ***4344*. Diffuse Metabolic Abnormalities in Acute Mild Traumatic Brain Injury: A Quantitative Proton MR Spectroscopy Study**

Ivan Kirov[1], James Babb[1], Joseph Reaume[1], Robert Grossman[1], Oded Gonen[1]

[1]Radiology, New York University, New York, NY, United States

Since injury in mild traumatic brain injury is likely both minimal and diffuse, we used a proton MR spectroscopy (1H-MRS) strategy of both high coverage and sensitivity. To achieve the former, a 3D 1H-MRS volume-of-interest (VOI) covered 360cc of mostly white matter, and whole-brain 1H-MRS accounted for all the brain. For high sensitivity, all 480 spectra of the 3D VOI were summed, yielding one spectrum per subject. Since B0 homogeneity is better across small voxels, spectra alignment before summation resulted in excellent spectral resolution. Results revealed no neuronal dysfunction or atrophy, but diffuse elevation of choline and myo-inositol in the 3D VOI.

15:30 ***4345*. Parcellating Disconnectivity: Understanding the Microstructural Abnormalities Associated with Neurocognitive Deficits in Traumatic Brain Injury**

Virginia F. Newcombe[1,2], Jo G. Outtrim[1], Dot A. Chatfield[1], Anne Manktelow[1], Peter J. Hutchinson[3], Jon P. Coles[1,2], Guy B. Williams[2], Barbara Sahakian[4], David K. Menon[1,2]

[1]Division of Anaesthesia, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [2]Wolfson Brain Imaging Centre, University of Cambridge, Cambridge, Cambridgeshire, United Kingdom; [3]Academic Department of Neurosurgery, University of Cambridge, Cambridge, United Kingdom; [4]Department of Psychiatry, University of Cambridge, Cambridge, United Kingdom

Impairment in decision making is commonly impaired post TBI contributing to the burden on healthcare systems worldwide. Diffusion tensor imaging (DTI) in selected ROIs was correlated with neurocognitive performance in a decision making task, the Cambridge Gambling Task; CGT. Cognitive performance on neuropsychological testing correlated significantly with diffusivity parameters in cognate brain regions. Our data add to the evidence that loss of microstructural integrity, as detected by DTI, is an important determinant of function following TBI, and confirm the involvement of key neurochemical networks in these complex neurocognitive tasks. DTI may be a useful research and clinical tool in this setting.

Tuesday 13:30-15:30 Computer 78

13:30 ***4346***. **A Diffusion Tensor Imaging Study of Longitudinal White Matter Degeneration in Amyotrophic Lateral Sclerosis**

Yu Zhang[1,2], Norbert Schuff[1,2], Susan C. Woolley[3], Gloria Chiang[1,2], Lauren Boreta[1,2], Jonathan S. Katz[3], Michael W. Weiner[1,2]
[1]CIND VA Medical Center, San Francisco, CA, United States; [2]UC San Francisco, San Francisco, CA, United States; [3]Forbes Norris ALS Center, California Pacific Medical Center, San Francisco, CA, United States

We report longitudinal differences of white matter degradation in 16 amyotrophic lateral sclerosis (ALS) patients who were scanned at 7-month intervals, by using a preliminary longitudinal assessment of diffusion tensor MRI (DTI). Both tractography-guided ROI analysis and voxel-wise whole brain analysis showed a significant decline of fractional anisotropy (FA) over time in the right corticospinal tract (CST). Furthermore, the FA decline was significant in the localized (mild) subgroup of ALS but not the generalized (severe) subgroup. These preliminary results suggest that longitudinal DTI measurements capture clinical progression of ALS.

14:00 ***4347***. **Correlation of Quantitative Diffusion Tensor Tractography with Clinical Grades of Subacute Sclerosing Panencephalitis**

Richa Trivedi[1], H Anuradha[2], Atul Agarwal[2], Ram KS Rathore[3], Kashi N. Prasad[4], Rajendra P. Tripathi[1], Rakesh Kumar Gupta[5]
[1]NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences, Delhi, India; [2]Neurology, Chhatrapati Shahuji Maharaj Medical University, Lucknow, Uttar Pradesh, India; [3]Mathematics and Statistics, Indian Institute of Technology, , Kanpur, Uttar Pradesh, India; [4]Microbiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [5]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Diffusion tensor tractography using FACT algorithm was performed on 20 children with different grades of subacute sclerosing panencephalitis (SSPE) to look for probable correlation between tract-specific DTI metrics in major white matter pathways and Jabbour classification based clinical grades. A significant inverse correlation was observed between fractional anisotropy (FA) in major white matter tracts and clinical grades. We conclude that FA is a better measure than conventional MRI for the assessment of clinical grade in these patients.

14:30 ***4348***. **Diffusion Tensor Imaging of Optic Neuritis and Its Recovery**

Nourhan Zayed[1], Fiona Costello[2], Michael Smith[3,4], Bradley Goodyear, [23]
[1]Electrical and Computer Engineering , University of Calgary, Calgary, Alberta, Canada; [2]Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada; [3]Electrical and Computer Engineering, University of Calgary, Calgary, Alberta, Canada; [4]Radiology, University of Calgary, Calgary, Alberta, Canada

Appropriate DTI measures to characterize the presence and severity of optic neuritis (ON) as well as its recovery are not established. We hypothesized that the optic nerve experiencing ON may not actually exhibit significantly different FA or ADC from that of the unaffected eye or over the course of recovery. Instead, we predicted that ON is characterized by a greater distribution of FA and ADC, suggesting that acute ON is associated with more heterogeneous diffusion within the optic nerve. Variability of DTI measures, rather than means, may be a more sensitive indicator of the presence of ON and its recovery.

15:00 ***4349***. **Effect of Central Nervous System Involvement in Systemic Lupus Erythematosus Patients : Examination Using Diffusion Parameters and Volumetric Measurement**

Shiou-Ping Lee[1], Jie-Zhi Cheng[2], Wen-Yang Chiang[3], Chung-Ming Chen[2], Kao-Lun Wang[1]
[1]Department of Medical Imaging and Technology, Far Eastern Memorial Hospital, Taipei, Taiwan; [2]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan; [3]Center for Optoelectronic Biomedicine, National Taiwan University Medical College, Taipei, Taiwan

None of systemic lupus erythematosus (SLE) studies examined diffusion tensor imaging (DTI) and volumetric measurement in the same groups. This paper aimed to investigate the effect of central nervous system (CNS) involvement in SLE patients on two diffusion parameters, i.e., fractional anisotropy (FA) and mean diffusivity (MD), and one volumetric measurement, i.e., volume. To accurately define the corpus callosum boundaries, an automatic segmentation algorithm, cell-competition method, was adopted to delineate the boundaries of the corpus callosum on mid-sagittal FA maps to calculate FA, MD and volume of corpus callosum.

Wednesday 13:30-15:30 Computer 78

13:30 ***4350***. **In Vivo Vascular Hallmarks of Diffuse Leukoaraiosis**

Jinsoo Uh[1], Uma Yezhuvath[1], Yamei Cheng[1], Hanzhang Lu[1]
[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

We characterized multiple domains of vascular changes in leukoaraiosis using in vivo MR techniques. Compared to NAWM, CBF in leukoaraiosis regions was 38% lower ($p=0.01$) and CVR was 48% lower ($p=0.005$). Significant BBB leakage was also detected ($p=0.04$). Quantitative analysis revealed that the extent of BBB leakage was positively correlated with apparent diffusion coefficient. In addition, the total area of leukoaraiosis in the brain is correlated with the CVR in NAWM. This study shows that the vascular

changes in leukoaraiosis include both an ischemic and a toxicity component, suggesting a central role of vascular endothelium in the formation of leukoaraiosis.

14:00 ***4351***. **Relation Between Cerebral Small Vessel Disease and Vascular Reactivity - A 7 Tesla Study**

Mandy Conijn[1], Hans Hoogduin, Jeroen Hendrikse, Mirjam Geerlings, Peter Luijten
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands

Lacunar infarcts and white matter lesions are thought to be caused by changes in the small vessels of the brain. It is possible that these changes influence the vascular reactivity in the brain. This study assessed if the presence of lacunar infarcts or white matter lesions is associated with a reduction of vascular reactivity, measured through the BOLD response at 7T. Both the whole brain signal change and the percentage of activated voxels were significantly decreased in patients with lacunar infarcts, but both measures were not related to white matter lesions.

14:30 ***4352***. **Characteristics of White Matter Hyperintensities in MR Images of Cerebral Amyloid Angiopathy**

Junya Konishi[1,2], Julien Milles[2], Jeroen van der Grond[2], Mark A. van Buchem[2]
[1]Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan; [2]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands

MRI manifestations of cerebral amyloid angiopathy (CAA) are white matter hyperintensities (WMH) and cerebral micobleeds (CMB), and the characteristics of CAA-related WMH have not been studied before. The purpose of this study was to study the volume and distribution of CAA-related WMH using an automated method for probability maps and voxelwise statistical maps of WMH on MRI. Our study demonstrated that CMB are associated with WMH, and increased numbers are associated with increased volumes of WMH. Also we found evidence for differences in distribution of WMH associated with CAA-type CMB as compared to other types of CMB.

15:00 ***4353***. **Asymmetric Dilatation of Virchow-Robin Space in Unilateral Internal Carotid Artery Stenosis**

Tae-Sub Chung[1], Ah Young Park[1], Sang Huyn Suh[1]
[1]Diagnostic Radiology, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, Republic of

Problem: To test the hypothesis that chronic ischemia followed by white matter atrophy is associated with Virchow-Robin spaces (VRSs) dilatation by determining the relationship between unilateral internal carotid artery (ICA) stenosis and asymmetric dilatation of VRSs on the same side. Methods: We retrospectively reviewed axial T2-weighted and diffusion weighted MR images (GE Signa Excita 3-T) of 46 patients with severe unilateral ICA stenosis (>70%), diagnosed by carotid contrast MRA and carotid digital subtraction angiography (DSA) between Feb. 2007 and Sep. 2009. Hyperintense lesions in the pre- and post-central gyri and corona radiata along CST pathway in the high convexity white matter on T2WI were included as VRSs. All lesions were graded into score 0 (None), score 1 (linear hyperintensity not extending to the corona radiata), score 2 (linear hyperintensity extending to the corona radiata) and score 3 (round or oval hyperintensity larger than 2mm). We statistically analyzed the difference of VRSs score between bilateral hemispheres, the correlation between VRSs socre and severity of ICA stenosis, the correlation between VRSs score and age, and the difference of ipsilateral VRSs scores according to existence of infarction. Results: The VRSs on the ipsilateral and contralateral sides showed statistical difference ($p<0.01$). The relationship between the patient's age and VRSs score showed positive correlation($p<0.01$) There was no significant correlation between VRSs score and ICA stenosis severity. The ipsilateral VRS scores were significantly higher in the cases with infarction than without infarction($p<0.05$).Conclusion: Our results suggest that chronic ischemic process and subsequent white matter degeneration and atrophy is a factor of VRSs dilatation. Therefore, if we detect the unusual VRSs dilatation on brain MR, it is worth considering the possibility of ischemic condition and necessity of further workup.

Thursday 13:30-15:30 Computer 78

13:30 ***4354***. **Correlations of Brain 1H-MRS, DTI, and Post-Mortem Findings in Patients with Mitochondrial Neurogastrointestinal Encephalomyopathy (MNGIE).**

Caterina Tonon[1], David Neil Manners[1], Claudia Testa[1], Emil Malucelli[1], Piero Parchi[2], Rita Rinaldi[3], Roberto De Giorgio[4], Carlo Casali[5], Michio Hirano[6], Giuseppe Plazzi[2], Valerio Carelli[2], Bruno Barbiroli[1], Raffaele Lodi[1]
[1]MR Spectroscopy Unit, Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Italy, Italy; [2]Department of Neurological Sciences, University of Bologna; [3]Neurology Unit, Policlinico S. Orsola-Malpighi, Bologna; [4]Department of internal Medicine and Gastroenterology, Policlinico S. Orsola-Malpighi, Bologna; [5]Department of Neurology, University la Sapienza, Roma; [6]Department of Neurology, College of Physicians and Surgeons, Columbia University,, New York City, NY

The aim of this study was to clarify the pathophysiology of leucoencephalopathy in five patients with Mitochondrial NeuroGastroIntestinal Encephalomyopathy, a rare disorder caused by loss of function mutations in the gene encoding tymidine phosphorylase. The reduction of all 1H-MRS metabolites detected in the white matter (WM) can be explained by a dilution effect due to increased brain water content demonstrated by the increased of WM mean diffusivity (MD). On the basis of the negative correlation between WM MD values and WM [NAA], we hypothesize that the brain damage in MNGIE is compartmentalised and mediated by the impairment of the osmoregulation where also NAA has been implicated.

14:00 **4355. In Vivo Quantitative Imaging and Postmortem Protein Analysis Reveal CNS Hypomyelination in the Restless Legs Syndrome**

Byeong-Yeul Lee[1], Padmavathi Ponnuru[2], James R. Connor[2], Qing X. Yang, [1,3]
[1]Bioengineering, Penn State Hershye Medical Center, Hershey, PA, United States; [2]Neurosurgery, Penn State Hershye Medical Center, Hershey, PA, United States; [3]Radiology, Penn State Hershye Medical Center, Hershey, PA, United States

Iron deficiency has been known as a contributing factor for restless legs syndrome (RLS), resulting in the disruption of iron availability in the brain. In this study, we investigated the ex vivo myelin analysis in RLS autopsy brain tissue and imaging-based analysis using voxel-based morphometry (VBM). Our data showed that a decrease in expression of myelin-specific protein and decrease in the white matter volume in RLS brain. These results support our hypothesis that global iron deficiency may cause reduction of myelin (hypomyelination), which in turn leads to structural change of white matter in RLS.

14:30 **4356. Multimodality Study for Restless Legs Syndrome Revealed Local Morphological Changes Associated with T2: Hypomyelination or Iron Deficiency?**

Byeong-Yeul Lee[1], James R. Connor[2], Qing X. Yang, [1,3]
[1]Bioengineering, Penn State Hershye Medical Center, Hershey, PA, United States; [2]Neurosurgery, Penn State Hershye Medical Center, Hershey, PA, United States; [3]Radiology, Penn State Hershye Medical Center, Hershey, PA, United States

Restless leg syndrome (RLS) is a sensory-motor disorder characterized by uncontrollable urges to move the legs, causing chronic sleep disturbances. Brain iron deficiency has been considered as an important contributing factor to RLS. In this study, we applied voxel-based relaxometry (VBR) for in vivo iron measurement and voxel-based morphometry (VBM) for morphological study respectively to a same study cohort, aiming to determine the impact of iron deficiency on brain morphology. Our results revealed a striking association of local T2 change with brain atrophy.

15:00 **4357. 7T MRI Demonstrates Diffuse Iron Deposition in the Putamen and Caudate Nucleus in CADASIL**

Michael K. Liem[1], Saskia A.J. Lesnik Oberstein[2], Maarten J. Versluis[1], Marion L.C. Maat-Schieman[3], Joost Haan[3], Andrew G. Webb[1], Michel D. Ferrari[3], Mark A. van Buchem[1], Jeroen van der Grond[1]
[1]Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Clinical Genetics, Leiden University Medical Center, Leiden, Netherlands; [3]Neurology, Leiden University Medical Center, Leiden, Netherlands

In this study we quantified focal and diffuse iron deposition in cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL), using in-vivo and ex-vivo 7 Tesla MRI. Twenty-five CADASIL patients and 15 healthy controls were examined using high resolution susceptibility-weighted imaging on 7 Tesla MRI. Three ex-vivo CADASIL brain specimens were scanned with extra high resolution. Focal areas of signal loss were found in 36% of CADASIL patients, in a pattern consistent with microbleeds. Diffuse areas of signal loss were found in the putamen and caudate nucleus of CADASIL patients, in a pattern consistent with increased iron accumulation.

Advanced MRI in the Ageing Brain & Related Psychiatric Diseases

Hall B Monday 14:00-16:00 Computer 79

14:00 **4358. Evidence for Brain White Matter Damage and Atrophy with Aging: A Diffusion Tensor MRI Tractography Study**

Federica Agosta[1], Stefania Sala[1], Elisabetta Pagani[1], Domenico Caputo[2], Massimo Filippi[1]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Department of Neurology, Scientific Institute Fondazione Don Gnocchi, Milan, Italy

Linear and quadratic age-related WM tract microstructural and volumetric changes were evaluated in 84 healthy volunteers. Age-related MD increase and FA decrease were associated with region-specific patterns of radial diffusivity increase and both decrease and increase in axial diffusivity. The quadratic model better fitted DT-MRI changes in several WM tracts. A negative correlation was found between age and left cingulum and fornix volumes. The quadratic model better fitted volume decline in corpus callosum and right inferior-fronto-occipital fasciculus. WM integrity loss and atrophy varies with age by WM tract and may reflect different degrees of severity of changes in WM properties.

14:30 **4359. Large-Scale ADC Histogram Analysis of the Brain Aging: Normal Versus Abnormal (667 Subjects, 2 Days-93.8 Years)**

Memi Watanabe[1], Noreen Ward[1], Al Ozonoff[2], Steven Kussman[1], Koji Tanabe[1], Kaan Erbay[1], Naoko Saito[1], Hernan Jara[1,3], Osamu Sakai[1]

[1]Department of Radiology, Boston Medical Center, Boston University School of Medicine, Boston, MA, United States; [2]Department of Biostatistics, Boston University School of Public Health, Boston, MA, United States; [3]Department of Biomedical Engineering, Boston University, Boston, MA, United States

Purpose: To study age dependencies of ADC histogram and impact of brain abnormalities on ADC in a large and wide age ranged population. Methods: Brain data of 667 subjects (2 days-93.8 years) were obtained by DW-SE-sshEPI and ADC histograms of the whole brain were generated. The subjects were divided into normal and abnormal groups by MR findings and clinical histories. Results: The abnormal group showed higher ADC peak values compared with the normal. Conclusion: The aging patterns of ADC peak values of normal and abnormal brain groups have been demonstrated in a large and wide age ranged population.

15:00 **4360. Cortical Thickness Is Linked to Executive Functioning in Adulthood and Aging.**

Agnieszka Z. Burzynska[1], Irene E. Nagel[1], Claudia Preuschhof[1], Sebastian Gluth[1], Lars Bäckmann[1,2], Shu-Chen Li[1], Ulman Lindenberger[1], Hauke R. Heekeren[1,3]

[1]Max Planck Institute for Human Development, Berlin, Germany; [2]Aging Research Center, Karolinska Institutet, Stockholm, Sweden; [3]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

We investigated the cortical structural underpinnings of executive functioning in 129 healthy adults (73 younger, 20-32 years; 56 older, 60-71 years). We measured executive functions by Wisconsin Card Sorting Test (WCST) and cortical thickness by applying surface-based segmentation (Freesurfer). The structural underpinnings of WCST largely overlapped with previously defined WCST functional patterns and the structure-performance relationship was stronger in later than in earlier adulthood. Our data suggest that the extent of structural preservation in old age differentiates between high and low performers, underscoring the need of taking performance level into account when studying changes in brain structure across adulthood.

15:30 **4361. Assessing the Corticospinal Tract with Multimodal Quantitative MRI**

Pierre-Yves Herve[1], Eleanor F. Cox[2], Ashley Loftipour[2], Olivier Mougin[2], Sam Wharton[2], Richard W. Bowtell[2], Tomas Paus[1], Penny A. Gowland[2]

[1]Brain & Body Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]SPMMRC, Physics & Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

The study of human white matter fibre pathways was first performed on post-mortem material, notably via dissection or with the Weigert staining method for myelinated fibres (Dejerine, 1895). More recently, diffusion weighted imaging emerged as a non-invasive alternative for both the tracing and the measurement of quantitative parameters of fibre pathways. Here we use multimodal quantitative imaging to assess differences between white matter structures.

Tuesday 13:30-15:30 Computer 79

13:30 **4362. Mineralization of the Globus Pallidus as a Function of Age: Are There Major Differences Between Caucasians and Chinese?**

jiangtao liu[1], E Mark Haccke[2], Kuncheng li[1], Manju liu[2], Ana M. Daugherty[3], Ambreen Sattar[4], bo wu[2]

[1]Radiology, Xuanwu hospital, Beijing, China; [2]MRI Institute for Biomedical research, Wayne State University, Detroit, MI, United States; [3]Behavioral and Cognitive Neuroscience, Wayne State University, Detroit, MI, United States; [4]Diagnostic Radiology, Wayne State University, Detroit, MI, United States

SWI images for 37 age and gender matched healthy paired subjects (Chinese versus Caucasians) were retrospectively reviewed. the GP was measured in two adjacent slices. Two cutoffs were used and the percentage cutoff pixels between two groups was compared. Mineralization increases with age in the GP whether measured with phase or magnitude. For the right globus pallidus, healthy Chinese subjects have a higher percentage of mineralization at any age group while for the left side it tends to grow after age 40. SWI offers the potential to examine differences in disease that might correlate with mineralization.

14:00 **4363. Measuring T2 at Ultra High Field: Effects of Age and Sex**

Eleanor F. Cox[1], Susan E. Pritchard[1], Peter J. Wright[1], Tomas Paus[2], Penny A. Gowland[1]

[1]SPMMRC, Physics & Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Brain & Body Centre, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom

This study has examined the effects of age (40-75 years) and sex on the T2 of the human brain at 7.0 T. The results show that there is considerable variation in T2s across grey and white matter regions, and a trend for women to have longer WM T2s than men. The white matter T2s of men changed with age but the T2s of women did not.

14:30 **_4364_. Measurement of Iron Concentration in Human Brain Using Quantitative Susceptibility Mapping (QSM): Correlation with Age**

Tian Liu[1,2], Jing Liu[2], Ludovic de Rochefort[3], James Ledoux[2], Qing Zhang[4], Martin R. Prince[2], Jianlin Wu[4], Yi Wang[1]

[1]Biomedical Engineering, Cornell University, New York, NY, United States; [2]Radiology, Weill Cornell Medical College, New York, NY, United States; [3]MIRCen, I2BM, DSV, CEA, Fontenay-aux-Roses, France; [4]Radiology, The 1st Hospital of Dalian Medical University, Dalian, Liaoning, China

Increasing iron deposition with increasing age has been confirmed in postmortem studies and observed in in vivo MRI. In this 100 volunteer study, we specifically measured susceptibility in putamen, and converted it to Fe^{3+} concentration. A strong linear correlation was obtained between susceptibility and age. The iron concentration agreed well with postmortem results.

15:00 **_4365_. Improved Inter-Subject Functional Registration Using DARTEL in Individuals Prenatally Exposed to Alcohol**

Priya Santhanam[1], Zhihao Li[1], Claire Coles[2], Mary Ellen Lynch[2], Xiaoping Hu[1]

[1]Department of Biomedical Engineering, Georgia Institute of Technology/Emory University, Atlanta, GA, United States; [2]Department of Psychiatry and Behavioral Sciences, Emory University

On account of multifaceted structural damage induced by prenatal alcohol exposure (PAE), MR image registration problems have been a roadblock in the detailed analysis of images from this population. The present study examines the applicability of DARTEL (diffeomorphic anatomical registration through exponentiated lie algebra) to functional image registration in the PAE population. As compared to Talairach transformation, functional image registration by DARTEL had more group difference clusters in expected regions, and significant correlation between intensity over one difference cluster and known exposure-related measures. Results imply DARTEL may be a more accurate method for functional image registration for the PAE population.

Wednesday 13:30-15:30 Computer 79

13:30 **_4366_. Do Differences in Myelin Underlie the The Schizotypal Personality Spectrum?**

Katrina McMullen[1], Shannon Kolind[1,2], Emma Barkus[3], Sean CL Deoni[1]

[1]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, England, United Kingdom; [2]Centre for Functional Magnetic Resonance Imaging of the Brain, Oxford University, Oxford, England, United Kingdom; [3]Department of Psychiatry, University of Wollongong, NSW, New South Wales, Australia

Alterations in region grey matter volume, white matter structure and brain function are known associates schizophrenia and schizophrenia spectrum disorders. However, the underlying etiology of these disorders, believed to represent a spectrum of psychosis proneness, remains unknown. Increasingly, the role of white matter connectivity, mediated by myelin, to these disorders is being questioned. Here we report on a study of myelin content in schizotypy, revealing a linear association between schizotypy score and myelin water fraction, localized to the left hemisphere. These results, consistent with prior fMRI results, are suggestive of altered white matter efficiency and processing ability in high schizotypes.

14:00 **_4367_. Clinical 1H MRS Studies of Glutamatergic Neurotransmission in Bipolar Disorder**

Wen-Jang Chu[1,2], Mathew Norris[3], Renu Kotwal, Caleb M. Adler, Mi-Jung Kim, Rachel Whitsel, Jing-Huei Lee, [23], Melissa P. DelBello, Stephen M. Strakowski, [2]

[1]Psychiatry, Univ. of Cincinnati, Cincinnati, OH, United States; [2]Center for Imaging Research, Univ. of Cincinnati, Cincinnati, OH, United States; [3]Biomedical Engineering, Univ. of Cincinnati

Glutamate (Glu) has been found play an important role in Bipolar Disorder (BD). The accurate measurement of Glu has been hurdled by the large signals overlapping and broadening baseline. Instead of reporting Glu levels, the Glx (sum of glutamate, glutamine and GABA) has been widely used in glutamatergic neurotransmission research. In this work, we studied Glu levels using short echo PRESS spectroscopy, and TE-averaged spectroscopy in medication-free, lithium-treated BD patients and healthy volunteers. The results have allowed us to evaluate the Glu level differences between the two groups, and the effect of lithium treatment on Glu levels.

14:30 **_4368_. Impaired Brain Circuitry and High-Energy Phosphates in Bipolar Disorder**

Wen-Jang Chu[1,2], Amanda Stover[3], Jonathan Dudley[4], David Caldwell[2], Amanda Marie Opaskar[2], Mathew Norris[4], Martine Lamy[2,3], Jane Allendorfer[2,3], Stephen M. Strakowski[1,2], Jing-Huei Lee[2,4], James C. Eliassen[1,2]

[1]Psychiatry, Univ. of Cincinnati, Cincinnati, OH, United States; [2]Center for Imaging Research, Univ. of Cincinnati, Cincinnati, OH, United States; [3]Graduate Program in Neuroscience, Univ. of Cincinnati; [4]Biomedical Engineering, Univ. of Cincinnati

The combined approach of fMRI and 31P spectroscopy is used to investigate 1) abnormal brain activation, and 2) the correlation between high-energy phosphates and abnormal activation in the brains of patients with bipolar disorder. A behavioral task, the Balloon Analogue Risk Task, was used during fMRI to identify brain regions that differed between bipolar and healthy subjects. Several regions within anterior limbic network such as amygdala, ventrolateral prefrontal cortex and orbitofrontal cortex were identified by fMRI activation differences. 31P MRSI data showed significant alterations of Pi, PDE and PCr in some of these regions.

15:00 **4369. Brain Morphometry Correlates of Pharmacoresistancy in Schizophrenia**

Mario Quarantelli[1], Olga Palladino[2], Anna Prinster[1,3], Vittorio Schiavone[2], Barbara Carotenuto[4], Arturo Brunetti[4], Gianluca Ventrella[2], Angela Marsili[1], Andrea De Bartolomeis[2], Marco Salvatore[4]

[1]Biostructure and Bioimaging Institute, National Research Council, Naples, Italy; [2]Institute of Psychiatry, University "Federico II", Naples, Italy; [3] "S.D.N." Foundation, Naples, Italy; [4]Department of Biomorphological and Functional Sciences, University "Federico II", Naples, Italy

We assessed structural cerebral differences between 16 normal volunteers (NV), 16 Responder (R-SC), and 19 Non-Responder (NR-SC) schizophrenia patients. Segmented T1-weighted volumes were analyzed voxel-wise to assess local differences in gray matter volume between the three groups, using permutation tests implemented in the CamBA software. Main clusters of significant GM differences among the three groups emerged in bilateral frontal cortices, right insula and right medial temporal lobe, differences being mainly due to reduced GM volumes in NR-SC, as compared to both NV and R-SC, suggesting that differences between NV an SC may be mainly driven by NR-SC patients.

Thursday 13:30-15:30 Computer 79

13:30 **4370. Increased Anterior Cingulate GABA Level Following Electroconvulsive Therapy in Patients with Major Depressive Episodes**

Pallab Bhattacharyya[1], Erik Beall[1], Mark Lowe[1], Micheal Phillips[1], David Muzina[1]

[1]Cleveland Clinic, Cleveland, OH, United States

Gamma amino butyric acid (GABA) level in anterior cingulate is known to be reduced in depression patients. Electroconvulsive therapy (ECT) is a commonly used treatment for major depressive episodes (MDE). Using ^{1}H spectroscopy we have measured anterior cingulate GABA level 2 weeks before and 1-2 weeks after ECT treatment in MDE patients. Our preliminary data show an increase in anterior cingulate GABA level following ECT in MDE patients.

14:00 **4371. Cingulate Cortex Functional Connectivity Increase Predicts Relapse of Major Depression.**

Naranjargal Dashdorj[1], Neil L. Nixon[2], G Worwood[2], M Liotti[2], E Georgiadi[2], D P. Auer[1], P F. Liddle[2]

[1]Academic Radiology, University of Nottingham, Nottingham, United Kingdom; [2]Division of Psychiatry, University of Nottingham, Nottingham, United Kingdom

Functional imaging studies suggest alterations in cortico-limbic circuit connectivity in depression. Moreover, these functional connectivity (fc) changes were found to correlate with symptom severity and normalised upon antidepressant treatment. The direction of these fc changes is however debated with one group showing increased default network connectivity and another showing decreased cortico-limbic connectivity. Nonetheless, more studies implicate cingulate gyrus as a focus of dysfunction. In this study, we compared fc of the rostral anterior cingulate between patients with history of remitted recurrent depression and healthy controls.

14:30 **4372. Regional Gray Matter Changes in Major Depressive Disorder: An Optimized Voxel-Based Morphometry Study**

Zhiyun Jia[1], Tijiang Zhang[1], Qizhu Wu[1], Junran Zhang[1], Su Lu[1], Xiaoqi Huang[1], Weihong Kuang[2], Qiyong Gong[1]

[1]Huaxi MR Research Center (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, Sichuan province, China; [2]Department of Psychiatry, West China Hospital of Sichuan University

High resolution 3-dimensional T1-weighted (T1W) images were acquired using a 3.0T MR scanner in fifty two patients experiencing major depression (MDD) and fifty two normal controls. Using voxel based morphometry (VBM), we demonstrated that MDD patients have higher volume and density of grey matter in multiple brain areas than controls, especially in bilateral thalamus. This is consistent with a previous postmortem study which demonstrated increased neuronal number in the thalamus of patients with depression relative to the nonpsychiatric comparison subjects. Further study should reveal this change in thalamus using multiple methods.

15:00 **4373. Thickness Profile Generation for the Corpus Callosum Using Laplace's Equation**

Christopher Leslie Adamson[1], Amanda Wood[1,2], Jian Chen[1], Sarah Barton[1], David Reutens[3], Mark Walterfang[4,5]

[1]Developmental and Functional Brain Imaging, Murdoch Childrens Research Institute, Melbourne, VIC, Australia; [2]Department of Medicine, Southern Clinical School, Monash University, Melbourne, VIC, Australia; [3]Centre for Advanced Imaging, University of Queensland, Brisbane, QLD, Australia; [4]Neuropsychiatry Unit, Royal Melbourne Hospital, Melbourne, VIC, Australia; [5]Melbourne Neuropsychiatry Centre, University of Melbourne, Melbourne, VIC, Australia

We present a method to generate thickness profiles of the corpus callosum from midsagittal slices of MR images. The method is mostly automated, robust and computationally efficient. We utilise the method to reveal morphological changes of the corpus callosum at different stages of schizophrenia.

Developing Brain I

Hall B Monday 14:00-16:00 Computer 80

14:00 ***4374*.** **Static and Dynamic Characteristics of Resting State CBF in Newborn Infants**

Feng Liu[1,2], Zhishun Wang[1,2], Yunsuo Duan[1,2], Fernando Zelaya[3], David J. Lythgoe[3], Alayar Kangarlu[1,2], Bradley S. Peterson[1,2]

[1]Psychiatry, Columbia University, New York, NY, United States; [2]New York State Psychiatric Institute, New York, NY, United States; [3]Institute of Psychiatry, King's College London, University of London, London, United Kingdom

Resting-state networks in the infant brain have been studied recently using BOLD fMRI in order to better understand the early developmental phase of default mode network. Perfusion MRI with arterial spin labeling (ASL) has been implemented to study resting-state functional connectivity in the adult brain. We applied pulsed ASL on unsedated, sleeping newborns, and studied the static and dynamic characteristics of cerebral blood flow (CBF) with a method using high-pass filtering and demodulation. We demonstrated the ability to detect the functional connectivity using the CBF fluctuation extracted from ASL signals during the resting state of newborns.

14:30 ***4375*.** **The Dynamics of Brain and CSF Growth in Normal Versus Hydrocephalic Development in a Mouse Model**

Jason Gregory Mandell[1,2], Thomas Neuberger[3], Corina S. Drapaca[1], Andrew G. Webb[4], Steven J. Schiff[1,5]

[1]Center for Neural Engineering, Department of Engineering Science and Mechanics, Pennsylvania State University, University Park, PA, United States; [2]Department of Bioengineering, Pennsylvania State University, University Park, PA, United States; [3]Huck Institutes of the Life Sciences, Pennsylvania State University, University Park, PA, United States; [4]C.J. Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands; [5]Departments of Neurosurgery and Physics, Pennsylvania State University, University Park, PA, United States

Hydrocephalus has traditionally been quantified by linear measurements of ventricle size. However, clinical outcome is related to brain cognitive function, which is more directly related to brain volume. We quantified brain and ventricular volume growth in normal versus kaolin-induced hydrocephalic development in mice from ages 2-12 weeks using 14T MRI. Hydrocephalic mice responded with brain growth either consistent with or faster than normal, correlating to the absence or presence of parenchymal edema. Clinical measurements were unable to discriminate between these patterns, demonstrating the clinical importance of brain volume measurements and the feasibility of constructing normative brain and fluid growth curves.

15:00 ***4376*.** **CSF and Cerebral Blood Flows in Paediatric: Evaluation with Phase Contrast MRI**

Olivier Balédent[1], Véronique Courtois[2], Béatrice Krepjowicz[2], Julie Schauvliege[3], Anthony Fichten[4], Guy Kongolo[5], Roger Bouzerar[1], Catherine Gondry-Jouet[3]

[1]image processing, university hospital, Amiens, Picardie, France, Metropolitan; [2]Ecole supérieure d'ostéopathie et de biomécanique, Paris; [3]radiology, university hospital, Amiens, Picardie, France, Metropolitan; [4]image processing, neurosurgery, Amiens, Picardie, France, Metropolitan; [5]pediatry, university hospital, Amiens, Picardie, France, Metropolitan

The purpose of this study is to quantify with PC-MRI, CSF and cerebral vascular flows maturation in paediatric population and demonstrate how altered flows in children with hydrocephalus can be pointed. 36 children (5days-8years) were defined as a paediatric control group. 6 newborns (9days-6weeks) with ventricular dilation associated to intra ventricular haemorrhage (IVH) were individually studied. Arterial, venous, cervical CSF and aqueductal CSF flows were presented function of age. The 6 IVH newborn presented alterations of their cerebral flows. Quantitative assessments of CSF and blood flows indicate the potential usefulness of PC-MRI in paediatric hydrocephalus.

15:30 ***4377*.** **Direct Phase Imaging in Neonate**

Kai Zhong[1], Lynn Anderson[2], Linda Chang[2], Thomas Ernst[2], Oliver Speck[1]

[1]Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Saxon-Anhalt, Germany; [2]Department of Medicine, University of Hawaii, Honolulu, HI, United States

Direct phase images have been shown to yield superior gray (GM) and white matter (WM) contrast at high field compared to conventional magnitude images. However, the contrast mechanisms are still being discussed. Previous studies are limited to high field and adult volunteers or patients. In this study, phase imaging in neonates is demonstrated for the first time and provides insights to the various factors contributing to phase contrast, such as water macromolecule exchange (WME) and myelination. Phase differences between GM and WM are significantly reduced in neonates prior to myelination and seem to originate primarily from WME contrast. Therefore, direct phase imaging can study brain development and related pathologies in neonates.

Tuesday 13:30-15:30 Computer 80

13:30 ***4378*. Evolving Modular Structures During Early Functional Brain Development**

Wei Gao[1], Hongtu Zhu[2], John Gilmore[3], Weili Lin[4]
[1]Biomedical Engineering, UNC-Chapel Hill, Chapel Hill, NC, United States; [2]Biostatistics and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill; [3]Psychiatry, University of North Carolina-Chapel Hill; [4]Radiology and Biomedical Research Imaging Center, University of North Carolina-Chapel Hill

The integrated action between functionally connected yet spatially distributed regions to form different ¡°modules¡± is central to normal brain function. Numerous studies have been performed to detect possible brain modules supporting specific functions including sensory processing and the higher level cognition in adults. However, the formation of modular structures is likely to be substantially influenced by both structural maturation and learning, particularly during the early stage of brain development. In this study, healthy pediatric subjects 2 wks to 2 yrs of age were recruited and modularity analysis was performed to discern whole brain functional networks so as to delineate the emerging and developing trajectory of brain modular structures in a critical time period of early brain development.

14:00 ***4379*. Diffuse Microstructural Abnormalitites in Non-Cystic Focal White Matter Necrosis**

Arabhi C. Nagasunder[1], Lisa Paquette[2], Caroline Jane Tavare[3], Tena Rosser[4], Floyd H. Gilles[3], Marvin D. Nelson[1], Stefan Bluml[1,5], Ashok Panigrahy[1,6]
[1]Department of Radiology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [2]Division of Neonatology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [3]Department of Neuropathology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [4]Division of Neurology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [5]Rudi Schulte Research Institute, Santa Barbara, CA, United States; [6]Department of Radiology, Childrens Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States

Neonatal brain is highly vulnerable to injury resulting in subsequent cognitive and motor disabilities. Our goal was to show that there are microstructural abnormalities in regions of the brain separate from the focal necroses in non-cystic periventricular leukomalacia. A diverse cohort of neonates was scanned at term equivalent age using DTI. We found that there is microstructural injury in white matter regions both proximal and distant from necrotic foci.

14:30 ***4380*. Snapshot Inversion Recovery (SNAPIR): A Robust, Optimised T1-Weighted Fetal Brain MRI Protocol for Improved Anatomy Delineation**

Christina Malamateniou[1], Amy McGuinness[1], Prachi Patkee[1], Joanna M. Allsop[1], Mary A. Rutherford[1], Jo V. Hajnal[1]
[1]Imaging Sciences Department, MRC Clinical Sciences Centre, Imperial College London, Hammersmith Hospital, London, United Kingdom

Image quality of standard gradient echo T1-weighted fetal brain MRI acquisitions is poor because of artefacts relating to fetal and maternal motion. The Snapshot Inversion Recovery (SNAPIR) sequence, an optimised T1-weighted protocol using single shot techniques, offers a potential robust alternative to standard T1-weighted methods. Qualitative analysis showed that significantly increased visualisation of the fetal brain anatomy was achieved with SNAPIR in 24 out of 32 anatomical structures studied, compared to the reference protocol. Additionally, quantitative analysis showed that SNAPIR presented with significantly increased contrast ratios between grey and white matter in the upper ($p=0.01$) and lower cerebrum ($p=0.0001$).

15:00 ***4381*. Construction of a Dynamic 4D Probabilistic Atlas for the Developing Brain**

Maria Murgasova[1], Latha Srinivasan[2], Ioannis S. Gousias[2], Paul Aljabar[1], Joseph V. Hajnal[2], A David Edwards[2], Daniel Rueckert[1]
[1]Computing, Imperial College London, London, United Kingdom; [2]Imaging Sciences, Imperial College London

Probabilistic atlases have been established in the literature as a standard tool for enhancing the intensity-based classification of brain MRI. The rapidly growing neonatal brain requires an age-specific spatial probabilistic atlas to guide the segmentation process. In this paper we describe a method for dynamically creating a probabilistic atlas for any chosen stage of neonatal brain development. We present an atlas created from the segmentations of 153 subjects providing prior tissue probability maps for six structures - cortex, white matter, subcortical gray matter, brainstem and cerebellum, for ages of 29 to 44 weeks of gestation.

Wednesday 13:30-15:30 Computer 80

13:30 ***4382*. Early Neonatal Brain Development: Correlation Between DTI and MRS**

Lynn Michelle Anderson[1], Linda Chang[1], Steven Buchthal[1], Brian Keating[1], Christine Cloak[1], Thomas Ernst[1]
[1]Department of Medicine, John A. Burns School of Medicine, University of Hawaii at Manoa, Honolulu, Hi, United States

Normal infant brain development was evaluated using both DTI and MRS. Apparent diffusion (ADC) and fractional anisotropy (FA) were correlated to brain metabolites within the same MRS voxel in 5 brain regions. With increasing postconceptional age, increases in FA and decreases in ADC were associated with increases in NA, in the frontal white matter, which reflect more coherent fiber organization and axonal growth. Similar age-related changes in DTI measures in the CST were associated with decreased MI which

suggests myelination or a reduction in radial glia. Decreased tCr and CHO in the FGM combined with decreased ADC suggest cellular pruning.

14:00 *4383*. **More Than Meets the Eye: Age and Pathology-Related MTR Changes in Very Preterm Brains**

Andrew David Chung[1], Revital Nossin-Manor[1,2], Hilary E. A. Whyte[2,3], Margot J. Taylor[1,2], Manohar M. Shroff[1], John G. Sled[4,5]
[1]Diagnostic Imaging, Hospital for Sick Children, Toronto, ON, Canada; [2]Neurosciences & Mental Health, Research Institute, Hospital for Sick Children, Toronto, ON, Canada; [3]Neonatology, Hospital for Sick Children, Toronto, ON, Canada; [4]Physiology Experimental Medicine, Research Institute, Hospital for Sick Children, Toronto, ON, Canada; [5]Medical Biophysics, University of Toronto, Toronto, ON, Canada

Our study compared MTR values of the basal ganglia (BG), thalami, and pons in the very preterm (<32 weeks GA) brain. Forty-four infants were separated into four groups based on radiological findings on conventional MR scans: normal, WM-injury, Grade I GMH + WM-injury, Grade II GMH + WM-injury. MTR increased with GA in both the BG and thalami in the normal and WM-injury groups. This relation was not seen in the pons in any of the groups. In the BG, the normal group demonstrated consistently higher MTR values than the WM-injury group, indicating GM effects not detected on conventional MRI.

14:30 *4384*. **Investigating the Relationships Between T1 and T2 Relaxation Times and Myelin Water Fraction During Neurodevelopment**

Sean CL Deoni[1], Evelyne Mercure[2,3], Anna Blasi[2,3], David Gasston[2], Mark Johnson[3], Steven CR Williams[2], Declan G. Murphy[4]
[1]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, United Kingdom; [2]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, England, United Kingdom; [3]Centre for Brain and Cognitive Development, Birkbeck University, London, England, United Kingdom; [4]Department of Psychological Medicine, Institute of Psychiatry, London, England, United Kingdom

T1 and T2 are commonly cited as reflecting myelin content and used as surrogate markers. However, the relationships between myelin content changes and changes in these relaxation parameters have not yet been established. In this study, we investigated the relationship between brain T1, T2 and myelin water fraction (MWF) during the developmental period from 3 through 8 months of age in healthy infants. We demonstrate that while T1 is generally correlated with MWF, T2 is a poor predictor of myelin content. Results of this study suggest care should be taken in using relaxation parameters to infer alterations in myelin content.

15:00 *4385*. **Altered Small-World Properties in Newborns at High Risk for Schizophrenia**

Feng Shi[1], Yong Fan[1], Pew-Thian Yap[1], Weili Lin[1], John Gilmore[2], Dinggang Shen[1]
[1]Department of Radiology and BRIC, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States; [2]Department of Psychiatry, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

We evaluated the brain structural networks on three groups of subjects, as high risk newborns of schizophrenic parents, healthy newborns, and healthy adults. All three groups showed small-world network properties. From healthy newborns to healthy adults as brain develops, global efficiency is increased while local efficiency is decreased, with reduced regularity and enhanced randomness. This suggests that brain networks develop from a ‘‘local to distributed’’ organization. However, high risk newborns showed a more localized pattern and lack global integration compared with healthy newborns. This indicates that a delay might have occurred during brain development of the high risk group.

Thursday 13:30-15:30 Computer 80

13:30 *4386*. **Age Norms for Diffusion Tensor Data - Evaluation with TBSS**

Nancy Rollins[1,2], Paul Glasier[3], Leanne Tamm[4], Linda Butwell, Jonathan Chia[5], Michael Morriss, Zhiyue Jerry Wang
[1]Radiology, Childrens Medical Center, Dallas, TX, United States; [2]University Texas Southwestern Medical Center, Dallas, TX, United States; [3]Psychiatry, paul.glasier@childrens.com, Dallas, TX, United States; [4]Psychiatry, University Texas Southwestern Medical Center; [5]Philips HealthCare Systems

Using TBSS, variable age effects on tensor metrics are seen across the brain in school-aged children suggesting valid comparisons of FA and diffusivities between typically developing children and children with neuro developmental or psychiatric conditions probably require age-matched cohorts unless the affects of the disease are known to be large in comparison to the scale of age effects.

14:00 *4387*. **Exploring Developmental Structural Connectivity Patterns by in Vivo Diffusion Tensor Imaging Tractography on Longitudinal Pediatric Data**

Pew-Thian Yap[1], Yong Fan[1], Yasheng Chen[1], John H. Gilmore[2], Weili Lin[1], Dinggang Shen[1]
[1]Department of Radiology, University of North Carolina, Chapel Hill, NC, United States; [2]Department of Psychiatry, University of North Carolina, Chapel Hill, NC, United States

Our objective is to study pediatric brain networks by applying DTI based fiber tractography on 39 healthy pediatric subjects with longitudinal data collected at the average ages of 2 weeks, 1 year, and 2 years. Our results indicate that the small-world architecture exists at birth, with low global and local efficiencies, and is strengthened in later stages of development. In addition, we found that the node degree distributions of the networks have Gaussian tails, signifying their single-scale nature. We also observe, across

development, that the brain network seems to evolve progressively from a local, predominantly proximity based, connectivity pattern to a more distributed, predominantly functional based, connectivity pattern.

14:30 ***4388***. **Imaging Myelination in Infant Neurodevelopment**

Sean CL Deoni[1], Evelyne Mercure[2,3], Anna Blasi[2,3], David Gasston[1], Alex Thomson[3], Mark Johnson[2], Steven CR Williams[1], Declan GM Murphy[3]

[1]Centre for Neuroimaging Sciences, King's College London, Institute of Psychiatry, London, United Kingdom; [2]Centre for Brain and Cognitive Development, Birkbeck University of London, London, United Kingdom; [3]Department of Psychological Medicine, King's College London, Institute of Psychiatry, London, United Kingdom

We report on the use of multi-component relaxation time measurement (MCR) to investigate myelination during human neurodevelopment. Using the mcDESPOT MCR technique, we present the first ever in vivo visualization of healthy white matter myelination from 3 through 8 months of age. Obtained results faithfully reproduce the spatio-temporal sequence established via post-mortem histological studies.

15:00 ***4389***. **Cortical Development in Children Between 6 and 11 Years**

L. Tugan Muftuler[1], Kevin Michael Head[2], Claudia Buss[2], Orhan Nalcioglu[1], Curt A. Sandman[2], Elysia Poggi Davis[2]

[1]Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Psychiatry & Human Behavior, University of California, Orange, CA, United States

There is evidence that various cognitive and psychiatric disorders might stem from abnormal cerebral development during childhood. Therefore, understanding normal cortical development is important to study these abnormalities. For that purpose, we analyzed high resolution MRI images from 129 normally developing children between ages 6 and 11 years. Cortical development between 6 an 11 years as well as within 2 year windows was investigated. The results demonstrated that the cortical development was expressed in different anatomical locations within each time frame. The findings reveal the cortical development in a much finer spatial and temporal detail than has been previously reported.

Developing Brain II

Hall B Monday 14:00-16:00 Computer 81

14:00 ***4390***. **Evidence of Neuronal Growth Spurts During Development in Healthy Children and Adolescents Using a Multi-Voxel *In Vivo* ^{31}P Spectroscopy at 4 Tesla**

Jeffrey A. Stanley[1], Dalal Khatib[1], Rachel M. Dick[1], Olivia A. McGarragle[1], Frank P. MacMaster[1], Arthur L. Robin[1], David R. Rosenberg[1], Brian Martis[2], Vaibhav A. Diwadkar[1]

[1]Psychiatry and Behavioral Neurosciences, Wayne State University School of Medicine, Detroit, MI, United States; [2]Psychiatry, VA Ann Arbor HCS, University of Michigan, Ann Arbor, MI, United States

The high prevalence of the onset of many psychiatric disorders during childhood and adolescence highlights the importance of understanding the molecular biochemistry of healthy neurodevelopmental trajectories in the maturing brain. *In vivo* ^{31}P spectroscopy is a neuroimaging method that is sensitive in detecting biochemical changes as the brain develops. The purpose of this study is to investigate changes in membrane phospholipid metabolites of healthy children and adolescents to discern developmental growth spurts in cortical and subcortical structures using *in vivo* ^{31}P spectroscopy at a higher magnetic field strength.

14:30 ***4391***. **An MR/CT Compatible Neonatal Incubator**

Martyn Paley[1], Anthony Hart[1], Mark Lait[2], Paul Griffiths[1]

[1]Academic Radiology, University of Sheffield, Sheffield, Yorkshire, United Kingdom; [2]Advanced Health Technology, Hertford, Hertfordshire, United Kingdom

A lightweight MR/CT compatible neonatal incubator has been developed to allow scanning of neonates on whole body MRI systems.

15:00 ***4392*.** **Dti Study in the Infants Brain; Methodolgy and Validation in Infants with Hypoxic-Ischemic-Encephalopathy**

Moran Artzi[1,2], Liat Ben Sira[3], Haim Bassan[4], Varda Gross-Tsur[5,6], Irit Berger[7], Ronella Marom[7], Yael Leitner[4], Maya Weinstein[1,8], Ronny Geva[9], Dafna Ben Bashat[1]
[1]The Wohl Institute for Advanced Imaging, Brain Imaging Center, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [2]Sackler Faculty of Medicine, Tel Aviv University, Tel-Aviv, Israel; [3]Department of Radiology , Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [4]Pediatric Neurology and Child Development Unit, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [5]Neuropediatric Unit, Shaare-Zedek Medical Center, Jerusalem, Israel; [6]Department of Family Medicine, Hebrew University, Jerusalem, Israel; [7]Department of Neonatology, Lis Maternity Hospital, Tel Aviv Sourasky Medical Center, Tel-Aviv, Israel; [8]Department of Psychology, Gonda Multidisciplinary Brain Research Center, Bar Ilan University , Ramat-Gan , Israel; [9]Department of Psychology, Gonda Multidisciplinary Brain Research Center, Bar Ilan University, Ramat-Gan, Israel

The ability to diagnose abnormal MR-signal in the infant's brain is challenging. The aim of this study is to present a methodology that enables quantification and comparison between infants' brains, by creating a standard space that includes the imaging data and templates and atlases adjusted to infants. Preliminary results of DTI in HIE infants with and without hypothermia (cooling to 33°c for 72 hours) compared with normal controls are presented, demonstrating the applicability of this methodology in the pathological brain. Diffusivity values in different VOIs and histogram analysis show the effect of the therapeutic hypothermia in HIE.

15:30 ***4393*.** **Abnormal Microstructure of the Thalamus in Childhood Survivors of Prematurity: Assessment with Diffusion Tensor Imaging**

Arabhi C. Nagasunder[1], Hannah C. Kinney[2], Caroline Jane Tavare[3], Tena Rosser[4], Floyd H. Gilles[3], Marvin D. Nelson[1], Stefan Bluml[1,5], Ashok Panigrahy[1,6]
[1]Department of Radiology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [2]Department of Pathology, Children's Hospital of Boston, Boston, MA, United States; [3]Department of Neuropathology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [4]Division of Neurology, Childrens Hospital Los Angeles, Los Angeles, CA, United States; [5]Rudi Schulte Research Institute, Santa Barbara, CA, United States; [6]Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States

Long-term survivors of prematurity with periventricular leukomalacia (PVL) suffer major cognitive deficits. One of the critical structures is the thalamus which is involved in cognition via extensive interconnections with the cerebral cortex. The goal of this study was to show combined volumetric and DTI data within the parenchyma of the thalamus in childhood survivors of prematurity with PVL. We found significant atrophy in combination with microstructural abnormalities with preferential pulvinar injury.

Tuesday 13:30-15:30 Computer 81

13:30 ***4394*.** **Value of Susceptibility-Weighted Imaging for Diagnosing Intracranial Hemorrhage in Neonates According to Anatomic Location**

Tetsu Niwa[1], Taro Takahara[1], Thomas Kwee[1], Manon Benders[2], Linda de Vries[2], Vincent O. Boer[1], Freddy Visser[1], Peter R. Luijten[1], Floris Groenendaal[2]
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Neonatology, Wilhelmina Children’s Hospital/University Medical Center Utrecht, Utrecht, Netherlands

Susceptibility-weighted imaging provides additional value for increasing certainty to detect or rule out hemorrhage in neonates

14:00 ***4395*.** **Correlations Between Increased ASL Perfusion and Decreased ADC in Newborns with Hypoxic Ischemia**

Rudolph Pienaar[1,2], Neel Madan, [23], Patricia Ellen Grant[1,2]
[1]Radiology, Childrens Hospital Boston, Boston, MA, United States; [2]Radiology, Harvard Medical School, Boston, MA, United States; [3]Radiology, Massachusetts General Hospital, Boston, MA, United States

We have developed a methodology to detect correlations between increased ASL-CBF perfusion and decreased ADC values in areas of hypoxic ischemia

14:30 ***4396*.** **Specific White Matter Diffusion Characteristics in the Newborn Period Correlate with Either Neuromotor or Neurocognitive Outcome at 2 Years. a Voxel Based Analysis**

Tamara Faundez[1], Rebecca Recker[1], Cristina Borradori Tolsa[1], Gregory Lodygensky[1], Francois Lazeyras[2,3], Petra Susan Huppi[1]
[1]Division of Child Growth & Development, University of Geneva and University Hospitals, Geneva, Switzerland; [2]Service of Radiology, University of Geneva and University Hospital of Geneva, Geneva, Switzerland; [3]Center for Biomedical Imaging (CIBM), Lausanne and Geneva, Switzerland

The goal of this study is to assess by diffusion MRI, neonatal structural deficit of premature babies related to neurocognitive deficits later in life. Using voxel-based analysis, we correlate ADC measures at birth with neuromotor and neurocognitive outcome at the age of 2 years. We observed distinct ADC changes with respect to mental and physical scores. Mental score is correlated with regions linked to future cognitive function like language. Neuromotor-related regions include precentral white matter linked to motor pathways. ADC changes are negatively correlated with cognitive scores, which speak in favour of a possible myelination delay already present at birth.

15:00 ***4397**.* **Effects of the Cumulative Exposure to Lypopolysaccharide and Hyperoxia on the Developing Rat Brain Assessed by High-Field Diffusion Tensor Imaging**

Yohan van de Looij[1,2], Marco Sifringer[3], Felix Brehmer[4], Bettina Gerstner[5], Petra S. Hüppi[1], Rolf Gruetter[2,6], Ursula Felderhoff-Müser[7], Stéphane V. Sizonenko[1]

[1]Division of Child Growth & Development, Department of Pediatrics, University of Geneva, Geneva, Switzerland; [2]Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [3]Department of Anesthesiology, Charité-Universitätsmedizin Berlin, Berlin, Germany; [4]Department of Neonatology, Charité-Universitätsmedizin Berlin, Berlin, Germany; [5]Department of Pediatric Cardiology, University Hospital Giessen, Giessen, Germany; [6]Department of Radiology, University of Geneva and Lausanne, Geneva and Lausanne, Switzerland; [7]Department of Pediatrics, University Hospital Essen, Essen, Germany

In premature infants, periventricular leukomalacia (PVL) is a common type of cerebral white matter injury and animal models of PVL can be achieved by lipopolysaccharide (LPS) exposure. Furthermore, premature infants are subjected much earlier to relative hyperoxia, because of a dramatic rise of oxygen tissue tension compared with intrauterine conditions but hyperoxia is supposed to negatively influence brain development and maturation. The goal of this study was to characterize changes in the pup rat brain following LPS and/or hyperoxia exposure by DTI derived parameters. This study confirmed white matter damages following LPS injection and/or Hyperoxia revealed by DTI derived parameters.

Wednesday 13:30-15:30 Computer 81

13:30 ***4398**.* **A Combined Brain Proton MR Spectroscopy and Amplitude- Integrated Electroencephalography Study in Term Newborns with Hypoxic-Ischemic Encephalopathy**

Caterina Tonon[1], Claudia Testa[1], David Neil Manners[1], Emil Malucelli[1], Gina Ancora[2], Giovanni Tani[3], Paolo Ambrosetto[3], Bruno Barbiroli[1], Raffaele Lodi[1]

[1]MR Spectroscopy Unit, Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Italy, Italy; [2]Institute of Neonatology, Department of Woman, Child and Adolescent Health,, Policlinico S'Orsola-Malpighi, Bologna, Italy; [3]Paediatric Radiology Unit, Department of Woman, Child and Adolescent Health, Policlinico S'Orsola-Malpighi, Bologna, Italy

Perinatal hypoxic ischemic encephalopathy (HIE) remains a frequent cause of neurological sequelae and death. The accurate assessment of HIE is crucial for determining the prognosis.The aim of the study was to relate the brain metabolic changes detected by 1H-MRS to the amplitude integrated- electroencephalogram (a-EEG) time course findings in newborns at term and to evaluate their correlation with outcome. Both 1H-MRS and a-EEG findings showed a good correlation with the severity and the outcome of cerebral HI injury. These data, obtained from 1H-MRS and a-EEG in non-treated infants, represent reference data for future investigations to select candidates for cool cap therapy.

14:00 ***4399**.* **Anisotropy of Callosal Motor Fibers Predicts Functional Impairment in Children with Periventricular Leukomalacia**

Inga Koerte[1,2], Paula Pelavin[2], Martha E. Shenton[2], Marek Kubicki[2], Berit Kirmess[3], Steffen Berweck[3], Maximilian Reiser[1], Florian Heinen[3], Birgit Ertl-Wagner[1]

[1]Institute of Clinical Radiology, Ludwig-Maximilians-University, Munich, Germany; [2]Psychiatry Neuroimaging Laboratory, Brigham and Women's Hospital, Boston, MA, United States; [3]Dr. von Hauners Children's Hospital, Ludwig-Maximilians-University, Munich, Germany

Patients with periventricular leukomalacia are known to have altered white matter structure of motor tracts1. We aimed to evaluate the microstructure (DTI), interhemispheric inhibitory competence as measured by transcranial magnetic stimulation (TMS) and hand motor function in children with mild cerebral palsy compared to normal controls.Anisotropy values of transcallosal motor fibers appear to correlate with functional impairment of hand motor function in children with PVL. The microstructure of transcallosal motor fibers could serve as a potential predictor for hand motor function in patients with cerebral palsy.

14:30 ***4400**.* **Preliminary Experience with DTI and Multi-Exponential T2 Relaxation Imaging of Myelin in Children Treated for ALL**

Wilburn E. Reddick[1], Qing Ji[1], David C. Carver[1], John O. Glass[1], Jun-Yu Guo[1], Zoltan Patay[2]

[1]Division of Translational Imaging Research, St. Jude Children's Research Hospital, Memphis, TN, United States; [2]Division of Diagnostic Imaging, St. Jude Children's Research Hospital, Memphis, TN, United States

We investigated the feasibility and utility of performing DTI (FA, D_{radial}) and multi-exponential T2 relaxation imaging (MWF, long-T2) to assess differing degrees of myelin disruption early in the course of therapy for ALL in two 4 year old patients with varying degrees of leukoencephalopathy. Relatively low FA, increased D_{radial}, and decreased MWF were evident in regions of the T2 hyperintensities. Long-T2 maps demonstrated that one patient had more sever myelin and axonal damage than the other patient. This study is the first to conduct DTI and multi-exponential T2 relaxation imaging during ALL therapy and provides support for additional prospective studies.

15:00 **4401. Quantitative Analysis of the Brain Anatomy in Cerebral Palsy**

Andreia Vasconcellos Faria[1,2], Alexander Hoon[3], Elaine Stashinko[3], Ameneh Mashayekh[1], Xin Li[4], Hangyi Jiang[1,4], Kazi Akhter[1], Kenichi Oishi[1], Jiangyang Zhang[1], Peter van Zijl[1,4], Michael Miller[5], Susumu Mori[1]

[1]Radiology, Johns Hopkins University, Baltimore, MD, United States; [2]Radiology, State University of Campinas, Campinas, SP, Brazil; [3]Division of Neurology and Developmental Medicine, Kennedy Krieger Institute, Baltimore, MD, United States; [4]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States; [5]Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States

We developed a new method to provide a comprehensive quantitative analysis of brain anatomy in cerebral palsy patients, based on two technical points: diffusion tensor imaging and an automated 3D whole brain segmentation based on our brain atlas and a nonlinear normalization technique (large-deformation diffeomorphic metric mapping). This method was applied to thirteen patients and the reliability of the automated segmentation measured by Kappa revealed "almost perfect" agreement with the manual segmentation. We illustrate some potential applications on individual characterization and group comparison. This technique also provides a framework to determine the impact of various neuroanatomic features on brain functions.

Thursday 13:30-15:30 Computer 81

13:30 **4402. Metabolic Abnormalities in Perituberous Tissue: Initial Results of a Proton MR Spectroscopy Study of Pediatric Tuberous Sclerosis Complex**

Ivan Kirov[1], Joseph Oved[2], Sarah Milla[1], Orrin Devinsky[3], Howard Weiner[3], Oded Gonen[1]

[1]Radiology, New York University, New York, NY, United States; [2]School of Medicine, New York University, New York, NY, United States; [3]Neurosurgery, New York University, New York, NY, United States

While traditionally the MRI-defined tuber has been the primary surgery target for abolishing seizures in Tuberous Sclerosis Complex (TSC), there is evidence that non-tuberous tissue, specifically surrounding the active tuber, may also be epileptogenic. We use 3D proton MR spectroscopy (1H-MRS) to characterize tubers and normal-appearing tissue. Initial results reveal metabolic abnormalities in tubers and its adjacent tissue (peritubers). In one case electro-encephalography identified a seizure locus and 1H-MRS showed high lipid signal in its perituberous tissue. In all, these findings have implications for improved identification and definition of the epileptogenic zone in TSC.

14:00 **4403. White Matter Microstructure Correlates with Reading Ability in Healthy Subjects and Those with Fetal Alcohol Spectrum Disorder**

Catherine Lebel[1], Carmen Rasmussen[2], Katy Wyper[1], Gail Andrew[3], Christian Beaulieu[1]

[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada; [2]Pediatrics, University of Alberta, Edmonton, Alberta, Canada; [3]Glenrose Rehabilitation Hospital, Edmonton, Alberta, Canada

Diffusion tensor imaging (DTI) studies of reading consistently highlight left temporal-parietal white matter. We used DTI to correlate fractional anisotropy (FA) with reading ability in 40 subjects with fetal alcohol spectrum disorder (FASD) aged 5-19 years and 40 healthy controls. The control group had three significantly correlated clusters in the left temporal-parietal area and one in the genu (all positive), in good agreement with previous findings. The FASD group had 9 clusters with significant correlations (3 negative, 6 positive). These included 3 left temporal-parietal clusters, showing consistent involvement in this area, but also demonstrating more widespread correlations than controls.

14:30 **4404. Pituitary Volumes and Functions in Children with Growth Hormone Deficiency: Volumetric Magnetic Resonance Data**

Miyuki Takasu[1], Chihiro Tani[1], Masaki Ishikawa[1], Keizo Tanitame[1], Hiroshi Fukuda[1], Jun Horiguchi[1], Akihisa Tamura[2], Yoshikazu Nishi[3]

[1]Radiology, Hiroshima University Hospital, Hiroshima, Japan; [2]Radiology, Hiroshima Red Cross Hospital, Hiroshima, Japan; [3]Pediatrics, Hiroshima Red Cross Hospital, Hiroshima, Japan

We investigated correlations between pituitary volumes measured from 3D volumetric MR imaging and the severity of the clinical and biochemical features in 69 patients with growth hormone deficiency. Pituitary volumes of all patient groups were smaller than the age-matched published norms. Pituitary volumes of both female groups were significantly smaller than that of controls. Pituitary volumes of male pubertal or postpubertal group were significantly larger than that of prepubertal one, but this difference was not significant between female groups. IGF-1 levels were significantly correlated with pituitary volumes. LH levels were significantly correlated with pituitary volumes in male patients.

15:00 **4405. MRI Assessment of Iron-Mediated Pathology Following Juvenile Traumatic Brain Injury**

Lei Huang[1], Arash Adami[2], Andre Obenaus[1,3]

[1]Radiation Medicine, Loma Linda University, Loma Linda, CA, United States; [2]Neuroscience, University of California, Riverside, Riverside, CA, United States; [3]Radiology, Loma Linda University, Loma Linda, CA, United States

In a rat model of graded juvenile traumatic brain injury (jTBI), we characterized iron mediated neuropathology using multi-modal MRI that correlated with histology and tissue iron measures. Our results showed that SWI was sensitive to monitor pathological iron

accumulation in vivo following increasing jTBI severity that correlates with increased tissue iron deposition, especially, non-heme iron concentration. The iron-mediated neuropathology was dominant in corpus callosum at this age.

Clinical Stroke Imaging

Hall B Monday 14:00-16:00 Computer 82

14:00 *4406*. **High Resolution Wall and Lumen MRI of the Middle Cerebral Arteries at 3-Tesla**

Chang-Woo Ryu[1], Geon-Ho Jahng[1], Eui-Jong Kim[2], Woo_Suk Choi[2], Dal-Mo Yang[1]
[1]Radiology, East-West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; [2]Radiology, Kyung Hee University Hospital, Kyung Hee University, Seoul, Korea, Republic of

We imaged the walls of stenotic MCAs in symptomatic and asymptomatic patients using high resolution BB-MRI, in order to characterize vulnerable plaques. Multi-contrast (T1-, T2-, and proton density)-weighted BB-MRIs were acquired in 16 MCA stenosis. The plaque signal intensity was interpreted and the total wall thickness was measured at the most stenotic segment. Hyperintense foci were demonstrated more frequently within the plaques of symptomatic stenoses than within the plaques of asymptomatic stenoses Total wall thickness in the symptomatic stenoses was significantly higher than that seen in the asymptomatic stenoses. High-resolution, multi-contrast-weighted BB-MRI has the potential to characterize intracranial atherosclerotic plaques.

14:30 *4407*. **Carotid Plaque Imaging with BLADE and SPACE**

Masahiro Ida[1], Kenji Saitoh[1], Shunsuke Sugawara[1], Yuko Kubo[1], Keiko Hino[1], Naoya Yorozu[1]
[1]Department of Radiology, Tokyo Metropolitan Ebara Hospital, Tokyo, Japan

BLADE is a self-navigating method for motion correction by repeated acquisition of the center of k-space. BLADE reduces physiological motion artifact. SPACE is based on 3D fast SE sequence with high turbo-factor and exploits refocusing pulses with variable flip-angle. This study attempts to estimate clinical utilities of BLADE and 3D SPACE for the evaluation of carotid plaques. BLADE sequences without cardiac gating are feasible for detecting not only atherosclerotic plaque but also the neighboring turbulent flow. Multi-slice BLADE sequences and 3D SPACE are useful methods and the initial sequences of choice for screening of carotid plaque and its risk factors.

15:00 *4408*. **High-Resolution Vessel Wall MRI of Chronic Unilateral MCA Occlusion**

Chang-Woo Ryu[1], Geon-Ho Jahng[1], Dal-Mo Yang[1], Woo-Suk Choi[2]
[1]Radiology, East-West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; [2]Radiology, Kyung Hee University Hospital, Seoul, Korea, Republic of

We acquired high-resolution vessel wall MRI of MCA in patients with chronic unilateral MCA occlusion and evaluated the characteristics of MRI and clinical findings. We selected 17 consecutive patients who presented with unilateral MCA occlusion. High resolution PD-weighted TSE MRI with the saturation of arterial flow, were acquired the occluded MCA using 3T MRI. As the presence of MCA on MRI, MCA occlusion was classified plaqued MCA (13/17): the clear demonstration of MCA and atrophic MCA group (4/17): no MCA in the sylvian fissure. The vessel wall MRI might be a useful imaging tool that characterizes MCA occlusion in vivo.

15:30 *4409*. **Identification of Basilar Plaque Components Using Multicontrast High-Resolution 3-Tesla MRI**

Xin Lou[1], Lin Ma[1], weijian Jiang[2], Ning Ma[2], Tingqiang Zhao[1]
[1]PLA Gerneral Hospital, Radiology Department, Beijing, China; [2]Beijing Tiantan Hospital, Interventional Neuroradiology, Beijing, China

Multicontrast high-resolution MR imaging (HRMRI) is an effective tool for the assessment of carotid plaque vulnerability, but there has been no report on identification of plaque components of basilar atherosclerosis. We therefore performed this prospective cohort study on 3T multicontrast HRMRI for 24 patients with >70% symptomatic atherosclerotic stenosis of basilar artery (BA). Our preliminary results revealed that multicontrast HRMRI (TOF, T1W, PDW, and T2W) can be used to study plaque components of severe basilar atherosclerosis with good interobserver and intraobserver agreements for the identification of LR/NC, IH and calcification.

Tuesday 13:30-15:30 Computer 82

13:30 *4410*. **Measuring Longitudinal Changes in Cbf in Post-Stroke Recovery Using Partial Volume Corrected Asl Perfusion Mri**

Iris Asllani[1], Sophia Ryan, Eric Zarahn, John W. Krakauer
[1]Columbia University, New York, NY, United States

Stroke leads to a reduction in cerebral blood flow (CBF) in areas remote from the focal infarct, often in another arterial territory. This phenomenon is called diaschisis and is thought to reflect a reduction in neuronal metabolism mediated transynaptically from the infarct region. Our study has two main goals: 1) To characterize diaschisis after subacute strokes using partial volume corrected (PVEc) arterial spin labeling (ASL) MRI. 2)To determine if resolution of diaschisis correlates with recovery from hemiparesis. We present ASL CBF images in stroke patients in the first month and then again at 6 months. The change in CBF is correlated with improvements in motor deficit over the same time period. ASL CBF images from each patient are also compared with age-matched stroke-free controls via a one-to-many statistical analysis.

14:00 **4411. Recovery Pattern in Chronic Stroke Post-Physiotherapy : An FMRI Study**

Ashu Bhasin[1], Senthil S. Kumaran[2], M.V. Padma[1], Sujata Mohanty[3], Rohit Bhatia[1]
[1]Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; [2]DEPARTMENT OF N.M.R., ALL INDIA INSTITUTE OF MEDICAL SCIENCES, NEW DELHI, DELHI, India; [3]Stem Cell Facility, All India Institute of Medical Sciences, New Delhi, India

Synopsis: Physiotherapy based on mirror therapy concept was administered to stroke patients for 8 weeks. BOLD mapping was carried out for fist-clenching tasks of paretic hand. It has been observed that during observation of a movement, motor areas in the primary and premotor cortex show enhanced activation when a subject observes the unaffected hand in a mirror or in simulated environments.

14:30 **4412. Voxel Based Lesion Symptom Mapping for the Identification of Critical Regions for Motor Recovery After Stroke**

Peter Chang[1], Xue Wang[1], Darren Gitelman[1,2], Ryan Lo[1], Robert Levy[1,3], Justin Hulvershorn[4], Todd Parrish[1]
[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Neurology, Northwestern University; [3]Neurological Surgery, Northwestern University; [4]Northstar Neuroscience, Seattle, Wa

VLSM was conducted on 151 chronic stroke subjects from 26 imaging centers with different MR vendors and field strengths. The results identify regions in the corona radiata that appear to assimilate motor, pre-motor and sensory information similarly for right and left hemisphere lesions. There were significant results for dominant lesions but not non-dominant lesions. This indicates that following stroke of the non-dominant hemisphere, reorganization of the dominant hemisphere occurs to a greater degree than the reorganization of the non-dominant hemisphere following a dominant lesion. This population based study may improve the ability to give an accurate prognosis and optimize treatment.

15:00 **4413. Autologous Intravenous Stem Cells Infusion in Chronic Stroke : A Pilot Study in Indian Patients**

Ashu Bhasin[1], Senthil S. Kumaran[2], M.V. Padma[1], Sujata Mohanty[3], Rohit Bhatia[1]
[1]Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; [2]Department of N.M.R., All India Institute of Medical Sciences, New Delhi, Delhi, India; [3]Stem Cell Facility, All India Institute of Medical Sciences, New Delhi, India

Autologous mesenchymal stem cells were infused intravenously in chronic stroke patients with a dose of 5×10^{8} cells through median cubital vein in 4-6 hours. The experimental group was treated with stem cells and a focused physiotherapy regime and the control group with only physiotherapy regime. It was observed that stem cell transplantation leads to therapeutic benefits as measured on clinical (fugel meyer & barthel index) and functional markers (BOLD, DTI) augmenting neural plasticity.

Wednesday 13:30-15:30 Computer 82

13:30 **4414. Where Is the "clinical Relevant" Penumbra? a Voxel-Based Analysis in Acute Stroke Patients**

Charlotte Rosso[1,2], Yohan Attal[2], Sophie Crozier[1], Romain Valabrègue[3], Dider Dormont, [2,4], Sylvain Baillet[2], Stephane Lehericy[3,5], Yves Samson[1]
[1]Urgences Cerebro-Vasculaires, Pitie-Salpetriere Hospital, Paris, France; [2]CRICM, INSERM UMR S_975, CNRS UMR_7225, Equipe COGIMAGE, Pitie-Salpetriere Hospital, Paris, France; [3]Centre for NeuroImaging Research – CENIR, Pitie-Salpetrière Hospital, Paris, France; [4]Neuroradiology Department, Pitie-Salpetriere Hospital, Paris, France; [5]Neuroradiology Department, Pitie-Salpetriere, Paris, France

In this study, we used, in 43 MCA acute stroke patients with initial and follow-up MRI, ADC maps to study the tissue-at-risk location. To investigate this issue, time course of ADC changes between initial and follow-up MRI, impact of recanalization in final ADC-defined infarct areas, and relationship with key regions associated with poor outcome were assessed. Infarct expansion concerns perisylvian regions but also the deep MCA territory and part of the CST. The comparison of ADC maps of recanalized vs. non-recanalized and good vs. poor outcome patients shows a great overlap and involved the lenticular nucleus and the CST.

14:00 **4415. Acute Change of Tissue Perfusion in Acute Stroke Patients After TPA Treatment**

Hongyu An[1], Andria Ford[2], Cihat Eldeniz[1], Katie Vo[2], Rosana Ponisio[2], Yasheng Chen[1], William Powers[1], Jin-Moo Lee[2], Weili Lin[1]
[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States; [2]Washington University in St. Louis, St. Louis, MO, United States

Spatial heterogeneity of tissue perfusion change was detected in acute patients after tPA treatment. Concurrent development of reperfusion and new hypoperfusion were observed. Compared to the reperfused region, the nonreperfused region had a significantly greater MTT prolongation, suggesting that tissue with a more severe initial injury is more likely to remain hypoperfused. Moreover, the nonreperfused regions had the highest risk of infarction, followed by new hypoperfused and reperfused regions.

14:30 ***4416*****.** **ADC-Based Prediction of MCA Infarct Growth: Validation in 216 Acute Stroke Patients**

Charlotte Rosso[1,2], Yohan Attal[2], Sandrine Deltour[1], Nidiyare Hevia-Montiel[2], Eric Bardinet[2,3], Dider Dormont[2,4], Stephane Lehericy[2,4], Sylvain Baillet[2], Yves Samson[1,5]
[1]Urgences Cerebro-Vasculaires, Pitie-Salpetriere Hospital, Paris, France; [2]CRICM, INSERM UMR S_975, CNRS UMR_7725, Equipe COGIMAGE, Pitie-Salpetriere Hospital, Paris, France; [3]Centre for NeuroImaging Research – CENIR, Pitie-Salpetriere Hospital, Paris, France; [4]Neuroradiology Department, Pitie-Salpetriere Hospital, Paris, France; [5]CRICM, INSERM UMR S_975, CNRS UMR_7725, Equipe COGIMAGE, Pitie-Salpetriere, Paris, France

In this work, we used ADC maps to predict infarct growth. The method is based on an algorithm able to make the initial infarct lesion growing up, taking in account the slight ADC decrease which occurs in the at-risk tissue. Patients (n=216) with MCA acute stroke confirmed by an initial (<6H) and a control MRI have been tested. Predicted vs. final infarct sizes and growths were significantly correlated. The accuracy to predict infarct growth status (patients with or without infarct growth) reached 76 %. The ADC-defined tissue-at-risk is a hallmark of the penumbra since MCA recanalization could spare it.

15:00 ***4417*****.** **Change in Axial and Radial Diffusional Kurtoses for Ischemic Stroke**

Jens H. Jensen[1], Maria F. Falangola[1,2], Caixia Hu[1], Ali Tabesh[1], Calvin Lo[1], Otto Rapalino[1,3], Joseph A. Helpern[1,2]
[1]Radiology, New York University School of Medicine, New York, NY, United States; [2]Center for Advanced Brain Imaging, Nathan S. Kline Institute, Orangeburg, NY, United States; [3]Department of Radiology, Massachusetts General Hospital, Boston, MA, United States

Diffusional kurtosis imaging was applied to measure the axial and radial diffusional kurtoses for three patients with subacute focal ischemic stroke. For all three patients, the axial diffusional kurtoses increased substantially in the affected regions (relative to the contralateral side), but for two of the subjects, the radial diffusional kurtoses showed little change. In these two cases, the affected regions appeared to be primarily in white matter, suggesting that for white matter ischemia mainly alters the diffusional kurtosis in the axial direction.

Thursday 13:30-15:30 Computer 82

13:30 ***4418*****.** **Arterial Spin Label Imaging of Transient Ischemic Attack**

Greg Zaharchuk[1], Jean-Marc Olivot[2], Roland Bammer[1], Ajit Shankaranarayanan[3], Michael Mlynash[2], Gregory W. Albers[2], Michael E. Moseley[1]
[1]Department of Radiology, Stanford University, Stanford, CA, United States; [2]Department of Neurology and Neurological Sciences, Stanford University, Stanford, CA, United States; [3]Applied Sciences Laboratory - West, GE Healthcare, Menlo Park, CA, United States

ASL can detect subtle alterations in CBF and arterial arrival times. ASL abnormalities (including the borderzone sign) can be detected in the majority of acute hemispheric TIA patients and may therefore be able to provide objective evidence of a true vascular event.

14:00 ***4419*****.** **Susceptibility Weighted Imaging in Patients with Occlusion of Middle Cerebral Artery**

Bum-soo KIM[1], Jae-Young Byun[1], Yoon-joo Lee[1], So-lyung Jung[1], Kook-jin Ahn[1], Won-san Jung[1], Won-jong Yoo[1], Young-joo Kim[1]
[1]Department of Radiology, The Catholic University of Korea, Seoul, Korea, Republic of

In this study, imaging findings of SWI were retrospectively reviewed and analysed for 12 consecutive patients with occlusion of middle cerebral artery. Total or partial loss of arterial bright signal intensity in ipsilateral sylvian fissure was most frequently seen, followed by dark blooming of intravascular clot, prominent venous hypointense signal of the medullary / cortical vein, global hemorrhagic transformation. SWI provides valuable information in diagnosis and evaluation of patient with middle cerebral artery stroke.

14:30 ***4420*****.** **PC-MRI Study of Cerebral Blood and CSF Flow Patterns in Patients with Diagnosed Cerebral Venous Thrombosis.**

Souraya Stoquart-Elsankari[1], Marek Czosnyka[2], Pierre Lehmann[3], Hervé Deramond[3], Olivier Balédent[1]
[1]Biophysics and Image Treatment, Amiens University Hospital, Amiens, France; [2]Department of Neurosciences, University of Cambridge, Addenbrooke's hospital, Cambridge, United Kingdom; [3]NeuroRadiology, Amiens University Hospital, Amiens, France

Our objectives were to study by PC-MRI intracranial flow alterations in patients with cerebral venous thrombosis (CVT). Thanks to a specific selection of MRI parameters, and of key-parameter velocity encoding values, intracerebral and cervical arterial and venous flows, as well as cervical and ventricular CSF flows were evaluated in 6 patients with diagnosed CVT on MR Venography. PCMRI did not detect any venous flow in the veins and/or sinuses with thrombosis detected on Venography, and it showed alterations of CSF flows in 5/6 patients. PC-MRI is a complementary tool in the evaluation of venous thrombosis effects on intracranial dynamics.

15:00 **4421**. **Clinical Significance of Ischemic Hypointense Findings in Vessels and Tissue in Gradient Echo T2*-Weighted Images at 3 Tesla Evaluated by Simple Visual Estimation in Stroke Patients Treated with Intravenous Rt-PA**

Masafumi Harada[1], Hitoshi Kubo[1], Naomi Morita[2], Hiromu Nishitani[2], Tsuyoshi Matsuda[3]

[1]Department of Medical Imaging, Univeristy of Tokushima, Institute of Health Biosciences, Tokushima City, Tokushima, Japan; [2]Department of Radiology, Univeristy of Tokushima, Institute of Health Biosciences, Tokushima City, Tokushima, Japan; [3]GE Healthcare Japan, Hino, Tokyo, Japan

The purpose of this study was to determine the clinical significance of Ischemic vessels (IschV) and tissue (IschT) signs in gradient echo T2*-weighted images (Gre T2*-WIs) and the correlation of clinical outcome with visual recognition of these signs. The current study may indicate that IschT sign in Gre T2*-WI at 3 tesla would include more severe ischemia than IschV sign and is therefore a candidate for determination of risk for deteriorated outcome with Gre T2*-WI at 3 tesla.

MRA & CSF Studies with Clinical Applications

Hall B Monday 14:00-16:00 Computer 83

14:00 **4422**. **Resolving Arterial Contributions in Vessel Encoding Dynamic Angiography**

Michael A. Chappell[1,2], Tom W. Okell[1], Peter Jezzard[1], Mark W. Woolrich[1]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom; [2]Institute for Biomedical Engineering, University of Oxford, Oxford, United Kingdom

Using a Vessel Encoded Arterial Spin Labelling preparation it is possible to provide non-invasive vessel selective angiography. However, the ability to separate the contributions from all the labelled arteries, e.g. all four carotids and vertebrals, can be limited by the specification of the acquisition. Here a new analysis method for VE-ASL data, that can separate different vessel contributions with even limited data, is modified and applied to angiographic images. Results for separation of carotids and vertebral are presented indicating that this is a viable alternative to highly invasive intra-arterial contrast methods.

14:30 **4423**. **Flow Velocity Measurement in the Carotid Bifurcation Using 4D Flow-Sensitive MRI and Doppler Ultrasound**

Andreas Harloff[1], Timo Zech[1], Felix Wegent[1], Simon Bauer[1], Martin Schumacher[1], Michael Markl[1]

[1]University Hospital Freiburg, Freiburg, Baden-Württemberg, Germany

Flow-sensitive 4D MRI was used to assess absolute blood flow velocities within the carotid bifurcation in healthy volunteers and patients with high-grade internal carotid artery (ICA) stenosis before and after carotid endarterectomy. MRI data were compared with Doppler ultrasound as the reference method. Reliability and reproducibility of MRI based measurements were tested. Velocity measurement was feasible at any desired site of the carotid bifurcation. Compared to Doppler ultrasound, however, MRI underestimated systolic blood flow velocity by approximately 30%.

15:00 **4424**. **Implementing VERSE for Time of Flight RF Pulses at 7Tesla: Methodological Considerations**

Sebastian Schmitter[1], Soeren Johst[2], Michael Bock[2], Kamil Ugurbil[1], Pierre-Francois van de Moortele[1]

[1]University of Minnesota, Center for Magnetic Resonance Research, Minneapolis, MN, United States; [2]German Cancer Research Center, Heidelberg, Germany

It has been shown that successful Time-of-flight (TOF) images can be obtained at 7T benefiting from higher SNR and longer tissue T1. However, because of SAR constraints, magnetization transfer pulses that are used at 1.5T/3T cannot be used at 7T, saturation pulses are often skipped and the flipangle is limited. These issues can be addressed using the VERSE principle to decrease SAR. However, VERSE pulses are more sensitive to $\delta B0$. Here, we investigate in simulations and in vivo the impact of off-resonance frequencies on RF excitation profile of ramp shaped RF pulses (TONE) when applying VERSE at 7T.

15:30 **4425**. **Insight Into the Anatomy of Cerebrospinal Fluid Flow in the Human Ventricular System Using MR Velocity Mapping**

Andreas Stadlbauer[1], Wilma van der Riet[2], Erich Salomonowitz[1]

[1]MR Physics Group, Department of Radiology, Landesklinikum St. Poelten, St. Poelten, Austria; [2]European MRI Consultancy (EMRIC), Strasbourg, France

To study the spatial and temporal dynamics of CSF flow in the ventricular system of 40 normal volunteers using time-resolved 3D magnetic resonance velocity mapping. Classification of CSF flow based on calculation of 3D particle path lines over the cardiac cycle revealed one uniform flow pattern for the lateral ventricles, three categories for the third and two categories for the fourth ventricle. We found no significant aging effects on both the presence of a specific CSF flow pattern and on flow velocities. Our results provide the first detailed demonstration of the anatomy of CSF flow within the human ventricular system.

Tuesday 13:30-15:30 Computer 83

13:30 ***4426*. 3D MRA with Dynamic Sequence Switching: Improved Imaging of the Arterial and Venous Phases**

Petrice M. Mostardi[1], Clifton R. Haider[1], Norbert G. Campeau[1], Stephen J. Riederer[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

Time-resolved CE-MRA is widely used for imaging the intracranial arterial system, while a single high spatial resolution acquisition is generally used for the intracranial venous system. The goal of this work was to combine these two studies into a single contrast-enhanced acquisition. A time-resolved CAPR sequence was played out for about 50 sec for arterial phase imaging, providing images every 3.57 sec. Then, by seamlessly switching to a high spatial resolution, 38 sec long scan, data for a venogram was acquired. High speed reconstruction further allows the time of switching to be done in real time on a patient-specific basis.

14:00 ***4427*. High-Resolution Non-Contrast Enhanced Dark Blood Brain Vessel Imaging Using a Balanced Steady State 3D Projection Reconstruction Sequence**

Aiming Lu[1], Keith R. Thulborn[1]
[1]Center for MR Research, University of Illinois at Chicago, Chicago, IL, United States

Balanced steady-state free precession (SSFP) sequences have been used for non-contrast enhanced vessel imaging due to its high SNR efficiency and bright blood signal. However, as cerebrospinal fluid (CSF) signal is also bright in SSFP images, the application of these techniques to brain has been limited. In this work, we demonstrate that instead of appearing as bright signal, the vessels in the brain have low signal intensity in high-resolution 3T images. Using a dual-half-echo 3D projection reconstruction based SSFP sequence, our results show that non-contrast enhanced high-resolution vessel imaging can be obtained rapidly along with high quality T2-contrast images.

14:30 ***4428*. Automated Calculation of Wall Shear Stress in the Middle Cerebral Arteries of Healthy Volunteers Using PC-VIPR and Spline Interpolation**

Warren Chang[1], Yijing Wu, Kevin Johnson, Andrew Wentland[2], Steven Kecskemeti[3], Charles Mistretta[1], Patrick Turski[1]
[1]Radiology/Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States; [2]Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison , WI, United States; [3]Physics/Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States

Time-average wall shear stress in the M1 segment of the middle cerebral arteries of 10 healthy volunteers was calculated using automated spline interpolation. The velocity measurements were acquired using PC-VIPR, a fast undersampled phase-contrast MRA technique that allows whole-brain imaging in 5 minutes with sub-millimeter spatial resolution. The calculated average WSS for the proximal MCA was 0.20 Pa (S.D. 0.016 Pa) consistent with published values for PC-MRA. This report shows that fast, automated, non-invasive estimation of wall shear stress can be obtained in middle and large-sized intracranial arteries that are prone to the development of atherosclerosis and other cerebrovascular disorders.

15:00 ***4429*. Low Dose, Supraortic 3D Time-Resolved MR Angiography at 3T: Comparison with High Spatial Resolution 3D Contrast-Enhanced MR Angiography**

Yoon-joo Lee[1], Jae-young Byun[1], So-lyung Jung[1], Won-jong Yoo[1], Young-joo Kim[1], Kook-jin Ahn[1], Bum-soo KIM[1]
[1]Department of Radiology, The Catholic University of Korea, Seoul, Korea, Republic of

This study evaluates feasibility and effectiveness of low-dose TR-CEMRA (with injection of 1cc of Gadobutrol followed by 20cc of saline) performed in the assessment of supraaortic vessel, acquired with combination of parallel imaging (GRAPA) and view-sharing technique (TWIST) at 3T. Retrospective evaluation of image quality and stenosis grade by two neuroradiologist was done, and compared with the results from high-resolution single-phase CEMRA. The overall image quality for low-dose TR-CEMRA was in diagnostic range, comparable to HR-CEMRA. In grading of stenosis, TR-CEMRA showed concordant results with HR-CEMRA in 90.8%, with relatively more number of overestimation than underestimation.

Wednesday 13:30-15:30 Computer 83

13:30 ***4430*. Non-Contrast Dynamic MRA Using TrueFISP Based Spin Tagging with Alternating Radiofrequency (TrueSTAR) in Cerebral Arteriovenous Malformation**

Sumei Wang[1], Lirong Yan[2], Yan Zhuo[2], Ronald L. Wolf[1], Michael F. Stiefel[1], Jing An[3], Elias R. Melhem[1], Jiongjiong Wang[1]
[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China; [3]Siemens Mindit Magnetic Resonance Ltd., Shenzhen, China

Five patients with arteriovenous malformations (AVMs) were evaluated using a novel dynamic MRA (dMRA) technique termed TrueFISP based Spin Tagging with Alternating Radiofrequency (TrueSTAR). The results are compatible with time-of-flight (TOF) MRA results. Dynamic MRA demonstrated the blood flow pattern through feeding arteries, nidus and draining veins with high temporal resolution (<100ms), and may provide complementary information in the clinical evaluation of AVMs.

14:00 ***4431*. Assessment of Cervical Venous Stenosis in Multiple Sclerosis Patients Using 4D Flow MRI**

Albert Hsiao[1], Greg Zaharchuk[1], Robert Herfkens[1], Nancy J. Fischbein[1], Marcus T. Alley[1], Michael Dake[2]

[1]Department of Radiology, Stanford University, Stanford, CA, United States; [2]Department of Cardiothoracic Surgery, Stanford University, Stanford, CA, United States

Multiple sclerosis patients have unusual venous drainage patterns, which we have characterized using 4D velocity-encoded cine phase contrast MRI.

14:30 ***4432*. High Field in Vivo Magnetic Resonance Imaging of Lenticulostriate Arteries in CADASIL**

Michael K. Liem[1], Saskia A.J. Lesnik Oberstein[2], Maarten J. Versluis[1], Joost Haan[3], Andrew G. Webb[1], Michel D. Ferrari[3], Mark A. van Buchem[1], Jeroen van der Grond[1]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands; [2]Clinical Genetics, Leiden University Medical Center, Leiden, Netherlands; [3]Neurology, Leiden University Medical Center, Leiden, Netherlands

In this study we examined luminal diameters of lenticulostriate arteries in patients with cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL). Twenty-two CADASIL patients and 11 controls were examined using high resolution 3D-time-of-flight magnetic resonance angiography (TOF MRA) imaging on a 7-Tesla MRI scanner. No differences between CADASIL patients and controls were found in length, total number or total cross-sectional area of lenticulostriate artery lumina. Measurements of lenticostriate arteries were not associated with lacunar infarct load in the basal ganglia area.

15:00 ***4433*. Comparison Between 3D Phase Contrast MRI and Computational Fluid Dynamics in Unruptured Intracranial Aneurysms.**

Joppe Schneiders[1], Pim van Ooij[2], Joost van den Berg[1], Ed van Bavel[2], Aart J. Nederveen[1], Charles B. Majoie[1]

[1]Radiology, Academic Medical Center, Amsterdam, Netherlands; [2]Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Netherlands

In this study we compare time averaged 4D MRI of intracranial aneurysms and surrounding vessels with simulations created using Computational Fluid Dynamics(CFD). The vessel geometry is obtained from high resolution 3D rotational angiography and inflow velocity is derived from 2D PC MR velocity measurements. We compared 4 patients with unruptured aneurysms, visualising the intra-aneurysmal flow pattern. With both modalities it is possible to visualise intra-aneurysmal flow patterns, with good agreement between the two different techniques.

Thursday 13:30-15:30 Computer 83

13:30 ***4434*. Global Pulse Wave Velocity in 87 Patients with Acute Ischemic Stroke and Aortic Atherosclerosis**

Andreas Harloff[1], Wolf Wallis, Christoph Strecker, Stephanie Brendecke, Jan Simon, Cornelius Weiller, Jürgen Hennig[2], Michael Markl[2]

[1]Neurology, University Hospital Freiburg, Freiburg, Baden-Württemberg, Germany; [2]Diagnostic Radiology/MR Physics

The aim was to evaluate the feasibility of a new method for estimating aortic pulse wave velocity (PWV) using flow-sensitive 4D MRI. PWV was calculated by fitting a plane to all available data of the upslope portion of multiple flow waveforms along the entire aorta. The value for the assessment of pulse wave velocity in the thoracic aorta was tested in 12 normal subjects and in 87 patients with advanced aortic atherosclerosis. Analysis included a systematic evaluation of reproducibility, inter- and intra-observer variability. Results indicate a relationship of the estimated compliance with age, aortic shape and the presence of disease.

14:00 ***4435*. Flow Residence Time Predicts the Location of Intra-Aneurysmal Thrombus: Numerical Modeling Based on MRA and MRV Data**

Vitaliy L. Rayz[1], Loic Boussel[2], Liang Ge[3], Joe R. Leach[1], Alastair J. Martin[1], Michael T. Lawton[4], David Saloner[1]

[1]Radiology, University of California San Francisco, San Francisco, CA, United States; [2]Creatis-LRMN (LB, PCD), Lyon, France; [3]Surgery, University of California San Francisco; [4]Neurological Surgery, University of California San Francisco

Thrombus deposition in cerebral aneurysms presents an increased risk of thrombo-embolism. The effect of increased flow residence time (RT) on thrombus deposition was investigated using a new numerical flow visualization technique. MR angiography and MR velocimetry data were used to construct patient-specific numerical models of the flow in three basilar aneurysms with known regions of thrombus deposition. The flow RT maps computed with CFD in the base-line geometries were compared with intra-aneurysmal regions that were observed to clot at the follow-up MRI studies. The results show that intra-aneurysmal regions with increased flow residence time are prone to thrombus deposition.

14:30 **_4436_. MR Velocity Mapping of 3D Cerebrospinal Fluid Flow in the Patients with Enlarged Ventricular System: Preliminary Results**

Andreas Stadlbauer[1], Wilma van der Riet[2], Erich Salomonowitz[1]
[1]MR Physics Group, Department of Radiology, Landesklinikum St. Poelten, St. Poelten, Austria; [2]European MRI Consultancy (EMRIC), Strasbourg, France

To study the CSF-flow dynamics in nine patients with enlarged ventricular system and nine volunteers using time-resolved 3D MR velocity mapping. Particle-path-lines were calculated to visualize CSF-flow patterns. From six patients with suspected hydrocephalus internus, four showed a hypomotile and two showed a hypermotile CSF-flow. From two patients with suspected normal pressure hydrocephalus, one showed hypomotile and the other hypermotile CSF-flow. One patient who had undergone a ventriculostomy 10 yrs ago showed normal CSF-flow dynamics. These preliminary findings indicated changes in CSF-flow dynamics in patients with enlarged ventricular system, but further and more detailed studies are necessary.

15:00 **_4437_. Variability in Growth Rates of Fusiform, Dysmorphic Intracranial Aneurysms as Evaluated by CE-MRA**

David Saloner[1,2], Loic Boussel[3], Vitaliy Rayz[1], Alastair Martin[1], Michael Lawton[4]
[1]Radiology, UCSF, San Francisco, CA, United States; [2]VA Medical Center, San Francisco, CA; [3]Radiology, CREATIS-LRMN, Lyon, France; [4]Surgery, UCSF, San Francisco, CA, United States

Estimation of the stability of dysmorphic fusiform aneurysms of the intra-cranial internal carotid artery requires precise monitoring of their volumes. We used MRA and 3D post-processing to study the evolution of these aneurysms on a prosepective cohort of patients with fusiform aneurysms of the intra-cranial internal carotid artery who were studied over multiple time points. The study found that MRA is an excellent method to monitor growth and that 3D quantitative volumetric methods should be employed to monitor whether any growth has occurred. In dysmorphic, fusiform aneurysms of the anterior circulation growth rate was very slow supporting "watchful waiting".

High Resolution Brain Imaging

Hall B Monday 14:00-16:00 Computer 84

14:00 **_4438_. Increased Detectability of Alzheimer Plaques at 7T Vs. 3T Using High Resolution BSSFP**

Michael Zeineh[1], Hagen Kitzler[2], Scott Atlas[1], Brian Rutt[1]
[1]Radiology, Stanford University Medical Center, Stanford, CA, United States; [2]Neuroradiology, Technische Universitaet Dresden, Dresden, Germany

Beta amyloid plaques may have a significant role in the development of Alzheimer's disease. MRI has been used to visualize these plaques in humans ex vivo, but the etiology of the signal changes associated with plaques is unclear. We imaged 5 human AD specimens and 5 normal specimens at 3.0T and 7.0T with a 3.5 hour bSSFP sequence tailored to visualize plaques. While image SNR was approximately 1.7 times higher at high field, presumed plaque CNR was three times higher. This nonlinear increase may be explained by a field-sensitive microscopic component of amyloid plaques.

14:30 **_4439_. Reliable Amygdala Segmentation Using Clustering of Multimodal Data at 7 Tesla.**

Eugenia Solano-Castiella[1], Gabriele Lohmann[1], Andreas Schäfer[1], Robert Trampel[1], Robert Turner[1]
[1]Neurophysics, Max Planck Institute, Leipzig, Sachsen, Germany

The amygdala is a relatively small brain structure. Its location next to the sphenoidal sinus results in a variety of MR image artifacts, which increase with field strength. However, brain scanning at 7T provides considerable improvement of SNR and CNR having the potential for in vivo parcellation of amygdala images into neurologically significant subdivisions that may improve interpretation of fMRI-based neuropsychological studies. To improve clustering we used the strategy of combining images (GRE and TSE) having different contrast mechanisms. The analysis and clustering techniques we have developed for this purpose may assist parcellation of other deep brain structures.

15:00 **_4440_. Segmentation of the Frontal Lobe Using Inversion Recovery Cortical Layers Imaging**

Daniel Barazany[1], Ory Levy[1], Yaniv Assaf[1]
[1]Neurobiology, Tel Aviv University, Tel Aviv, Israel

Inversion recovery (IR) MRI provides a unique contrast that enables segmentation of the cortex in a laminar way. In this work we used multi IR images to cluster the frontal lobe into 5 distinct laminar sub-cortical structures. We found that each cluster has its own relaxation curve. Statistical analysis on the composition of 6 Brodmann's areas (BA) along the frontal lobe has shown that there is an interaction between different BAs and the MRI clusters. To validate our methodology, we were capable to identify the stripe of Gennari at BA17 in the visual cortex using this framework.

15:30 **4441. Anatomical Imaging at 7 T Using 2D GRASE – a Comparison with 2D TSE**

Robert Trampel[1], Robin Martin Heidemann[1], Robert Turner[1]
[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Specific absorption rate (SAR) is a serious problem at high field strengths, especially for sequences such as Turbo Spin-Echo (TSE). For a given desired tissue contrast, SAR reduction can provide either faster imaging or greater spatial coverage per unit time. By omitting most of the refocusing pulses of TSE, and replacing them with segmented EPI readouts, GRASE (Gradient-and-Spin-Echo) incurs much less SAR. Careful comparison of TSE and GRASE images at 7 T showed very similar SNR and contrast. The very slight decrease in GRASE image quality is balanced by a significant reduction in scan time (x 1/3) or increase in spatial coverage (x 3) as compared with TSE.

Tuesday 13:30-15:30 Computer 84

13:30 **4442. MEG-Guided Surface Coil Imaging at 3 Tesla in Patients with Refractory Epilepsy: Preliminary Results**

Samuel Lapere[1], Evelien Carrette[2], Paul Boon[2], Kristl Vonck[2], Xavier De Tiège[3], Eric Achten[1], Karel Deblaere[1]
[1]Department of Radiology, Ghent University Hospital, Ghent, Belgium; [2]Reference Center for Refractory Epilepsy, Department of Neurology, Ghent University Hospital; [3]Laboratoire de Cartographie Fonctionelle du Cerveau, ULB Erasmus Hospital Brussels, Belgium

Patients with refractory epilepsy in whom the epileptogenic zone cannot be precisely identified are not likely to undergo resective surgery. This study aims to assess the potential of surface coil imaging at 3T guided by magnetoencephalography (MEG) to locate the epileptogenic zone. Fifteen patients with dipole clustering on MEG (indicating the possible epileptogenic zone) were scanned with a surface coil at 3T. MEG-guided surface coil imaging at 3T showed an added value in the detection of lesions previously not visible or missed on 3T MRI, and demonstrated an improved delineation and electrophysiological validation of previously known lesions.

14:00 **4443. Increased Gray Matter Volume and Cortical Surface Area of Left Pars Opercularis in Male Orchestral Musicians Correlated Positively with Years of Musical Performance**

Ihssan Abdul-Kareem[1], Andrej Stancak[2], Laura Parkes[3], Vanessa Sluming[1]
[1]School of Health Sciences, Magnetic Resonance and Image Analysis Research Centre, University of Liverpool, Liverpool, United Kingdom; [2]Department of Psychology, University of Liverpool, Liverpool, United Kingdom; [3]Department of Imaging Science and Biomedical Engineering, School of Cancer and Imaging Sciences, University of Manchester, Manchester, United Kingdom

Musicians' brains have long been studied for possible structural brain differences in response to skill acquisition. Broca's region is crucial for several musically relevant abilities. We compare manual gray and white matter volume measurements and automatic cortical surface area measurements of Broca's region subparts: pars opercularis (POP) and pars triangularis between 26 musicians and 26 non-musicians, all right handed. Musicians have significantly increased gray matter volume and cortical surface area of left POP which was positively correlated with years of musical performance. We hypothesize that prolonged skill acquisition is an environmentally enriching activity resulting in structural reorganization of left POP.

14:30 **4444. High Resolution Magnetization Transfer Imaging at 3T VS. 1.5T**

Ying Wu[1,2], Christine O'Brien[3], Christopher Glielmi[4], Hongyan Du[5], Robert Edelman[2,3], Ann Ragin[6]
[1]Radiology , NorthShore University HealthSystem, Evanston, IL, United States; [2]Radiology , University of Chicago; [3]Radiology, NorthShore University HealthSystem, Evanston, IL, United States; [4]Cardiovascular MR R&D, Siemens Healthcare; [5]NorthShore University HealthSystem Research Institute; [6]Radiology, Northwestern University

The increased field strength at 3T significantly improved image quality of high resolution Magnetization Transfer Images, while the increased scan variation at higher field strength is a potential concern; this investigation indicated that relative to 1.5T, the 3T scanner is conducive to more consistent MTR measurement over time. Importantly, our findings in the human study indicate excellent reproducibility in regions such as the hippocampus that are critical regions for detecting early changes in Alzheimer's disease and other neurological disorders. Our results demonstrate the promising potential of high resolution MT for clinical application.

15:00 **4445. Complex Histogram Based Analysis for Visualization of MRI Data**

Peter Arjan Wassenaar[1], Michael V. Knopp[1], Petra Schmalbrock[1]
[1]Radiology, The Ohio State University, Columbus, OH, United States

Especially at high fields, MRI data contain useful information stemming from the presence of paramagnetic material. This work introduces a new approach to visualizing complex MRI data based on the concept of complex histograms. Complex histograms provide a representation of both magnitude and phase data simultaneously. Furthermore, a complex color mapping scheme is introduced for the visualization of complex images, while retaining both magnitude and phase information. Finally, complex histograms may provide the starting point to tissue segmentation through constraints defined in the complex plane.

Wednesday 13:30-15:30 Computer 84

13:30 ***4446*. Imaging at 7T Reveals New Septated Fine Structure in the Human Corpus Callosum**

Chris Wiggins[1], Andreas Schaefer[2], Bibek Dhital[2], Denis Le Bihan[1], Robert Turner[2]
[1]CEA NeuroSpin, Gif-sur-Yvette, France; [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

At 7 T, high resolution structural imaging shows fine details of brain structures in vivo. Examining such images of the adult human corpus callosum, we have discovered two-dimensional planar structures never previously described with traditional histological techniques. Analysis of good quality DTI data at 3T supports this observation, showing a second preferred direction of water diffusion. Interhemispheric axonal connections show detailed laminar ordering at submillimeter scale.

14:00 ***4447*. Magnetic Resonance Imaging of Cranial Nerves at 7 Tesla**

Astrid Ellen Grams[1,2], Oliver Kraff, [1,2], Stephan Orzada, [1,2], Stefan Maderwald, [1,2], Janine Kalkmann[1], Mark E. Ladd, [1,2], Michael Forsting[1], Elke Ruth Gizewski[1,2]
[1]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany; [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Hospital Essen, Essen, NRW, Germany

In the present study the feasibility of cranial nerve imaging with a 7 Tesla whole body scanner was investigated. For this purpose four sequences were evaluated. A 3D-TrueFISP sequence allowed the best cranial nerve detection rate in a reasonable scan time. This sequence seems to be superior at the moment as in the 3D-CISS, the “gold standard” sequence at lower magnetic field strengths, no parallel imaging could be performed.

14:30 ***4448*. Imaging of the Inner Ear at 7T: Initial Results**

Taro Takahara[1], Hans Hoogduin[1], Fredy Vissor[1], Shinji Naganawa[2], Thomas Kwee[1], Peter Luijten[1]
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Radiology, Nagoya Univeristy, Nagoya, Aichi, Japan

To our knowledge, this is the first time the inner ear was imaged at 7T using a 3D-turbo spin echo sequence. Although not all parts of the inner ear could be visualized well due to inhomogeneities, our results are promising and may have a positive impact for future (MR) studies of cochlear implants. Improvement in B1 shimming and dedicated RF pulses are expected to further improve image quality.

15:00 ***4449*. Anatomical Phenotyping of Cerebellum and Vestibulo-Cochlear Organ in Mice Using Contrast Enhanced Micro-MRI**

Kamila Urszula Szulc[1], Edward Joseph Houston[1], Roy V. Sillitoe[2], Alexandra L. Joyner[3], Daniel H. Turnbull[1,4]
[1]Skirball Institute, NYU School of Medicine, New York, NY, United States; [2]Neuroscience, Albert Einstein College of Medicine, New York, NY, United States; [3]Developmental Biology Program, Sloan-Kettering Institute, New York, NY; [4]Radiology, NYU School of Medicine, New York, NY, United States

In this study we demonstrate a potential of contrast enhanced micro-MRI approach for simultaneous anatomical phenotyping of the cerebellum and the vestibulo-cochlear organ in wild type mice and Gbx2-CKO mutant mice, which have severe defects in the Cb in the form of deletion of its central part. Additionally, these mice display abnormalities in the anatomy of flocculus-paraflocculus complex, a region of the Cb that receives projections from the vestibular organs and is critical for normal vestibular function. It was therefore of interest to determine whether the Cb defects were accompanied by additional, previously overlooked abnormalities in the vestibulo-cochlear organ.

Thursday 13:30-15:30 Computer 84

13:30 ***4450*. The Reproducibility of Phase and R_2^* Acquired with Multi Echo Susceptibility Weighted Imaging**

Christian Denk[1], Alexander Rauscher[1]
[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada

Due to their high sensitivity to changes in iron content, phase images and maps of R2* relaxation obtained with gradient echo techniques have been gaining popularity in the imaging of neurodegenerative diseases. However, the reproducibility of these techniques has not been investigated yet. Therefore, we determined the reproducibility of phase and R2* maps acquired with multi echo susceptibility weighted imaging and found that the intersession coefficient of variation is much smaller in phase images than in R2* maps.

14:00 **4451. Vessel Contrast in Susceptibility Weigthed Imaging (SWI) Under Inhalated Anesthesia with Different Oxygen Pressure**

Marina Benito[1], Alexia Rodríguez-Ruano[2], Cristina Chavarrias[1], Paula Montesinos[1], Manuel Desco[1]
[1]Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain; [2]Unidad de Medicina y Cirugía Experimental , Hospital General Universitario Gregorio Marañón, Madrid, Spain

SWI allows to delineate the cerebral veins in high quality, however during the MRI exam animals are anaesthetized. Anesthetics make vary the venous contrast depending on the deepness of anesthesia, but when using inhalated anesthesia the venous response on SWI also depends on the partial pressure of oxygen (pO2) in the supplied gas. This study investigates how the pressure of oxygen in the supplied gas affects the venous contrast in SWI in order to study the microvasculature of the rat brain.

14:30 **4452. Detection of Cerebral Microbleeds with Dual Echo T2*-Weighted MR Imaging at 7.0 Tesla**

Mandy Conijn[1], Mirjam Geerlings, Peter Luijten, Jaco Zwanenburg, Jeroen Hendrikse
[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands

The interest in microbleeds is increasing, however, prevalence estimates differ substantially between studies, due to differences in image protocols and field strengths. This study assessed the visualization of cerebral microbleeds with dual-echo T2*-weighted imaging at 7T MRI in ten patients with vascular disease. The first echo images showed a large contrast between microbleeds and the surrounding tissue. On the second echo images microbleeds were larger in size, but some were not visible due to overlap with structures with a high susceptibility. Dual-echo T2*-weighted imaging combines the advantages of the first and second echo time for the visualization of microbleeds at 7T.

15:00 **4453. High Spatiotemporal Resolution Whole Brain Susceptibility Weighted Imaging Using Parallel Imaging**

Song Lai[1], John Lackey[1]
[1]Radiology, Thomas Jefferson University, Philadelphia, PA, United States

Parallel imaging was explored for speeding up data acquisition of susceptibility-weighted imaging (SWI). Combination of SENSE with segmented EPI lead to sub-minute data acquisition with whole brain coverage and 1mmx1mmx1mm isotropic voxels, making SWI a completely clinically applicable technique for many applications.

fMRI in Brain Disorders

Hall B Monday 14:00-16:00 Computer 85

14:00 **4454. Compensatory Mechanisms During Motor Sequence Learning in Parkinson's Disease. a FMRI Study.**

Maite Aznarez-Sanado[1], Maria Asuncion Fernandez-Seara[1], Federico Villagra[1], Francis R. Loayza[1], Jaione Irigoyen[1], Gonzalo Arrondo[1], Elena Erro[2], Maria Asuncion Pastor[1]
[1]Neuroscience, Center for Applied Medical Research. University of Navarra, Pamplona, Navarra, Spain; [2]Servicio de Neurología, Hospital de Navarra, Pamplona, Navarra

We aimed to study using fMRI differences in neural patterns during motor sequence learning and automatic performance in Parkinson's disease (PD) patients. The comparison of the early learning phase in the PD group with the control group revealed increased activity in cortical and cerebellar areas and right putamen in the PD group. The most affected hand recruited contralateral basal ganglia more significantly than the non affected hand in the PD group.

14:30 **4455. Differential Brain Activation Pattern for a Simple Motor Task in Parkinsonism: An FMRI Study**

Mohit Saxena[1], Senthil S. Kumaran[2], Sumit Singh[1], Madhuri Behari[1]
[1]Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; [2]Department of N.M.R., All India Institute of Medical Sciences, New Delhi, Delhi, India

Parkinsonism including Parkinson's disease, multiple system atrophy and progressive supranuclear palsy, is characterized by motor dysfunction. In this fMRI study, we observed differential activation pattern among the above three categories. Also, motor dysfunction improved with the intake of dopaminergic drugs.

15:00 **_4456_. Levodopa Differentially Modulates Subcortical Activity in Parkinson's Disease During Self-Initiated Internally Timed Movements Compared to Movements Following a Cued Period.**

Jolyn NA D'Andrea[1], Angela Haffenden[2], Sarah Furtado[2], Oksana Suchowersky[2,3], Bradley G. Goodyear, [2,4]

[1]Medical Science, University of Calgary, Calgary, AB, Canada; [2]Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada; [3]Medical Genetics, University of Calgary, Calgary, Alberta, Canada; [4]Radiology, University of Calgary, Calgary, Alberta, Canada

Parkinson's patients have difficulty performing self-initiated movements. Levodopa can reduce this functional deficit by focusing brain activity to areas necessary for task performance. The current study investigates how levodopa modulates brain activity in Parkinson's patients during the performance of internally timed motor tasks, with and without a preceding cue. Our results show that levodopa has a differential effect on the involvement of ipsilateral basal ganglia and thalamus depending on whether internally driven movements are self-initiated or initiated by a cue. This has practical implications for helping Parkinson's patients cope with behavioral deficits, and could impact future pharmacological interventions.

15:30 **_4457_. Gender Dependent Response of Dopaminergic Administration in Parkinson's Disease: A FMRI Study**

Mohit Saxena[1], Senthil S. Kumaran[2], Sumit Singh[1], Madhuri Behari[1]

[1]Department of Neurology, All India Institute of Medical Sciences, New Delhi, India; [2]Department of N.M.R., All India Institute of Medical Sciences, New Delhi, Delhi, India

Parkinson's Disease is a neurodegenerative disorder characterized by tremors apart from bradykinesia, rigidity and postural imbalance. The tremors often present motor dysfunction. We carried out this FMRI study to distinguish the brain activation pattern in the male and female Parkinson's disease patients and the response of dopaminergic drugs in male and female patients.

Tuesday 13:30-15:30 Computer 85

13:30 **_4458_. Prenatal Alcohol Exposure Alters Cortical Functioning in Sustained and Shifting Attention Tasks**

Xiangchuan Chen[1], Claire D. Coles[2], Mary E. Lynch[2], Xiaoping Hu[1]

[1]Biomedical Imaging Technology Center, Emory University, Atlanta, GA, United States; [2]Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, GA, United States

Neural basis underlying behavioral alterations induced by prenatal alcohol exposure (PAE) remains unclear. In this study, fMRI was used to investigate the cortical functioning of individuals with PAE in sustained and shifting attention tasks. The results suggest that the composition of the cortical attention network is not significantly changed by PAE. Instead, the neural activity of some critical regions in this network (FEF and IPS) is significantly reduced, resulting in more involvement of other regions when PAE individuals are performing more difficult tasks. PAE individuals with or without external features may have different functional reorganization and compensation mechanisms.

14:00 **_4459_. Neural Underpinning from Goal-Directed Drug Seeking to Dysfunctional Stimulus-Response Habit: Increased Nucleus Accumbens – Caudate Connectivity in Heroin Addicts**

Alexander D. Cohen[1], Chunming Xie[2], Wenjun Li[1], Theodore Tianrun Zhang[1], Zheng Yang[3], Shi Jiang Li[1]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Biophysics, Medical College of Wisconsin, Milwaukee , WI, United States; [3]Beijing Institute of Basic Medical Science, Beijing, China

This abstract compares resting state functional connectivity (FC) in heroin addicts to matched-control subjects using the nucleus accumbens (NAc) as a seed in an attempt to better understand the underlying processes of addiction. Correlation values were obtained for each subject on a voxelwise basis in 13 addiction associated regions, and then compared via t-test between groups. Increased positive correlation was seen in the left insula, left precuneus, left posterior cingulate cortex, and bilateral caudate body in heroin subjects vs. controls. These results suggest increased NAc – caudate connectivity may underlie the shift from goal directed to habitual behavior in drug addiction.

14:30 **_4460_. Cocaine Exposure History Leads to Distinct Spatial and Temporal Response Patterns to Acute Cocaine Challenge in Rats**

Hanbing Lu[1], Svetlana Chefer[1], Pradeep Kurup[1], Karine Guillem[2], D. Bruce Vaupel[1], Thomas J. Ross[1], Yihong Yang[1], Laura L. Peoples[2], Elliot A. Stein[1]

[1]Neuroimaging Research Branch, National Institute on Drug Abuse, NIH, Baltimore, MD, United States; [2]Department of Psychiatry, University of Pennsylvania School of Medicine, Philadelphia, PA

Drug abuse remains a serious social problem. Long-lasting neuroadaptations following repeated drug exposure are thought to mediate compulsive drug seeking and taking behavior. In the present study, rats were trained to self-administered (SA) either I.V. cocaine (n=10) or oral sucrose (n=13) for 20 days using a long-access exposure regimen (6-h sessions), followed by 30 days of abstinence. A third untreated group (naïve rats, n=10) served as a control. Following an acute cocaine challenge, rats with repeated cocaine exposure history demonstrate significantly reduced response. In particular, in such regions as the prelimbic cortex, the infralimbic cortex and the ACC, cocaine SA rats have negative fMRI response, in contrast to positive response in cocaine naïve rats. These findings reinforce the role of prefrontal cortex in translation of motivational stimuli into adaptive motor response.

15:00 ***4461*.** **Altered Prefrontal-Amygdala Structural Connectivity in Adolescents Prenatally Exposed to Cocaine**

Priya Santhanam[1], Zhihao Li[1], Longchuan Li[1], Claire Coles[2], Mary Ellen Lynch[2], Xiaoping Hu[1]
[1]Department of Biomedical Engineering, Georgia Institute of Technology/Emory University, Atlanta, GA, United States; [2]Department of Psychiatry and Behavioral Sciences, Emory University

As prenatal cocaine exposure (PCE) is known to affect emotional regulation, and since we have previously shown a functional disconnect in the PCE group between regions responsible for such regulation (VMPFC: ventral medial prefrontal cortex and bilateral amygdala), the present study examined the effect of PCE on structural connectivity between the VMPFC and amygdala. Using probabilistic tractography to identify tracts, results showed significantly lower tract volume and FA along the tracts connecting the VMPFC and left amygdala in the PCE group versus controls. This reduced structural integrity may affect functional connectivity and thus emotional regulation in individuals with PCE.

Wednesday 13:30-15:30 Computer 85

13:30 ***4462*.** **Evidence for a Decreased Activity of the Resting State Motor Network in Patients with ALS**

Massimo Filippi[1], Martina Absinta[1], Federica Agosta[1], Maria A: Rocca[1], Paola Valsasina[1], Stefania Sala[1], Nilo Riva[2], Alessandro Prelle[3], Domenico Caputo[4], Michele Perini[5], Raffaella Fazio[2], Giancarlo Comi[2]
[1]Neuroimaging Research Unit, Institute of Experimental Neurology, Division of Neuroscience, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [2]Department of Neurology, Scientific Institute and University Hospital San Raffaele, Milan, Italy; [3]Dino Ferrari Center, Department of Neuroscience, University of Milan, Milan, Italy; [4]Department of Neurology, Scientific Institute Fondazione Don Gnocchi, Milan, Italy; [5]Department of Neurology, Ospedale di Gallarate, Gallarate, Italy

Functional connectivity within the sensorimotor networks during rest were explored in 19 amyotrophic lateral sclerosis (ALS) patients. Relationship between resting state (RS) fMRI and corticospinal tract (CST) damage was assessed. ICA analysis revealed two networks related to the sensorimotor system. ALS patients had voxels of decreased RS connectivity in the left primary sensorimotor cortex (SMC). Compared with controls, ALS patients also showed decreased average percentage RS signal change in several sensorimotor regions. Decreased RS activity in the SMC correlated with CST damage. Dysfunction of RS sensorimotor connectivity in ALS is likely to be a response to a selective CST damage.

14:00 ***4463*.** **Comparison of Cortical Stimulation and FMRI for Language and Motor Localization in Pediatric Patients**

Andrew Poliakov[1], Dennis Shaw[2], Hillary Shurtleff[3], Molly Warner[3], Russell Saneto[4], John Kuratani[4], Edward Novotny, Jeff Ojemann[5]
[1]Radiology , Seattle Children's Hospital, Seattle, WA, United States; [2]Radiology, Seattle Children's Hospital, Seattle, WA, United States; [3]Neurology, Seattle Children's Hospital, Seattle, WA, United States; [4]Clinical&Translational Science, Seattle Children's Hospital, Seattle, WA, United States; [5]Neurological Surgery, Seattle Children's Hospital, Seattle, WA, United States

We review our experience comparing fMRI to ESM for surgical planning in pediatric patients with intractable epilepsy.

14:30 ***4464*.** **Clinical FMRI Memory Evaluation in Pediatric Patients**

Andrew Poliakov[1], Hillary Shurtleff[2], Molly Warner[2], Dennis Shaw[3], Sumit Pruthi[1], Samuel Browd[4], Edward Novotny[4], Jeff Ojemann[4]
[1]Radiology , Seattle Children's Hospital, Seattle, WA, United States; [2]Neurology, Seattle Children's Hospital, Seattle, WA, United States; [3]Radiology, Seattle Children's Hospital, Seattle, WA, United States; [4]Integrative Brain Research, Seattle Children's Hospital, Seattle, WA, United States

We developed a evaluated and fMRI paradigm for visual-spatial memory testing in pediatric patients

15:00 ***4465*.** **Altered Brain Activity of Defautl Mode Network in Patients with Liver Cirrhosis**

Tun Wei Hsu[1,2], Wei Che Lin[1,3], Ching Po Lin[1]
[1]Institute of Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan; [2]Department of Diagnostic Radiology, Taipei Veterans General Hospital, Taipei, Taiwan; [3]Department of Diagnostic Radiology, Chang Gung Memorial Hospital, Kaohsiung, Taiwan

Hepatic encephalopathy (HE) is one of the major complications of liver cirrhosis and a complex neurophysiological syndrome. It will be acts of confusion, personality changes, conscious changes and ups and downs of the neurological manifestations. Our purpose of this study is to investigate abnormalities of default mode networks in patients with liver cirrhosis.

Thursday 13:30-15:30 Computer 85

13:30 ***4466*. fMRI in Systemic Lupus Erythematosus and Antiphospholipid Syndrome**

Aziz M. Ulug[1], An Vo[1], Elisabeth Kozora[2,3], Glendalee Ramon[4], Joann Vega[4], Robert D. Zimmerman[5], Doruk Erkan[4], Michael D. Lockshin[4]

[1]The Feinstein Institute for Medical Research, Manhasset, NY, United States; [2]National Jewish Heath, Denver, CO, United States; [3]University of Colorado Medical Center, Denver, CO, United States; [4]Hospital for Special Surgery, New York, United States; [5]Weill Medical College of Cornell University, New York, United States

Fourteen SLE patients, five APL patients and four normal controls were studied using fMRI and DTI. We found significant DTI and fMRI differences among three groups. In both patient groups, word generation task shows abnormal activation patterns in the frontal areas suggestive of recruitment of these areas during these tasks. In the hippocampal area, there is a significant difference between APL and SLE group during N-back, word generation and rhyming tasks. In addition to regional differences, there is also whole brain diffusion changes between the patient groups and controls.

14:00 ***4467*. Retinotopy Extension in Primary Visual Cortex Associated with Perimetry Improvement in a Case of Hemianopia After Visual Restoration Therapy**

Yi-Ching Lynn Ho[1,2], Amandine Cheze[2], Esben Thade Petersen[2,3], Albert Gjedde[1,4], Kong-Yong Goh[5], Yih-Yian Sitoh[2], Xavier Golay[2,6]

[1]CFIN, University of Aarhus, Aarhus, Denmark; [2]Neuroradiology, National Neuroscience Institute, Singapore, Singapore; [3]Clinical Imaging Research Centre, NUS, Singapore; [4]University of Copenhagen, Denmark; [5]Eye Institute, Tan Tock Seng Hospital, Singapore; [6]Institute of Neurology, UCL, London, United Kingdom

So far, no clear physiological correlates have been given for the apparent visual field improvements of patients with post-chiasmal lesions after treatment, such as Visual Restoration Therapy (VRT). Using fMRI retinotopic mapping, we assessed a patient with complete homonymous hemianopia before and after VRT. The patient demonstrated residual neurovascular function and limited retinotopic organization around the lesion before therapy. Post therapy, the retinotopic representation around the lesion was modestly extended along with perimetry improvements, which may, to our knowledge, be the first report on primary visual cortex retinotopy recovery via ad hoc treatment of a patient with visual field loss.

14:30 ***4468*. fMRI Study of Sound-Color Synesthesia**

Jianli Wang[1], Melissa Robinson-Long[2], Khristy Thompson[3], Paul J. Eslinger[2,4], Catherine Lemley[5]

[1]Radiology, Penn State University College of Medcine, Hershey, PA, United States; [2]Neurology, Penn State University College of Medcine, Hershey, PA, United States; [3]Biology, Elizabethtown College, Elizabethtown, PA, United States; [4]Neural and Behavioral Sciences, Penn State University College of Medicine, Hershey, PA, United States; [5]Psychology, Elizabethtown College, Elizabethtown, PA, United States

Synesthesia is a condition that stimulation of one sensory modality will automatically trigger another un-stimulated perception modality. Here we reported the first fMRI study on sound-color synesthesia. The result shows that color center, angular gyrus and superior parietal cortex are involved in some sound-color photisms. Background noise control is critical in the study of sound-color synesthesia using fMRI. Our observation suggests that there may be different levels or subcategories of sound-color synesthesia and attention distraction may be an effective method for defining subcategories of this synesthesia.

15:00 ***4469*. fMRI in Patients with Lumbar Disc Disease: A Paradigm to Study Patients Over Time**

Harish A. Sharma[1], Raj Gupta[2], William Olivero[3]

[1]Beckman Institute, University of Illinois at Urbana-Champaign, Urbana, IL, United States; [2]University of Illinois College of Medicine; [3]Neurosurgery, Carle Foundation Hospital

Using fMRI to study pain has revealed new information about how the brain responds to painful stimuli and what regions of the brain are activated during pain. Unfortunately, many of the paradigms that are used in fMRI studies either fail to replicate the subject's pain or painful stimuli is used in volunteers without pain. Moreover, longitudinal fMRI studies that follow patients who develop chronic pain from the acute phase of pain have not been performed.We developed an fMRI paradigm that reliably mimics a clinical pain syndrome in patients who have low back pain and leg pain from acute lumbar radiculopathy and lumbar degenerative disc disease.

DTI - Clinical Applications

Hall B Monday 14:00-16:00 Computer 86

14:00 ***4470*. Relationship Between Diffusion Entropy and Axonal Density in Human Brain**

Quan Jiang[1,2], Niloufar Fozouni[1,2], Siamak Pourabdollah-Nejad[1], Zheng Gang Zhang[1], Norman L. Lehman[3], Steven Gu[4], Jiani Hu[5], Hassan Bagher-Ebadian[1], Michael Chopp[1,2]
[1]Neurology, Henry Ford Health System, Detroit, MI, United States; [2]Physics, Oakland University, Rochester, MI, United States; [3]Pathology, Henry Ford Health System, Detroit, MI, United States; [4]Cornell University; [5]MR Center, Wayne State University, Detroit

To overcome errors introduced via the assumption of a Gaussian diffusion tensor model when dealing with multiple fiber orientations, a diffusion entropy measurement is introduced to evaluate its relationship with axonal density and its ability to characterize brain tissues in different brain structures. Entropy appears not only to exhibit enhanced dynamic range of contrast compared with FA but also demonstrated a significant correlation with axonal density measured from immunohistological analysis. Our data suggest that entropy may provide important information on axonal reorganization in neurological diseases.

14:30 ***4471*. Comparison of FA Values from TBSS Vs Manual ROI**

Nancy Rollins[1,2], Michael Morriss[1], Jonathan Chia[3], Zhiyue Jerry Wang
[1]Radiology, Childrens Medical Center, Dallas, TX, United States; [2]Radiology, University Texas Southwestern Medical Center, Dallas, TX, United States; [3]Philips HealthCare Systems

Operator-indepedant computerized analysis of FA and manual ROI analysis may be complimentary. However, aalues derived from these 2 techniques may not be in agreement in all regions of the brain and the “gold standard” for determination of FA has not been determined.

15:00 ***4472*. Method for Assessing Reproducibility of Tractography Methods : Comparison Between Algorithms Used in Clinical Routine.**

Fatima Tensaouti[1,2], Ihssan Lahlou[2], Jean Albert Lotterie[1,2], Isabelle Berry[1,2]
[1]Service Biophysique et Médecine Nucléaire, CHU Toulouse Rangueil,, Toulouse, France; [2]Université Paul Sabatier, Toulouse III, Toulouse, France

The aim of the study is to evaluate the fiber tracking strategy in terms of acquisition schemes in conjunction with four algorithms: three deterministic (tensor deflection, tensor lines, streamlines) and statistical algorithm. The pyramidal tract was investigated in 12 healthy subjects. Quantitative comparison between tracts was calculated by using boolean operators on tractus volumes. Inter-exam reproducibility was evaluated by comparing fiber tracking results from the same acquisition scheme on the first and second exam. The study highlights growing reliability of reproducibility results based on the number of directions employed during the acquisition and the method of tractography used.

15:30 ***4473*. Novel Standardization Algorithm GAMA for Repetitive Evaluation of Fractional Anisotropy in Diffusion Tensor Imaging**

Akira Matsushita[1], Satoru Osuka[1], Yasushi Shibata[1], Kousaku Saotome[2], Yasushi Nagatomo[3], Yoji Komatsu[4], Satoshi Ayuzawa[1], Akira Matsumura[1]
[1]Department of Neurosurgery, University of Tsukuba, Tsukuba, Ibaraki, Japan; [2]Dept. of Radiological Technology, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan; [3]Dept.of Neurosurgery, Mito Gamma House, Katsuta, Ibaraki, Japan; [4]Dept. of Neurosurgery, Tsukuba Medical Center Hospital, Tsukuba, Ibaraki, Japan

It is important that the region of interest (ROI) has enough repeatability especially for serial measurement. We developed the novel algorithm and software GAMA using diffusion tensor imaging. The GAMA can point out the regions as corpus callosum or pyramidal tract automatically. Therefore, we can use GAMA with very brief handling. Additionally, GAMA could evaluate FA in that region with higher reproducibility than the conventional ROI methods with the free-handed ROI or the size-fixed sphere ROI.

Tuesday 13:30-15:30 Computer 86

13:30 ***4474*. White Matter Integrity Analyzed by Tract-Based Spatial Statistics in Elderly Subjects Without White Matter Lesions**

Daniel Han-en Chang[1], L Tugan Muftuler[1], Huali Wang[2,3], Orhan Nalcioglu[1], Min-Ying Lydia Su[1]
[1]Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Dementia Care Research Center, Peking University Institute of Mental Health, Beijing, China; [3]Key Laboratory for Mental Health, Ministry of Health, Beijing, China

Subjects with Alzheimer’s and mild cognitive impairment have decreased white matter integrity in comparison to healthy controls, which can quantified as fractional anisotropic (FA) and mean diffusivity (MD) values by DTI methods. Tract-based-spatial-statistics (TBSS) is a frequently used robust method for comparing FA maps between different subject groups; however, most published studies analyzed subjects without excluding subjects with white matter lesions, which may have an effect on FA and MD values. In order to examine this possible effect, we excluded subjects with white matter lesions from our study cohort and performed TBSS. Our results were consistent with what literature reports.

14:00 ***4475*. Probabilistic Fiber Tracking from the Pre-SMA and SMA Proper: Implications for Language and Motor White Matter Networks**

Kyung K. Peck[1], Seyedeh Jenabi[2], Robert Young, Lucas Parra[2], Andrei Holodny
[1]Medical Physics and Radiology, Memorial Sloan-Kettering Cancer Center, New York, United States; [2]City University of New York

In this study, we seek to expand on this study by using diffusion tensor imaging to compare the pattern of white matter fibers originating from two different fMRI guided seed regions; the pre-SMA and the SMA-proper defined by fMRI language and motor paradigm respectively. We hypothesized that pre-SMA seed derived from the language paradigm will connect more readily to the frontal areas known to be associated with language function including Broca's Area

14:30 ***4476*. Correlation of Quantitative Sensori-Motor Tractography with Clinical Grade of Cerebral Palsy**

Richa Trivedi[1], Shruti Agarwal[2], Vipul Shah[3], Puneet Goyal[4], Vimal K. Paliwal[5], Ram KS Rathore[6], Rakesh Kumar Gupta[7]
[1]NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences, Delhi, India; [2]Mathematics and Statistics, Indian Institute of Technology, Kanpur, Uttar Pradesh, India; [3]3Pediatric Orthopedic Surgery unit, Bhargava Nursing Home, Lucknow, Uttar Pradesh, India; [4]Anesthesiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [5]Neurology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India; [6]Mathematics and Statistics, Indian Institute of Technology, , Kanpur, Uttar Pradesh, India; [7]Radiodiagnosis, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

Diffusion tensor tractography using FACT algorithm was performed on 39 children with different grades of cerebral palsy (CP) defined using the Gross Motor Function Classification System (GMFCS) to look for probable correlation between tract-specific DTI metrics in sensorymotor pathways and clinical grades. A significant inverse correlation was observed between fractional anisotropy (FA) in both sensory and motor pathways and clinical grades. In this study we extend our understanding of the pathophysiology of CP by showing that DTI measures in both motor and sensory pathways reflects the degree of motor deficits.

15:00 ***4477*. Study of Neuropsychiatric Systemic Lupus Erythematosus with DTI and FAIR**

Xiaozhen Li[1], Zhengguang Chen[2]
[1]Radiology, Peking Union Medical College Hospital, Beijing, China; [2]Radiology, First Hospital of Tsinghua, Beijing, China

Conventional neuroimaging cannot help us either to differentiate between chronic and acute brain lesions or to improve in our understanding of systemic lupus erythematosus (SLE) pathogenesis because of the high probability of a Neuropsychiatric SLE (NPSLE) event. The fMRI including DTI, which demonstrates the tissue water mobility in brain tissue, and flow-sensitive alternating inversion recovery (FAIR), which reveals the relative cerebral blood flow, may help to further assess the possible abnormality in neuronal and neural vascular reactivity in NPSLE. In this study we found in combination of ADC, FA, rCBF have high sensitivity in detecting earlier pathologic changes in NPSLE.

Wednesday 13:30-15:30 Computer 86

13:30 ***4478*. Diffusion Tensor Imaging Permits Detection of Disjunct MD and FA Changes in the Basal Ganglia in Patients with Susac's Syndrome**

Michael Deppe[1], Ilka Kleffner[1], Siawoosh Mohammadi[1], Wolfram Schwindt[2], Katja Deppe[3], Simon S. Keller[1], E. Bernd Ringelstein[1]
[1]Neurology, University of Münster, Münster, Germany; [2]Radiology, University of Münster, Münster; [3]Neurology, Franz Hospital Dülmen

By employing a highly effective spatial normalization technique for diffusion weighted images we found evidence that DTI is sensitive in detecting damage to white matter that is of normal appearance in Susac's Syndrome using conventional MRI methods. Grey matter (GM) alterations in Susac's syndrome are also detectable by DTI as circumscribed FA and MD increases in the basal ganglia that are also not observed using conventional MRI. The alterations in basal ganglia MD and FA are differentially localized to the pallidum and putamen, respectably.

14:00 **_4479_. Voxel-Based Analysis of High- And Standard B-Value Diffusion Weighted Imaging and Voxel-Based Morphometry in Inherited Prion Disease**

Enrico De Vita[1,2], Harpreet Hyare[1,3], Gerard Ridgway[4], Simon Mead[3], Peter Rudge[3], John C. Collinge[3], Tarek A. Yousry[1,2], John S. Thornton[1,2]

[1]Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, United Kingdom; [2]Academic Neuroradiological Unit, Institute of Neurology, University College London, London, United Kingdom; [3]MRC Prion Unit, Institute of Neurology, University College London, London, United Kingdom; [4]Dementia Research Centre. Dept. of Neurodegenerative Diseases, Institute of Neurology, University College London, London, United Kingdom

Diffusion weighted imaging (DWI) is the most sensitive MRI sequence for diagnosis in human prion disease. High-b-value (b~3000s/mm2; b3k) DWI was shown to be more sensitive to pathology in sporadic Creutzfeldt-Jacob disease than standard DWI (b~1000s/mm2; b1k). Most previous prion disease studies used region of interest analyses. We employed operator-independent voxel-based morphometry and voxel-based analysis (VBA) of DWI (b1k and b3k) to characterise structural parenchymal changes in inherited prion disease (iPD) patients. In this cohort, DWI-VBA resulted more sensitive than VBM, potentially indicating microstructural changes occurring before grey matter atrophy becomes detectable; b1k acquisitions resulted relatively more sensitive vs b3k.

14:30 **_4480_. Mapping the Distribution of Local Cross-Term Gradients Using DTI in Patients with Alzheimer¡¯s Disease**

Geon-Ho Jahng[1], Songfan Xu[2], Chang-Woo Ryu[1], Dal-Mo Yang[1], Dong-Wook Sung[3], Dong Ho Lee[3], Seungjoon Park[4]

[1]Radiology, East West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; [2]Biomedical Science, Graduate School of Medicine, Kyung Hee University, Seoul, Korea, Republic of; [3]Radiology, KHU Hospital, Kyung Hee University, Seoul, Korea, Republic of; [4]Pharmacology and and Biomedical Science, School of Medicine, Kyung Hee University, Seoul, Korea, Republic of

To map the strength of a local cross-term gradient among diffusion, imaging, and background gradients in groups of AD, MCI, and cognitive normal (CN), two DT-MRI sets with positive and negative polarities of diffusion-sensitizing gradients were obtained in 15 AD and18 MCI patients and 16 CN controls with four b-values. The cross-term b-value (bc) maps for each subject group were calculated. The bc differs locally between AD patient and MCI or CN subjects, but not between MCI and controls and we may obtain the strength of a local background gradient using DTI data.

15:00 **_4481_. Lateralisation of Perisylvian Pathways with Age in Asperger’s Syndrome – a Cross-Sectional DTI Study**

Sanja Budisavljevic[1], Flavio Dell'Acqua, Stephanie Forkel, Michel Thiebaut de Schotten, Marco Catani

[1]Department of Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, King's College, London, United Kingdom

Using DT-MRI tractography we investigated lateralisation of perisylvian pathways with age in Asperger’s Syndrome. We observed that the indirect pathway of the arcuate fasciculus shows abnormal development with age in people with Asperger’s syndrome compared to controls. This suggests that abnormalities in white matter development may be a key feature of autism spectrum disorders and may explain impairments in language and communication.

Thursday 13:30-15:30 Computer 86

13:30 **_4482_. Longitudinal Changes of DTI Parameters During Acute and Sub-Acute Phase Following Mild Traumatic Brain Injury Using Tract-Based Spatial Statistics Analysis: The Preliminary Results**

Tong Zhu[1], Jeffrey Bazarian[2], Jianhui Zhong[1]

[1]Imaging Sciences, University of Rochester, Rochester, NY, United States; [2]Emergency Medicine, University of Rochester, Rochester, NY, United States

DTI studies of both human mTBI subjects and animal TBI models have shown different alteration patterns of tensor derived parameters, such as fractional anisotropy (FA), axial and radial diffusivity, with the accompanying neurological impairments following initial concussions. In this study, we performed a prospective longitudinal study of mTBI patients with three DTI scans for each subject to characterize the acute (within 24 hrs), late acute (1 week) and sub-acute (1 month) phase following mTBI. The tract-based spatial statistics (TBSS) was performed to achieve voxelwise statistical comparisons of longitudinal changes of DTI parameters for quantification of white matter micro-structural alterations. In 13 mTBI patients and 21 healthy controls analyzed so far we observed decreased FA and increased radial diffusivity in several major white matter tracts such as the genu corpus callosum, the anterior corona radiata and the internal capsule, although our findings are only approaching significance ($p<0.1$) due to the small number of subjects and subtle DTI changes in acute mTBI. Different from increased radial diffusivity due to demyelination in the recovery phase (9-15 months) of TBI, increased radial diffusivity as well as consequently decreased FA in the acute phase of mTBI may reflect possible neurofilament misalignments which create projections of the principal diffusivity onto the transverse plane.

14:00 **4483. Deformable Registration and Tract-Based Spatial Analysis of Diffusion Tensor MR Images in Mild Traumatic Brain Injury of Military-Related Blast Injury**

Ping-Hong Yeh[1], Binquan Wang, Terrence R. Oakes, [2], Louis M. French[3], David F. Moore[3], Gerard Riedy, [2,4]

[1]Henry Jackson Foundation for Military Medicine, Rockville, MD, United States; [2]National Capital Neuroimaging Consortium, Walter Reed Army Medical Center, Washington DC; [3]Defense and Veterans Brain Injury Center, Walter Reed Army Medical Center,; [4]Department of Radiology and Radiological Sciences, Uniformed Services University

Evaluating the white matter disruption in mild traumatic brain injury (mTBI) is challenging. The study investigated mTBI in military-related blast injury using diffusion tensor imaging. High-dimensional spatial normalization of diffusion tensor images, atlas reconstruction and tract-based spatial analysis were applied to assess the physiological and geometric changes in mTBI, and their relationships with neuropsychopathic symptoms. The features of micro- and macro-structural changes varied within the mTBI group. Greater severity of neuropsychopathic symptoms was associated with the disconnection in fronto-(sub)cortical, fronto-limbic and inter-hemispheric circuitry. Optimizing spatial normalization method can help detect white matter disruption in mTBI using a low field clinical scanner.

14:30 **4484. Diffusional Kurtosis Imaging of Deep Gray Matter in Mild Traumatic Brain Injury**

Elan J. Grossman[1], Yulin Ge[1], Jens H. Jensen[1], James S. Babb[1], Joseph Reaume[1], Jonathan A. Silver[2], Robert I. Grossman[1], Matilde Inglese[1]

[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, United States; [2]Department of Psychiatry, NYU School of Medicine, New York, United States

While conventional imaging has been unsuccessful detecting cerebral damage in mild traumatic brain injury (MTBI), investigations using DTI report evidence of diffuse axonal injury. The purpose of the current study is to assess whether DKI, which measures non-Gaussian diffusion of water, can provide additional complimentary information about MTBI pathology. In addition to white matter regions we investigated thalamus and basal ganglia in patients with MTBI using DKI and DTI. Differences from controls were observed in thalamus and posterior internal capsule of acute and chronic MTBI patients. This suggests that DKI and DTI might be prognostic markers of persistent post-concussive syndrome.

15:00 **4485. Combined Quantitative Diffusion Tensor and 1H Magnetic Resonance Spectroscopic Imaging Findings in Patients with Persistent Neurocognitive Deficits Following a Mild Traumatic Brain Injury.**

Brenda Bartnik Olson[1], Kimberly Conley[2], Karen Tong[1], Sarah Uffindell[3], Valerie Wong[4], Barbara Holshouser[1]

[1]Dept. of Radiology, Loma Linda University, Loma Linda, CA, United States; [2]School of Medicine, Loma Linda University, Loma Linda, CA, United States; [3]Dept. of Neurology, Loma Linda University, Loma Linda, CA, United States; [4]Redlands Pediatric and Adult Medicine, Loma Linda University, Loma Linda, CA, United States

Neurocognitive deficits occur in approximately 50-80% of mild TBI patients, which may persist for several years after injury even though conventional imaging is normal. In this study we used diffusion tensor and 1H magnetic resonance spectroscopic imaging to evaluate if microstructural and/or metabolic abnormalities are present in mTBI subjects with persistent neurocognitive deficits. Our findings show that regions of neuronal loss or dysfunction are present in the left anterior internal capsule and left occipital white matter of mild TBI patients. In addition, increased fractional anisotropy in the left anterior internal capsule may be related to an increase in extracellular space adjacent to remaining axons after the loss of a subset of corticospinal tract fibers. Our findings suggest that both metabolic and ultrastructural changes persist following a mild TBI which may relate to continued neurocognitive deficits seen in these subjects.

Animal Models of Stroke & Ischemia

Hall B Monday 14:00-16:00 Computer 87

14:00 **4486. Serial MR Analysis of Permanent and Transient Cerebral Ischemia in a Rat Model: High and Low B Value Diffusion – Weighted Imaging and Diffusion Tensor Imaging**

Ji-hoon Kim[1], Kee-Hyun Chang, Chul Ho Sohn, Sung Hong Choi, Yoo Jung Yim, Chang Min Park, In Chan Song

[1]Radiology, Seoul National University Hospital, Seoul, Korea, Republic of

We tried to determine the serial changes in FA, ADC and DWI signal intensity at high and low b values during early cerebral ischemia and transient ischemia and investigated their relationships. With 30 male Sprague-Dawley rats of middle cerebral artery occlusion (MCAO) of the suture occlusion model, PWI, DTI, high and low b value DWI were performed for hyperacute (n=9) and acute (n=13) permanent ischemia groups and transient (n=8) ischemia group. Although time-ADC curve showed early initial decrease until 3 hour and then increasing tendency, Time – FA curve showed initial increase, transient plateau until 1 hour, and then sequential decrease in permanent ischemia group. In transient ischemia group, FA showed transient reversibility and secondary decay in transient ischemia group, correlating with ADC change. Although the lesion contrast ratio of DWI in early ischemic tissue was larger at high b value. But, the lesion contrast ratio of ADC map was smaller at high b value than low b value. These results might be related to the initial shift of water from extracellular to intracellular space and biexponential decay of cerebral water diffusion.

14:30 **4487. Diffusion Tensor Imaging Indices in a Model of Focal Ischemia in Rats**

Usama Abo-Ramadan[1,2], Miia pitkonen[2], Eric Pedrono[2], Ivan Marinkovic[1,2], Aysan Durukan[1,2], Turgut Tatlisumak[1,2]

[1]Dept of Neurology, Helsinki Uiversity Central Hospital, Helsinki, Finland; [2]Experimental MRI Laboratory, Biomedicum Helsinki, Helsinki, Finland

We measure the DT indices changes in stroke model from the hyperacute to chronic phase. Rats are sub-jected to focal cerebral ischemia for 90 minutes followed by reperfusion. DT imaging studies were performed with a 4.7 T scanner. Significant DT indices changes were related to the evolution of the transient MCAO. DTI indices may allow separate evaluation of the treatment response of white and gray matter to neuroprotective therapy. DTI analysis of directional diffusivities could provide additional information to FA and MD, and may reflect more specifically the histological changes of reduced mye-lination and axonal injury.

15:00 **4488. Unique Pattern of Diffusion Metrics Sheds Light on Cellular Changes During Hypoxic-Ischemia**

Ahmed Shereen[1], Diana Lindquist[2], Chia-Yi Kuan[3]

[1]Department of Physics, University of Cincinnati, Cincinnati, OH, United States; [2]Imaging Research Center, Cincinnati Children's Hospital Medical Center, United States; [3]Division of Neurology, Cincinnati Children's Hospital Medical Center

Using diffusion tensor imaging (DTI), we characterized an animal model of leukoaraiosis, a condition caused by chronic hypoxic-hypoperfusion which often leads to post-stroke dementia. We observed radial diffusivity decrease in white matter, contrary to previous findings of increases in radial diffusivity attributed to demyelination after hypoxic-ischemia. Further examination using electron microscopy revealed rapid separation of myelin sheaths and protrusion of myelin-coated vesicles which created multiple intercellular compartments to restrict radial and axial diffusion with minimum change in fractional anisotropy. These results suggest a biophysical mechanism behind leukoaraiosis which may be inferred from unique patterns in DTI metrics.

15:30 **4489. Progression of MRI Changes and Their Correspondence with Histological Changes in the Descending Corticospinal Tract Following Neonatal Hypoxic-Ischemic Infarction.**

Ursula I. Tuor[1], Sanju Lama[2], Edwin Cheng[3], Dave Kirk, Tadeusz Foniok[4]

[1]Institute for Biodiagnostics (West), National Research Council of Canada , Calgary, Alberta, Canada; [2]Medical Science, University of Calgary; [3]Experimental Imaging Centre, University of Calgary, Calgary, Alberta, Canada; [4]Institute for Biodiagnostics (West), National Research Council of Canada, Calgary, Alberta, Canada

In the present study we investigate both the acute and chronic changes in T2 and diffusion weighted images containing the descending corticospinal tract following a unilateral cerebral hypoxic-ischemic insult in neonatal rats. Diffusion weighted and T2 increases along with ADC decreases occur at relatively acute times post hypoxia-ischemia whereas both T2 and ADC are increased more chronically. The corresponding axonal changes detected using immunohistochemistry for neurofilaments and silver staining provides corresponding evidence for Wallerian degeneration. These results should assist in the diagnosis and timing of MR imaging changes detected clinically in human neonates following stroke.

Tuesday 13:30-15:30 Computer 87

13:30 **4490. Spatial-Temporal MRI Responses of Stroke Rats to Oxygen Challenge**

Qiang Shen[1,2], Shiliang Huang[1], Fang Du[1], Timothy Q. Duong[1,2]

[1]Research Imaging Institute, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States; [2]Department of Ophthalmology/Radiology, University of Texas Health Science Center at San Antonio, San Antonio, TX, United States

The identification of ischemic penumbra is of utmost importance for the initiation of treatment strategies. Although diffusion/perfusion MRI mismatch has been used to be an estimate of penumbra, it has been demonstrated overestimation of penumbra. Beside perfusion deficit, a marker of metabolism is essential to better define penumbra. In this study, the spatial and temporal responses of stroke rats to 100% oxygen challenge were investigated. DWI/PWI mismatch region showed significant higher than normal T2*-weighted signal increase. Tissue with higher than normal T2*-weighted signal increase during OC and spatially around the ischemic core could be a better estimation of penumbra.

14:00 **4491. T2 Component "area Fractions": A Possible Marker for Ischemic Penumbra**

Jeff F. Dunn[1,2], Thorarin A. Bjarnason[3], Tonima Ali[3], Ying Wu[1,2], Cheryl R. McCreary[1,2], Ross J. Mitchell, [2,4]

[1]Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta, Canada; [2]Department of Radiology, University of Calgary, Calgary, Alberta, Canada; [3]Biomedical Engineering, University of Calgary; [4]Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada

Quantitative T2 (qT2) has been used to identify a range of pathophysiology in brain including multiple sclerosis. We have extended the application of qT2 to that of assessing heterogeneity of stroke within an experimental infarct in a rat brain. We have applied a recently published voxel-based approach, which allows for assessment of heterogeneity of T2 components. It was determined that the proportion of the total T2 which relates to the 50-60ms range results in visualization of the periphery of the infarct. This type of approach may be useful in identification of the ischemic penumbra.

14:30 **4492. Characterization of Mild Hypoxic-Ischemic Injury in Multiple White Matter Tracts in a Neonatal Rat Model by Diffusion Tensor MR Imaging**

Silun Wang[1,2], ED X. WU[3], Ho-fai Lau[3], Jing Gu[1], Jinyuan Zhou[2], Pek-lan Khong[1]
[1]Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong; [2]Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States; [3]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, Hong Kong

We evaluated hypoxic-ischemic (HI)-induced white matter (WM) injury in a mild HI neonatal rat model from Day1 to 90 post-HI by DTI. Results showed that significantly decreased FA in multiple injured WM tracts, including external capsule (EC), fornix (F), cerebral peduncle (CP) and optical tracts (OT), at different time points, but no differences were demonstrated in anterior commissure (AC). Our results support the use of DTI as an imaging biomarker to non-invasively monitor the severity and longitudinal changes of mild HI-induced WM injury. Different severity and patterns of WM tract injury may reflect disturbances of cerebral blood supply in this ischemic animal model.

15:00 **4493. DTI of Adult Visual Pathways After Severe Neonatal Hypoxic-Ischemic Cerebral Injury**

Kevin C. Chan[1,2], Abby Y. Ding[1,2], 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

This study employs in vivo diffusion tensor imaging (DTI) to determine the long-term outcomes of microstructural integrity along the visual pathways after severe neonatal hypoxic-ischemic (HI) injury to the entire ipsilesional visual cortex in rats at postnatal day 7. Quantitative analyses showed that, compared to age-matched normal brains, a significantly lower FA but higher $\lambda_{//}$, $\lambda_{\perp}$ and diffusion trace value were observed in the ipsilesional posterior optic tract in the HI-injured brains at postnatal day 60, whereas significantly lower FA but mildly lower $\lambda_{//}$ and higher $\lambda_{\perp}$ and trace were observed in the ipsilesional prechiasmatic optic nerve and contralesional anterior and posterior optic tracts. The results of this study are potentially important in determining and improving the functional consequences of the brain lesion after most compensatory and reparative phases have been passed.

Wednesday 13:30-15:30 Computer 87

13:30 **4494. Comparison of MRI Measured Mean Micro-Vessel Segment Length and Micro-Vessel Radius and Laser Scan Confocal Microscopy After Embolic Stroke**

Asamoah Bosomtwi[1,2], Quan Jiang[2,3], Li Zhang[2], Zheng Gang Zhang[2,3], Michael Chopp[2,3]
[1]Yerkes Imaging Center, Emory University, Atlanta, GA, United States; [2]Neurology, Henry Ford Hospital, Detroit, MI, United States; [3]Physics, Oakland University, Rochester, MI, United States

We investigated vascular remodeling after stroke using MRI mean segment length (MSL) and vessel size index (VSI) measurement and correlate the results with measurements using Laser Scanning Confocal Microscopy (LSCM). We demonstrate that MRI MSL and VSI can detect the microvascular status of brain tissue with different ischemic damage. The MSL and VSI measured by MRI were highly correlated with LSCM histological measurements. Our data demonstrate that these MRI measurements can quantitatively evaluate microvascular remodeling after stroke.

14:00 **4495. Cell-Based Treatment Induced White Matter Reorganization After Traumatic Brain Injury Measured by Gaussian, Q-Space DTI, and Histology**

Quan Jiang[1,2], Guang Liang Ding, Siamak Pourabdollah-Nejad[1], Chang Sheng Qu[3], Asim Mahmood[3], Li Zhang[1], Zheng Gang Zhang[1], Jiani Hu[4], Nassan Bagher-Ebadian[1], James R. Ewing[1], Michael Chopp[1,2]
[1]Neurology, Henry Ford Health System, Detroit, MI, United States; [2]Physics, Oakland University, Rochester, MI, United States; [3]Neurosurgery, Henry Ford Health System, Detroit, MI, United States; [4]MR Center, Wayne State University, Detroit, MI, United States

We investigated cell-based treatment induced white matter remodeling after traumatic brain injury (TBI) using Gaussian, q-ball, standard deviation (SD) DTI, and immuno-histochemistry staining. We demonstrate that in brain tissue with a preponderance of single oriented fibers, Gaussian DTI can correctly identify white matter reorganization and detect changes of axonal orientation in the boundary recovery region after TBI. However, SD and q-ball need to be employed to measure WM reorganization if substantial fiber crossing is present in the recovery tissue. Our data suggest that combination SD and FA data may provide information about the stage of white matter remodeling after TBI.

14:30 ***4496*. Effect of Mesenchymal Stem Cells on the Cerebral Microvascularisation in a Rat Model of Stroke: MRI Study**

Anaick Moisan[1], Emmanuelle Grillon[1], Emmanuel L. Barbier[1], Florence De Fraipont[2], Chantal Remy[1], Marie-Jeanne Richard[2,3], Olivier Detante[1,4]

[1]INSERM U836 / Joseph Fourier University (Functional and Metabolic Imaging), Grenoble Institute of Neurosciences (GIN), Grenoble, France, Metropolitan; [2]INSERM U823 / Joseph Fourier University, Albert Bonniot Institute, Grenoble, France, Metropolitan; [3]Cell and Tissue Therapy Unit, University Hospital, Grenoble, France, Metropolitan; [4]Stroke Unit, Department of Neurology, University Hospital, Grenoble, France, Metropolitan

In a rat model of stroke, the effects of human mesenchymal stem cells (hMSC) on the evolution of microvascularisation were studied. Seven days after transient cerebral ischemia, rats received a 10µL intracerebral administration of either cell culture medium or 4×105 hMSC. Two groups of healthy control rats underwent the same treatment. Groups were followed by MRI during 21 days (ADC, cerebral blood volume (CBV), vessel size (VSI)). One day after IC administration, hMSC abolish the CBV increase commonly observed after transient cerebral ischemia. VSI estimates suggest that hMSC also delay the vasodilation secondary to cerebral ischemia.

15:00 ***4497*. Microvascular Density Quantitative Changes After Rat Embolic Stroke Using MRI**

Asamoah Bosomtwi[1,2], Quan Jiang[2,3], Guanlian Ding[2], Li Zhang[2], Zheng Gang Zhang[2,3], Mei Lu[4], James R. Ewing[2,3], Michael Chopp[2,3]

[1]Yerkes Imaging Center, Emory University, Atlanta, GA, United States; [2]Neurology, Henry Ford Hospital, Detroit, MI, United States; [3]Physics, Oakland University, Rochester, MI, United States; [4]Biostatistics and Research Epidemiology, Henry Ford Hospital, Detroit, MI, United States

We investigated vascular remodeling after stroke using MRI microvascular density (MVD) measurement and gold standard immuno-histochemistry staining. We demonstrate that MRI MVD detect the microvascular status of brain tissue with different ischemic damage. The MVD measured by MRI was highly correlated with histological measures of MVD. Our data demonstrate that MRI MVD measurement can quantitatively evaluate microvascular remodeling after stroke.

Thursday 13:30-15:30 Computer 87

13:30 ***4498*. Stem Cell Treatment of Hemorrhagic Lesions Investigated by Longitudinal DTI Study of a Monkey Model**

Chenlu Feng[1], Qinyu Zeng[1], Zhengguang Chen[2], Tie-Qiang Li[3], Xiaoming Yin[1], Jianwei Huo[1], Ming Feng[4], Renzhi Wang[4]

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The treatment of hemorrhagic lesion with neuronal stem cell procedure was studied by diffusion tensor imaging in a monkey model using a clinical 3T MRI system. The longitudinal changes of the fractional anisotropy indicate that the procedure at the dosage of 0.5-2.5 million cells is very effective and DTI is a useful tool to monitor the time course of the neuronal repair and fiber track regeneration process.

14:00 ***4499*. Cerebral Blood Volume Imaging of Spreading Depression in S218L Mouse Model of Familial Hemiplegic Migraine Type 1**

Kwangyeol Baek[1,2], Katherina Eikermann_Haerter[3], Woo Shim[1,2], Cenk Ayata[3], Guangping Dai[1], Jeong Kon Kim[4], Bruce R. Rosen[1], Jaeseung Jeong[2], Young Ro Kim[1]

[1]Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]Bio and Brain Engineering, KAIST, Daejeon, Korea, Republic of; [3]Radiology, Massachusetts General Hospital, Charlestown, MA, United States; [4]Radiology, Asan Medical Center, Seoul, Korea, Republic of

Spreading depression (SD) is a propagating wave of cellular depolarization, and implicated in pathophysiology of migraine and peri-infarct depolarization. In last decade, MRI started to be used for non-invasive imaging of SD, but not much is known about the neurovascular coupling in SD, especially for subcortical regions. We investigated CBV changes induced by SD in cortical and subcortical regions using intravenous contrast agent. We observed marked CBV increase (up to 20%) in cortex, striatum, and hippocampus, but not in thalamus. The CBV response gradually reached peak ~5 min after the neuronal depolarization, suggesting neurovascular coupling is largely modified in SD.

14:30 ***4500*. The Quantification of Tissue Sodium Concentration Using ^{23}Na-Magnetic Resonance Microscopy at 7 T: Probing the Acute Stroke Phase**

Friedrich Wetterling[1,2], Lindsay Gallagher[3], Mhairi I. Macrae[4], Sven Junge[5], Andrew John Fagan, [1,6]

[1]School of Physics, Trinity College Dublin, Dublin, Ireland; [2]Computer Assisted Clinical Medicine, University of Heidelberg, Mannheim, Germany; [3]Glasgow Experimental MRI Centre, , Division of Clinical Neuroscience, Faculty of Medicine, University of Glasgow, Glasgow, Scotland, United Kingdom; [4]Glasgow Experimental MRI Centre, Division of Clinical Neuroscience, Faculty of Medicine, University of Glasgow, Glasgow,

Scotland, United Kingdom; [5]Bruker BioSpin GmbH, Ettlingen, Germany; [6]Centre for Advanced Medical Imaging, St. James's Hospital, Dublin, Ireland

The aim of this study was to accurately quantify subtle changes in Tissue Sodium Concentration (TSC) during the acute phase in a rodent stroke model. A double-tuned $^{23}Na/^{1}H$ dual resonator system was developed and a 2D radial sequence optimized for qNa-MRM (voxel sizes of 1.2µl, TA = 10min). A quantification accuracy of <10mM was achieved, which enabled the evolution of the TSC changes to be followed in the acute phase of stroke. TSC maps were computed and analyzed for each of the investigated five stroke and two sham rats from 30mins up to 8h after MCAO

15:00 ***4501*****.** **7 T ^{87}Rb MRI to Assess K^+ Dynamics in Ischemic Rat Brain in Vivo**

Victor E. Yushmanov[1], Alexander Kharlamov[1], Tamer S. Ibrahim[2,3], Tiejun Zhao[4], Fernando E. Boada[2,3], Stephen C. Jones, [3,5]

[1]Department of Anesthesiology, Allegheny-Singer Research Institute, Pittsburgh, PA, United States; [2]Department of Bioengineering; [3]Department of Radiology, University of Pittsburgh, Pittsburgh, PA, United States; [4]Siemens Medical Solutions USA, Pittsburgh, PA, United States; [5]Departments of Anesthesiology and Neurology, Allegheny-Singer Research Institute, Pittsburgh, PA, United States

To monitor K^+ in the brain in vivo, ^{87}Rb MRI in a rat model of focal ischemic stroke was performed. Rats pre-loaded with dietary Rb^+ were subjected to MCAO, and ^{87}Rb MRI was implemented using a dedicated built in-house RF coil and a spiral ultrashort-TE sequence (TR/TE of 3/0.07 ms). The data represent the world's first successful ^{87}Rb MRI in vivo co-registered with an anatomic image, and demonstrate the potential of ^{87}Rb MRI at high fields (7 T) to quantitatively assess the dynamics of K^+ efflux from the ischemic brain with 13-min temporal resolution in a single animal.

Applications of Manganese-Enhanced MRI/Animal Models of White Matter Disease

Hall B Monday 14:00-16:00 Computer 88

14:00 ***4502*****.** **Limits of Mn Detection in Vivo: Spatial Segregation of Relaxation Behavior**

Jessica A. M. Bastiaansen[1,2], Xiaowei Zhang[1], Russell E. Jacobs[1]

[1]Biological Imaging Center, California Institute of Technology, Pasadena, CA, United States; [2]CIBM, EPFL, Lausanne, Switzerland

In MEMRI, quantitative analysis of signal intensity is used to monitor Mn transport and accumulation, translating signal intensity into concentration. However, several factors may affect the relaxation behavior of Mn and little is known about the cellular uptake and distribution as well as whether the detection limit of Mn changes in different brain regions. Here we investigated changes in Mn relaxation behavior in cortical and striatal areas of the mouse brain in vivo and show that relaxation behavior is brain region-specific. The above has implications on the quantification of axonal transport rates and Mn concentration.

14:30 ***4503*****.** **High-Throughput Manganese Enhanced Magnetic Resonance Imaging in Newborn Rabbits for Olfactory Response to Nitric Oxide Stimulus**

Yirong Yang[1], Alexander Drobyshevsky[1], Xinhai Ji[1], Lei Yu[1], Sidhartha Tan[1]

[1]Department of Pediatrics, NorthShore University HealthSystem and University of Chicago, Evanston, IL, United States

Different nitric oxide (NO) level in olfactory nerves may affect the activity of neurons. Mn2+ will move along appropriate neuronal pathways in an anterograde direction. The function of olfactory neurons can be monitored in vivo by manganese enhanced magnetic resonance imaging (MEMRI). To observe manganese enhanced process, MRI experiments need several hours or even several days. Therefore, multi animal imaging strategy is needed to provide an efficient way to perform experiments and acquire data with enough statistical power. This abstract presents a high-throughput MEMRI method to determine whether nitric oxide can affect olfactory neuronal function in newborn rabbits.

15:00 ***4504*****.** **MEMRI Study of Mice Cerebellar Activation After Voluntary Wheel Running**

Iris Y. Zhou[1,2], April Mei Kwan Chow[1,2], Kevin C. Chan[1,2], Condon Lau[1,2], Ed X. Wu[1,2]

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

In the present study, we use *in vivo* MEMRI to detect the cerebellar activation in mouse brain induced by voluntary wheel running. The preliminary result of our study shows that after voluntary wheel-running exercise, mouse cerebellum regions such as vermis, Crus I and II of ansiform lobule and caudal pontine reticular nucleus are significantly activated compared to the sedentary animals. This difference can be feasibly detected by MEMRI, suggesting the great potential of MEMRI as an in vivo probe for mapping neural activity.

15:30 ***4505***. **Manganese-Enhanced MRI Detection of Neural Compensatory Changes After Neonatal Monocular Enucleation**

Iris Y. Zhou[1,2], April M. Chow[1,2], Shu Juan Fan[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

In this study, *in vivo* MEMRI was introduced to investigate cellular alteration and manganese-induced signal intensity changes after neonatal monocular enucleation. With MEMRI, impaired superior colliculi with high spatial resolution revealing the laminar structure and enhancement of monocular area of primary visual cortex can be observed after neonatal monocular enucleation noninvasively. Such MEMRI approach may be useful in investigation of neural plasticity and the adaptive and compensatory modifications within the brain following neonatal monocular enucleation.

Tuesday 13:30-15:30 Computer 88

13:30 ***4506***. **Manganese-Enhanced MRI of Perilesion Cortex in Subchronic Focal Brain Ischemia**

Kevin C. Chan[1,2], 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

In this study, MEMRI was employed to investigate into the late changes in Mn2+ enhancement in subchronic focal brain ischemia, with emphases on the temporal evolutions in different subregions of the perilesion cortex. The results of this study may provide a new tool for in vivo longitudinal monitoring of the of salvageable tissues and hence represent potential new therapeutic targets for improving the functional consequences after stroke.

14:00 ***4507***. **Bimodal FMRI for Exploring Brain Activity: A Striatal CBV Response Accompanied by Enhanced Nigrostriatal Activity Detected by MEMRI**

Chiao-Chi V. Chen[1], Yi-Hua Hsu[2], Chen Chang[2]
[1]Functional and Micro-Magnetic Resonance Imaging Center,, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan; [2]Functional and Micro-Magnetic Resonance Imaging Center, Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan

Brain activation can be evaluated by a bimodal fMRI protocol that utilizes hemodynamics based fMRI and manganese-enhanced MRI (MEMRI) in combination. The present study demonstrates a striatal CBV response accompanied by enhanced nigrostriatal activity detected by MEMRI following peripheral electrical stimulation.

14:30 ***4508***. **Regional Difference in Mn Uptake and Retention in Mouse Brain**

Abu-Bakar-Md-Ali Asad[1], Kai-Hsiang Chuang[1]
[1]Laboratory of Molecular Imaging, Singapore Bioimaging Consortium, Agency for Science, Technology and Research, Singapore, Singapore

We compared the difference in Mn uptake and retention rates at various brain regions after systemic administration of MnCl2. By estimating Mn concentration with the change in T1 relaxation rate (ΔR1), it was observed that different brain regions have considerable difference in the time-to-peak and bioelimination rate of Mn. The ΔR1-time course was fitted to a gamma variate model which showed reasonable fit and provides estimation of time-to-peak, peak value and half-life. The olfactory bulb reached the peak earliest and highest, while regions like thalamus reached peak at day 2. Olfactory bulb had fastest clearance with a half-life of 6.6 days, and cerebellum had longer half-life of 11.5 days. This method can allow better estimate of the uptake and retention and can be used to maximize tissue contrasts or applied to studying of transporter mechanism in animal models.

15:00 ***4509***. **Detection of Brain Activity During Chronic Pain Using Activity-Induced Manganese-Enhanced MRI in the Ra**

Yuko Kawai[1], Masahiro Umeda[1], Yasuharu Watanabe[1], Toshihiro Higuchi[2], Shoji Naruse[3], Chuzo Tanaka[2]
[1]Medical Informatics, Meiji University of Integrative Medicine, Kyoto, Japan; [2]Neurosurgery, Meiji University of Integrative Medicine, Kyoto, Japan; [3]Radiology, Kyoto Prefectural University of Medicine, Kyoto, Japan

Introduction **z**Nerve injury occasionally induces neuropathic pain, which is a type of chronic pain. The cardinal symptom of neuropathic pain is spontaneous or touch-evoked pain. The purpose of this study is to detect brain activation during foot stimulation by using Activity-induced manganese-enhanced (AIM) MRI in a segmental spinal nerve ligation (SNL) model. **Methods** The right L5–L6 spinal nerves were ligated with 5–0 silk sutures. AIM MRI were acquired using a 4.7-T MRI system. **Results** Pain-induced brain activation was successfully visualized using AIM MRI. It suggested that the AIM MRI is useful for the depiction of the conducting pathway of pain.

Wednesday 13:30-15:30 Computer 88

13:30 ***4510*.** **In Vivo DTI-Derived Axial Diffusivity Correlates with Neurological Assessments in EAE-Affected Mice**

Joong Hee Kim[1], Anne H. Cross[2], Sheng-Kwei Song[3]
[1]Radiology, Washington University , St. Louis, MO, United States; [2]Neurology, Washington University, St. Louis, MO, United States; [3]Radiology, Washington University, St. Louis, MO, United States

Diffusion tensor imaging (DTI) was used to examine the spinal cords of mice with experimental autoimmune encephalomyelitis (EAE), an animal model of Multiple Sclerosis. Compared to age-matched controls, EAE-affected mice exhibited a statistically significant decrease in axial diffusivity in spinal cord white matter. The decrease of axial diffusivity was parallel to disease severity examined by clinical scoring of EAE mice. The axial diffusivity threshold analysis on EAE-affected mice enabled quantifying the extent of abnormal or damaged axons, which correlated with four independent neurological assessments.

14:00 ***4511*.** **Contrasting Roles for CD4 and CD8 T Cells in a Murine Model of T1 Black Hole Formation**

Istvan Pirko[1], Jeremiah McDole[2], Yi Chen[2], Scott R. Dunn[3], Diana M. Lindquist[3], Aaron J. Johnson[2]
[1]Department of Neurology, Mayo Clinic, Rochester, MN, United States; [2]Department of Neurology, University of Cincinnati, Cincinnati, OH, United States; [3]Imaging Research Center, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States

TMEV infection of mice is an accepted model of multiple sclerosis. In C57B6/J mice, the formation of T1 black holes (T1BH) is detectable in this model. In this study we confirmed that CD8 T cells are the main contributors to T1BH formation, whereas CD 4 T cells prevent T1BH formation. We also determined that the involved CD8 T cells are classic epitope specific cytotoxic T cells. T1BH formation is thought to represent neuronal/axonal damage in MS; therefore, it is plausible that CD8 T cells play an important effector role targeted at neurons and axons in MS-related neuroinflammatory diseases.

14:30 ***4512*.** **Monitoring Demyelination in a Cuprizone Mouse Model with Longitudinal and Quantitative MRI Measurements**

Jonathan D. Thiessen[1], Yanbo Zhang[2], Handi Zhang[2], Lingyan Wang[2], Richard Buist[3], Jiming Kong[4], Xin-Min Li[2], Melanie Martin[1,5]
[1]Physics and Astronomy, University of Manitoba, Winnipeg, Manitoba, Canada; [2]Psychiatry, University of Manitoba; [3]Radiology, University of Manitoba; [4]Human Anatomy and Cell Science, University of Manitoba; [5]Physics, University of Winnipeg

Magnetic resonance imaging methods capable of quantifying changes due to demyelination can improve both the diagnosis and understanding of white matter diseases such as multiple sclerosis. T_2-weighted and magnetization transfer images (MTI) were acquired weekly in control (n=4) and cuprizone-fed mice (n=4) from 2 to 6 weeks of treatment. Diffusion tensor imaging, quantitative MTI, high-resolution T_2-weighted imaging, and histopathology were used to analyze ex vivo tissue. All in vivo methods showed significant differences longitudinally in the corpus callosum of the cuprizone-fed mouse. All in vivo and ex vivo methods showed significant differences in the corpus callosum between groups.

15:00 ***4513*.** **Correlation of Fractional Anisotropy (FA) Changes in Demyelination Lesion with Its Surrounding Edema in an Experimental Model**

Krithika Balasubramanian[1], Senthil S. Kumaran[1], Uma Sharma[1], Naranamangalam R. Jagannathan[1]
[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India

Evaluation of sequential changes in fractional anisotropy (FA) in demyelination lesion and associated edema in an experimental rat model of demyelination was carried out at 4.7T. Results showed that both FA(lesion) and FA(edema) decreased during demyelination till day 11. Decreased FA(lesion) is attributed to the damage of myelin which progressed till day 11 while reduced FA(edema) is due to breakdown of blood-brain barrier (BBB). From day 15 remyelination set in along with repair of BBB, which led to increased FA(lesion) and FA(edema). Our study thus showed that DTI may aid in better understanding of the pathophysiology of de- and re-myelination.

Thursday 13:30-15:30 Computer 88

13:30 ***4514*.** **Study of the Pathophyisology of Demyelination in an Experimental Model: Correlation of Lesion Volume with T2, Apparent Diffusion Coefficient (ADC) and Fractional Anisotropy (FA)**

Krithika Balasubramanian[1], Uma Sharma[1], Senthil S. Kumaran[1], Naranamangalam R. Jagannathan[1]
[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India

Evaluation of variation in T2, ADC and FA with the lesion volume at various stages of de- and re-myelination in a demyelinating rat model was carried out at 4.7 T. During demyelination lesion size, T2 and ADC increased while FA decreased indicating loss of myelin, while these values were reversed during remyelination. A strong positive correlation was observed between lesion volume and

T2 and between lesion volume and ADC, while FA showed strong negative correlation. Our data thus indicated the potential of parameters in characterizing the various stages of the de- and re-myelination thus providing useful information on its pathophysiology.

14:00 **_4515_. Cross-Relaxation Imaging of Age-Related Changes in Myelin Mutant Shaking Pup**

Alexey A. Samsonov[1], Andrew L. Alexander[2], Julia V. Velikina[3], Ian D. Duncan[4], Aaron S. Field[1]

[1]Department of Radiology, University of Wisconsin, Madison, WI, United States; [2]Departments of Medical Physics and Psychiatry, University of Wisconsin, Madison, WI, United States; [3]Department of Medical Physics, University of Wisconsin, Madison, WI, United States; [4]School of Veterinary Medicine, University of Wisconsin, Madison, WI, United States

We report results of studying of quantitative parameters of two-pool MT (cross-relaxation) model across ages in the shaking (sh) pup, a canine mutant with a profound paucity of myelin. All qMT measures were sensitive to changes between dysmyelinated and myelinated dogs. The bound pool fraction f provided the strongest discrimination between myelinated and dysmyelinated dogs confirming its high sensitivity to myelin content. The observed qMT measures may represent a result of mixing several potentially distinguishable bound pools including myelin protons. Including additional pool in a MT model may potentially help distinguishing myelin from other components of bound proton pool.

14:30 **_4516_. Multicomponent Relaxometry (McDESPOT) in the Shaking Pup Model of Dysmyelination**

Samuel Anthony Hurley[1], Pouria Mossahebi[2], Alexey A. Samsonov[3], Andrew L. Alexander[1,4], Sean C.L. Deoni[5], Ron Fisher[6], Ian D. Duncan[7], Aaron S. Field, [23]

[1]Medical Physics, University of Wisconsin, Madison, WI, United States; [2]Biomedical Engineering, University of Wisconsin, Madison, WI, United States; [3]Radiology, University of Wisconsin, Madison, WI, United States; [4]Psychiatry, University of Wisconsin, Madison, WI, United States; [5]Engineering, Brown University, Providence, RI, United States; [6]Waisman Lab for Brain Imaging and Behavior, University of Wisconsin, Madison, WI, United States; [7]Medical Sciences, University of Wisconsin, Madison, WI, United States

mcDESPOT is a recently proposed technique which provides two-component relaxometry using steady-state imaging. The relative fraction of water in two microstructural compartments may be estimated via the myelin water fraction map. We report initial results of this technique on the shaking pup myelin mutant. The shaking pup is a canine model which suffers from dysmyelination without the confounding effects of inflammation or edema, and is thus an excellent model for investigating the sensitivity and specificity of mcDESPOT parameters to myelin content in the brain.

15:00 **_4517_. Myelin Visualization Using Q-Space MRI**

Keigo Hikishima[1,2], Kanehiro Fujiyoshi[3], Masayuki Yamada[1,4], Yuji Komaki[1,2], Suketaka Momoshima[5], Kazuo Yagi[6], Norikazu Tamaoki[1], Yoshiaki Toyama[3], Masaya Nakamura[3], Hideyuki Okano[2]

[1]Central Institute for Experimental Animals, Kasawaki, Kanagawa, Japan; [2]Department of Physiology, Keio University; [3]Department of Orthopaedic Surgery, Keio University; [4]School of Health Science, Fujita Health University; [5]Department of Radiology, Keio University; [6]Graduate School of Health Science, Tokyo Metropolitan University

One of the most recently developed DWI methodologies is q-space imaging (QSI) which has been used to detect the size of microstructure using higher b-values. We developed the myelin mapping protocol using QSI by focusing on the strong restriction of water diffusion in myelin architecture. We compared myelin mapping with histological findings in spinal cords using dysmyelination mutant mice and monkeys with spinal cord injury. In this study we demonstrated that myelin mapping depicts the presence of myelin in spinal cord.

MRS of Animal Brain

Hall B Monday 14:00-16:00 Computer 89

14:00 **_4518_. In Vivo MRS Study of Adolescent Rhesus Monkeys with Early Life Stress Experience**

Yumei Yan[1], Xiaodong Zhang[1], Brittany Howell[2,3], Mar Sanchez[2,3]

[1]Yerkes Imaging Center, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States; [2]Psychiatry & Behavioral Sciences, Emory School of Medicine, Atlanta, GA, United States; [3]Psychobiology Division, Yerkes National Primate Research Center, Emory University, Atlanta, GA, United States

In vivo Magnetic Resonance Spectroscopy (MRS) was used to investigate the metabolic changes in basal ganglia (BG) and anterior cingulate cortex (ACC) of adolescent rhesus monkeys with Early Life Stress (ELS). The MRS findings suggest that ELS has an enduring impact on the brains of adolescent male monkeys, potentially reflecting neuropathological alterations or even neuronal loss in their BG (striatum). Males seem more vulnerable to these long-term alterations than females, supporting previous sex differences in vulnerability to ELS. The sex differences in Cho striatal concentrations could be due to differences in glial cell proliferation.

14:30 ***4519*.** **Metabolite Abnormalities in Rhesus Monkeys During Withdrawal of Methamphetamine: A ^{1}H MR Spectroscopy Study at 3T**

Shaolin Yang[1], Svetlana Chefer[1], D. Bruce Vaupel[1], Xi Chen[1], Pradeep K. Kurup[1], Thomas J. Ross[1], Elliot A. Stein[1], Yihong Yang[1]
[1]National Institute on Drug Abuse, National Institutes of Health, Baltimore, MD, United States

A proton magnetic resonance spectroscopy (^{1}H-MRS) study was performed to examine the metabolite abnormalities in the Rhesus monkeys during the abstinence from a long history of methamphetamine (METH) self-administration. The ^{1}H-MRS spectral data were acquired from the frontal lobe and striatum of Rhesus monkeys at 3T in 5 separate sessions (1-day, 1-week, 1-month, 3-month, and 6-month abstinence, respectively). Compared to the control group (n=5), the total choline (tCho) level in the striatum is significantly elevated during the early abstinence (up to 1 month) and continued to be elevated after 3 months of drug withdrawal in the METH-abstinence group (n=10).

15:00 ***4520*.** **Brain Metabolites B1-Corrected Proton T1 Mapping in the Rhesus Macaque at 3T**

Songtao Liu[1], Roman Fleysher[2], Lazar Fleysher[2], Chan-Gyu Joo[3], Eva-Maria Ratai[3], R Gilberto Gonzalez[3], Oded Gonen[2]
[1]National Institutes of Health Clinical Center, Bethesda, MD, United States; [2]New York University Medical Center, New York, NY, United States; [3]Massachusetts General Hospital, Boston, MA, United States

The rhesus macaque brain is an advanced model system for the study of neurological diseases. To correct for unknown T1 weighting in MRS quantification, the B1 corrected T1s of NAA, Cho and Cr in gray and white matter structures of rhesus macaques were measured at 3T. Data was acquired with 3D multivoxel proton MRSI at 180uL resolution. The macaques' NAA, Cr and Cho T1s are, 1232, 1238 and 1107ms. These values are in agreement with human 3T in vivo results.

15:30 ***4521*.** **High Spatiotemporal Resolution for Molecular Imaging with BIRDS**

Daniel Coman[1,2], Robin A. de Graaf[3], Douglas L. Rothman, [23], Fahmeed Hyder, [23]
[1]Diagnostic Radiology, Yale University, New Haven, CT, United States; [2]Quantitative Neuroscience with Magnetic Resonance (QNMR), Yale University, New Haven, CT, United States; [3]Diagnostic Radiology and Biomedical Engineering, Yale University, New Haven, CT, United States

***B**iosensor **I**maging of **R**edundant **D**eviation in **S**hifts* (BIRDS) is used for pH/temperature mapping in rat brain. The BIRDS method relies on strong dependence of non-exchangeable protons from thulium based macrocyclics, e.g., $TmDOTP^{5-}$ and $TmDOTMA^{-}$, for temperature and pH. Although high speed 2D CSI allows ~10μL voxels in rat's cerebral cortex within 5 minutes, many applications require whole brain coverage and high spatiotemporal resolution. Here we demonstrate a 3D CSI of a 2.5×2.5×2.5 cm field-of-view with 1μL voxels in 5 minutes using reduced k-space spherical encoding, which represents an order of magnitude sensitivity enhancement from the 2D CSI data acquisition.

Tuesday 13:30-15:30 Computer 89

13:30 ***4522*.** **Investigation of Spatial Distribution of Metabolites in Rat Brain at Elevated Plasma Glucose Levels**

Vladimir Mlynarik[1], Cristina Cudalbu[1], Hanne Frenkel[1], Nicolas Costers[1,2], Rolf Gruetter[1,3]
[1]Laboratory of Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Katholieke Universiteit Leuven, Leuven, Belgium; [3]Departments of Radiology, Universities of Lausanne and Geneva, Switzerland

Absolute metabolic maps of 12 metabolites were obtained in rat brain at different plasma glucose (Glc) concentrations (6.4 – 19 mmol/L) using short-echo-time proton spectroscopic imaging. A satisfactory linear fit of brain Glc concentration versus plasma Glc concentration in cortex, hippocampus and thalamus was found. The slope of this fit was the same within experimental error in all measured brain structures. The linear fit of increased lactate concentrations at increased plasma Glc levels was poor, indicating that other factors such as stress or impaired metabolism during long-term anesthesia can affect the lactate concentration in brain. Concentrations of myo-inositol, taurine, ascorbate, phosphoethanolamine, glutamine, GABA, N-acetylaspartate, total creatine, total choline and macromolecules were not substantially affected by acute hyperglycemia.

14:00 ***4523*.** **The Effect of Electroconvulsive Shock on the Neurochemical Profile in the Live Rat: Neurogenesis & Glutamate**

S. David Smith[1], June-Hee Park[2], Michael Ma[3], Mei Yu[4], Shaonan Zhang[3], Mirjana Maletic-Savatic[5], Annemie Van der Linden[6], G. Enikolopov[2], Helene Benveniste[4]
[1]Medical, Brookhaven National Laboratory, Upton, NY, United States; [2]Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, United States; [3]Stony Brook University, United States; [4]Anesthesiology, Stony Brook University, Stony Brook, NY, United States; [5]Baylor College of Medicine, TX, United States; [6]University of Antwerpen, Antwerpen, Belgium

We tested the hypotheses that 1) the electroconvulsive shock (ECS) induced increase in the 1.28ppm neural stem cell biomarker could be tracked using LCModel software and 2) that ECS being an effective anti-depressant treatment would result in changes in glutamate detectable by LCModel software. Analysis of our 1HMRS data acquired from the rat dentate gyrus before and after ECS demonstrated that the 1.28ppm signal was too low to be tracked by LCModel software (CRLB<30%). Further we show that glutamate increases

significantly in rats exposed to ECS suggesting a role for glutamate as an anti-depressant and/or as an important instigator of synaptic plasticity.

14:30 **4524. *In Vivo* Studies on a Hyperpolarized Choline Contrast Agent: Design and Implementation of a New Biomarker**

Hyla Allouche-Arnon[1], Aaron K. Grant[2], Elena Vinogradov[2], Xiaoen Wang[3], Robert E. Lenkinski[3], Ayelet Gamliel[1], Ruppen Nalbandian[1], Lucio Frydman[4], John Moshe Gomori[1], Claudia Monica Barzilay[5], Rachel Katz-Brull[1,6]

[1]Department of Radiology, Hadassah Hebrew University Medical Center, Jerusalem, Israel; [2]Department of Radiology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston,, MA, United States; [3]Department of Radiology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States; [4]Department of Chemical Physics, Weizmann Institute of Science, Rehovot, Israel; [5]Medicinal Chemistry-School of Pharmacy, Hebrew University of Jerusalem, Jerusalem, Israel; [6]BrainWatch Ltd., Tel-Aviv, Israel

Choline metabolism is known to be altered in neurodegeneration and malignancy. In order to enable the monitoring of choline metabolism in a direct and non-invasive manner *in vivo*, a stable-isotope labeled analog of choline namely, [1,1,2,2-D_4,2-^{13}C]-choline chloride, was designed and implemented for hyperpolarized magnetic resonance applications. The position enriched with ^{13}C in this molecule presents with both a long T_1 (35 sec) and a chemical shift that differentiates choline from its metabolites. Here we report on the first *in vivo* studies of carbon-13 hyperpolarized [1,1,2,2-D_4,2-^{13}C]-choline that suggest it is a promising new agent for metabolic imaging by MRI and MRSI.

15:00 **4525. Metabolite Profiling of Mild Hypothermia by 1H-MRS**

Kannie W. Y. Chan[1,2], April M. Chow[1,2], L. Xiao[1,2], Ed X. Wu[1,2]

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

Hypothermia has a profound effect on the protection of brain. However, its exact mechanisms remain to be elucidated. Hypothermia induces changes in brain metabolites. 1H-MRS can detect changes in metabolites and hence help us to have a better understanding of hypothermia. Our data shows changes in several metabolites in the cortex and thalamus. These metabolites are associated with cascade of events that lead to neuroprotection and thermoregulation, which are similar to ex vivo and microdialysis findings. This real time and site specific monitor of metabolites at 7T gives insight into how hypothermia protects the brain from various insults.

Wednesday 13:30-15:30 Computer 89

13:30 **4526. Effects of Lactoferrin on Altered Brain Metabolism in Pup Rats After Prenatal Exposure to Dexamethasone**

Yohan van de Looij[1,2], Pierre Larvaron[1], Emmanuel Somm[1], Bing Wang[3], Rolf Gruetter[2,4], Stéphane V. Sizonenko[1], Petra S. Hüppi[1]

[1]Division of Child Growth & Development, Department of Pediatrics, University of Geneva, Geneva, Switzerland; [2]Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [3]Department of Nutrition and Health, Nestlé Research Center, Lausanne, Switzerland; [4]Department of Radiology, University of Geneva and Lausanne, Geneva and Lausanne, Switzerland

Rat model of glucocorticoids exposure during gestation has shown reduction in brain weight. At P7, alterations of cerebral metabolism in the cortex and the hippocampus have been observed by in vivo 1H-MRS. Lactoferrin (Lf) is an iron-binding glycoprotein secreted in milk which has an antioxidant activity. The aim of this work was to evaluate the neuroprotective effect of Lf following prenatal exposure to glucocorticoids by high field localized 1H-MRS. Neurochemical profiles of the pup rat brains confirmed the altered brain development after Dex exposure and revealed the potential protective effect of Lf given to gestational and lactating dams.

14:00 **4527. Proton MRS in the Late Stage of Neonatal Hypoxic-Ischemic Cerebral Injury**

April M. Chow[1,2], Iris Y. Zhou[1,2], Shu Juan Fan[1,2], Kannie W.Y. Chan[1,2], Kevin C. Chan[1,2], Ed X. Wu[1,2]

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

Neonatal hypoxic-ischemic (HI) cerebral injury is major cause of permanent damage to neuronal cells. The neonatal brain undergoes regenerative processes late after HI injury. While ^{1}H MRS has been employed to investigate metabolic changes during acute-phase of HI injury, roles of major neurochemicals as markers for neurodegeneration and neuroprotection at late stage are also important for studying the neurophysiological changes. In this study, we showed that alteration in the metabolism at late stage in cortical and subcortical structures is associated with neonatal HI cerebral injury. This may provide insights into the plastic changes and adaptive modifications within brain following injury.

14:30 **_4528_. Localized _in Vivo_ ^{1}H NMR Spectroscopy of the Rat Brain at 16.4T**

Sung-Tak Hong[1], Dávid Zsolt Balla[1], Gunamony Shajan[1], Changho Choi[2], Kamil Ugurbil[3], Rolf Pohmann[1]
[1]High-Field Magnetic Resonance Center , Max-Planck Institute for Biological Cybernetics, Tuebingen, Baden-Wuerttemberg, Germany; [2]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

In vivo 1H NMR spectroscopy has several problems including narrow spectral dispersion and low SNR. Increasing a static field strength could alleviate these problems, providing feasibilities of quantifying metabolites not observable at lower field strength. The acquisition of an enhanced neurochemical profile was obtained by minimizing TE up to 1.7 ms in a STEAM sequence at 16.4T. The technique demonstrated possibilities of quantification of additional metabolites, acetate and ethanolamine, in the rat brain in vivo.

15:00 **_4529_. A Multinuclear NMR Study of Glucose Metabolismin Thiamine-Deficient Cerebellar Granule Cells: New Mechanistic Insights**

Abolghasem Mohammadi[1], Claudia Zwingmann[1]
[1]Département de médicine, Université de Montréal, Montreal, Quebec, Canada

Wernicke's encephalopathy is a neurological disorder which is characterized by disturbances in consciousness and region-selective brain lesions. Brain damage is associated with a deficiency in thiamine, an essential vitamine in carbohydrate metabolism. Multinuclear NMR spectroscopy was used to assess carbon fluxes and cellular energy state of thiamine-deficient cultured rat cerebellar granule neurons. The data show that neuronal energy failure and death likely result from a primary impairment of neuronal a-KGDH causing impaired carbon flux from glucose/pyruvate through PDH, decreased catabolism of glutamine, and lactate accumulation. Under hyperglycemic conditions, however, alternative explanations to the lactic acidosis hypothesis have to be considered.

Thursday 13:30-15:30 Computer 89

13:30 **_4530_. Taurine Change in Visual Cortex of Neonatal Monocular Enucleated Rat: A Proton MRS Study**

April M. Chow[1,2], Iris Y. Zhou[1,2], Shu Juan Fan[1,2], Kannie W.Y. Chan[1,2], Kevin C. Chan[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Neonatal monocular enucleation has been used to study developmental mechanisms underlying visual perception and the cross-modal changes in the central nervous system caused by early loss of the visual input. In this study, we demonstrated that alteration in the metabolism of taurine in visual cortex accompanied with neonatal monocular enucleation could be monitored using ^{1}H MRS at 7 T. The change in taurine signal with respect to creatine signal may possibly due to the increased taurine signal in the right control visual cortex, likely caused by the plasticity resulted from recruitment of resources to the remaining left eye for adaptation.

14:00 **_4531_. Simultaneously Measuring Glucose Transport Constants and Cerebral Metabolic Rate of Glucose by in Vivo ^{1}H MRS in the Rat Brain**

Fei Du[1,2], Yi Zhang[1], Xiao-Hong Zhu[1], Wei Chen[1]
[1]Radiology, Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States; [2]Psychiatry, McLean Hospital, Harvard University, Belmont, MA, United States

The basal brain activity and function depends upon a constant supply of glucose through the specific glucose transport mechanism mediated by transporter molecules, referred to as the blood-brain barierr (BBB). Therein the noninvasive method to reliably measure glucose cerebral metabolic rate and transport constants are of importance for understanding underlying glucose transport mechanism and energy consumption in the various physiological or pathological conditions. For instance, in our previous studies, we observed that compared to the light anesthesia (2% v-v isofulorane), brain glucose concentration significantly decreased although cerebral metabolic rate of glucose (CMRglc) decreased 37% at the iso-electric condition. This observation of glucose reduction seemingly contradicted with other studies showing a decreased brain glucose concentration accompanied by the increased CMR_{glc} due to the elevated stimulations. This apparent discrepancy can be explained by the changes of blood plasma glucose concentrations, which were found to be substantially decreased under the iso-electric conditions. Another possible reason is alterations of glucose transport constants (K_T and T_{max}). It was reported that pentobarbital reduced blood-brain glucose transfer in the rat brain and the glucose transport constants decreased compared to the awaken condition. Therefore, the aim of the current study is to build-up a noninvasive method to reliably and simultaneously measure CMR_{glc} and transport constants for fully understanding brain glucose concentration changes with alterations of anesthesia depth. The method was introduced and implemented by simultaneously measuring plasma and brain tissue glucose concentration time courses after stopping glucose infusion.

14:30 ***4532*. 1H MRS of Cortical and Subcortical Structures in Mild and Severe Neonatal Hypoxic-Ischemic Cerebral Injuries**

Kevin C. Chan[1,2], 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

This study employed in vivo 1H MRS to understand the metabolic alterations in cortical and subcortical structures during the recovery period upon mild and severe hypoxic-ischemic (HI) injuries to the neonatal rat brains. Relative to the Cr peak, results showed a further increase in Cho, Glu and Lac in the left cortex of severe HI group than mild HI group at 3 days after HI injury at postnatal day 7. These values then decreased slightly at 7 days after surgery in both HI groups. Tau also increased on both sides of the cortex at Day 3 and then drop at Day 7 for both HI groups. In the left thalamus of the severe HI group, NAA appeared to decrease transiently at Day 3 and normalize at Day 7, whereas Cho, Glu, Lac and Tau levels apparently peaked at Day 3. The results of this study may help to investigate potential therapies and the recovery mechanisms upon different severity of neonatal HI insults.

15:00 ***4533*. Early Metabolic Changes Following Focal Traumatic Brain Injury in Rats Measured Using ^{1}H MRS**

Su Xu[1,2], Steve Roys, [23], Jennifer Racz[4], Da Shi[1,2], Jiachen Zhuo[1,2], Rao Gullapalli, [23], Gary Fiskum[1,4]
[1]Core for Translational Research in Imaging @ Maryland (C-TRIM), University of Maryland School of Medicine, Baltimore, MD, United States; [2]Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States; [3]Core for Translational Research in Imaging @ Maryland (C-TRIM), University of Maryland School of Medicine, Baltimore, MD, United States; [4]Anesthesiology and the Center for Shock Trauma and Anesthesiology Research, University of Maryland School of Medicine, Baltimore, MD, United States

Traumatic brain injury is characterized by acute physiological changes that may play a significant role in the final outcome resulting from the injury. Experimental models of TBI provide a useful tool for understanding the early cerebral metabolic changes induced by the damage. In this study, we investigate the early post-traumatic changes in neuro-metabolites in the rat brain following controlled cortical impact injury using *in vivo* ^{1}H MRS at 7 Tesla. Significant changes in *N*-acetylaspartate, glutamate and choline were observed within the first 3 hours after injury in the pericontusional area suggesting a possible temporal window for therapeutic intervention.

Breast MR: Diffusion, Spectra & High Field

Hall B Monday 14:00-16:00 Computer 90

14:00 ***4534*. Diffusion MR Breast Imaging: Correlation of ADC Values to the Prognostic Factors**

Sunitha B. Thakur[1], David D. Dershaw[2], Dilip Giri[3], Junting Zheng[4], Chaya Moskowitz, Jessica Ferrara[2], Jason A. Koutcher[1], Elizabeth A. Morris[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]Epidemiology-Biostatistics, Memorial Sloan Kettering Cancer Center, New York, NY, United States

Treatment decisions and determination of breast cancer prognosis have traditionally been based on pathologic parameters such as tumorsize and axillary-nodal status, tumor-grade, and the results of tumor markers mainly ER/PR and HER-2/neu. Here we present the clinical usefulness of Diffusion-weighted MRI and measurement of apparent diffusion coefficients (ADCs) to correlate traditional markers such as histology and molecular markers such as ER, PR and HER-2. Mean tumor size is significantly higher in patients with positive lymph nodes. Although ADC values represent a valuable biomarker for detecting malignant lesions, the ADC cannot be a prognostic indicator for patients with breast cancer.

14:30 ***4535*. Post Lumpectomy MRI: Using Diffusion Weighted Imaging (DWI) to Distinguish Benign from Malignant Tissues**

Frederick Kelcz[1], Kendra S. Hain[1]
[1]Radiology, University of Wisconsin, Madison, WI, United States

We reviewed diffusion imaging results in post lumpectomy patients and preliminary results show a consisent ADC value in the benign range, despite persistent, occasionaly concerning enhancement. DWI may be of great value in ruling in benignancy when differentiating enhancing scar from malignancy.

15:00 **4536. Diffusion MR Breast Imaging: ADC Values for Differentiating of Malignant from Benign Breast Tumors**

Sunitha B. Thakur[1,2], David D. Dershaw[2], Dilip Giri[3], Junting Zheng[4], Chaya Moskowitz, Jason A. Koutcher[1,2], Elizabeth A. Morris[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]Epidemiology-Biostatistics, Memorial Sloan Kettering Cancer Center, New York, NY, United States

Diffusion MRI is a noninvasive technique which provides information about early changes in morphology and physiology of tissues by monitoring changes in the local apparent diffusion coefficient (ADC) of water molecules. Recently, diffusion-imaging has demonstrated potential in discriminating malignant from benign breast tumors and in assessing progression of disease following therapy. In this work we present the clinical usefulness of DWI and ADC values. ADC measurements are useful to differentiate malignant lesions from benign lesions yielding 98.4 % specificity and 90.9 % sensitivity with ADC cut-off value of 1.28×10^{-3} mm^2/s. ADC was less reliable for differentiating invasive and non-invasive carcinomas.

15:30 **4537. Diffusion Weighted Imaging of the Breast: Can It Decrease the Number of Unneeded Biopsies?**

Wafaa Raafat Abdel Hamid[1], Lobna Rashed Ezz El Arab, Mona Ahmed Mohamed[2], Yasser Abdel Azim Abbas

[1]Radiodiagnosis, Ain Shams University, Cairo, Egypt; [2]Johns Hopkins University school of medicine

Classic magnetic resonance imaging is based on the enhancement pattern of lesions in dynamic breast MRI and morphologic changes. However, there is an overlap of these criteria with benign lesions. Accordingly, problematic cases have always been subjected to biopsies and histopathological verification. In our work we are shedding light on the added value of Diffusion Weighted Imaging and ADC values in differentiating between benign and malignant breast lesions, with a major goal of sparing patients the invasiveness and complications of unneeded biopsies.

Tuesday 13:30-15:30 Computer 90

13:30 **4538. Motion and Distortion Correction in Diffusion-Weighted MRI of the Breast at 3T**

Lori R. Arlinghaus[1,2], E. Brian Welch[1,3], A. Bapsi Chakravarthy[4], Jaime S. Farley[5], John C. Gore[1,2], Thomas E. Yankeelov[1,2]

[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States; [3]MR Clinical Science, Philips Healthcare, Cleveland, OH, United States; [4]Radiation Oncology, Vanderbilt University, Nashville, TN, United States; [5]Vanderbilt University Medical Center, Vanderbilt University, Nashville, TN, United States

Diffusion-weighted imaging (DWI) is a promising surrogate biomarker for the characterization of human breast cancer. However, DWI acquisition sequences are susceptible to artifacts induced by subject motion and eddy currents. DWIs acquired with echo planar imaging (EPI) techniques are also prone to nonlinear distortion induced by B_0 field inhomogeneities, which worsen as field strength increases. We present evidence that image registration and B_0 field map correction improve the quality of apparent diffusion coefficient (ADC) maps derived from the DWI data and improve the registration of the DWI data with anatomical images for comparison with other parametric maps.

14:00 **4539. Operator Performance of Voxel Placement for Single-Voxel MRS of Breast Lesions**

Naomi R. Mraz[1], Michael T. Nelson[1], Jessica Kuehn-Hajder[1], Greg John Metzger[2], Patrick John Bolan[2]

[1]Radiology, University of Minnesota, Minneapolis, MN, United States; [2]Radiology/CMRR, University of Minnesota, Minneapolis, MN, United States

In order for single-voxel MRS measurements to be a useful clinical tool for characterizing breast lesions, voxel placement must be accurate and consistent. This project tested the consistency of voxel placement between four different operators using a retrospective study to simulate voxel placement on a MR scanner. The relative geometric intersection was used as a measure of concordance between readers. Overall concordance was lower than expected (ranging 0%-82.5%, mean 31.2%). Concordance was higher for masses than for non-mass-like lesions. These results suggest that further training, guidance, or software support should be used to improve voxel placement consistency.

14:30 **4540. 1H MR Spectroscopy of the Breast Cancer at 3.0-Tesla: Comparison Between Pre- And Post- Contrast Administration.**

Hisashi Kawai[1], Shinji Naganawa[1], Hiroko Satake[1], Satoko Ishigaki[1]

[1]Radiology, Nagoya University, Nagoya, Japan

The purpose of this study was to assess whether VOIs of MRS were located properly with non-contrast MRI and to compare the variability between pre- and post-contrast spectroscopic measurements at 3T-MRI.
Single-voxel MRS were performed in 92 breast cancer lesions. In 52 lesions, MRS was obtained before and after contrast-enhanced MRI. VOI were located in the lesion properly in 74 out of 92 breast cancers. The integral value of choline peak decreased significantly in post-contrast MRS compared to in pre-contrast MRS. MRS should be obtained before contrast administration not to be affected by Gadolinium contrast agents.

15:00 **_4541_. The Impact of Gd-DTPA on Breast ^{1}H MRS**

Patrick John Bolan[1], Eva H. Baker[2], Lance Jay DelaBarre[1], Hellmut Merkle[3], Doug Yee[4], Michael T. Nelson[5], Lenore Everson[5], Michael Garwood[1]
[1]Radiology/CMRR, University of Minnesota, Minneapolis, MN, United States; [2]Diagnostic Radiology Department, NIH Clinical Center, Bethesda, MD, United States; [3]National Institute Neurological Disorders and Stroke, NIH, Bethesda, MD, United States; [4]Masonic Cancer Center, University of Minnesota, Minneapolis, MN, United States; [5]Radiology, University of Minnesota, Minneapolis, MN, United States

While ^{1}H MRS is increasingly being used in clinical studies of breast cancer, there has been some evidence that the use of Gadolinium-based contrast agents prior to MRS can affect the spectra, broadening the choline resonance and reducing its area. This work describes a study performing ^{1}H MRS at 4T before and after a bolus of Gd-DTPA. It was found that after the contrast injection there was a small negative impact on both the choline and water peaks, with an effect size of 10-15%.

Wednesday 13:30-15:30 Computer 90

13:30 **_4542_. Measurement of the Breast Density Using IDEAL-Dixon Imaging at 3T**

Sungheon Kim[1], Tess Clendenen[2], Sherlin Lavianlivi[1], Linda Moy[1], Henry Rusinek[1], Malcolm C. Pike[3], Anne Zeleniuch-Jacquotte[4]
[1]Center for Biomedical Imaging, Radiology, NYU School of Medicine, New York, NY, United States; [2]Epidemiology, NYU School of Medicine, New York, NY, United States; [3]Preventive Medicine, USC Keck School of Medicine, Los Angeles, CA, United States; [4]Environmental Medicine, NYU School of Medicine, New York, NY, United States

This study was to assess if Dixon water/fat images could be used to monitor breast volume and density changes during the menstrual cycle. Reproducibility of the volume and density measurement was assessed with data from four subjects. In addition, five healthy premenopausal women were scanned once a week for four weeks. The median breast volume was smallest in the ovulatory phase and largest in the late luteal phase. FG density was lowest at the follicular phase and highest in the late luteal phase. This result demonstrates the feasibility of using Dixon imaging to monitor the change in the breast.

14:00 **_4543_. Quantitative Evaluation of Fat Suppression Techniques for Breast MRI at 3.0T**

Chen Lin[1], Laurie Owens[1], Hal Kipfer[1], Helmuth Schultze-Haakh[2], Brian Dale[2]
[1]Department of Radiology and Imaging Science, Indiana University School of Medicine, Indianapolis, IN, United States; [2]Siemens Healthcare, Marlven, PA

Quantitative assessment of the quality of fat suppression in breast MRI with four different techniques, conventional quick fat (QFS), spectrally selective adiabatic inversion recovery (SPAIR), water only excitation (WE) and two point dixon (2PT DIXON) was made at 3.0T. The result demonstrates similar but inferior performance for QFS, SPAIR and WE. While 2PT DIXON is shown to provide superior fat suppression, further development is needed.

14:30 **_4544_. Determining the Sensitivity and Specificity of High Spatial Resolution 3.0T Breast MRI in a High Risk Familial Breast Cancer Screening Cohort**

Martin D. Pickles[1], Lindsay W. Turnbull[1]
[1]Centre for MR Investigations, University of Hull, Hull, East Yorkshire, United Kingdom

Theoretically breast MR examinations at 3.0T should be superior to 1.5T studies. However, breast imaging on higher field strength systems also pose problems such as larger chemical shift, susceptibility artefacts, B1 inhomogeneities and increased T1 relaxation times. The aim of this work was to compare the sensitivity and specificity achieved by a 3.0T MR breast screening programme against the published results of screening studies at 1.5T. In conclusion the diagnostic accuracy of MR breast screening at 3.0T does not seem to be adversely effected by high field strength related artefacts and the results are comparable to those published at 1.5T.

15:00 **_4545_. Assessing the Accuracy of a Commercial Computer Aided Diagnosis Package (CADstream) in Determining the Level of Disease Post Neoadjuvant Chemotherapy in a Cohort of Breast Cancer Patients**

Martin D. Pickles[1], Lindsay W. Turnbull[1]
[1]Centre for MR Investigations, University of Hull, Hull, East Yorkshire, United Kingdom

CADstream is a computer aided diagnosis package developed to aid in the interpretation of breast MR. Reports have demonstrated that CADstream provides quicker interpretation, increased specificity and greater correlation with histological size. However, these reports are based on the assessment of pre-treatment lesions and not post chemotherapy lesions where a treatment induced vascular shutdown is anticipated. The aim of this study was to assess CADstream's accuracy post chemotherapy. In conclusion this study demonstrated by reducing the enhancement and difference thresholds the sensitivity can be increased resulting in fewer false negative results.

Thursday 13:30-15:30 Computer 90

13:30 ***4546*. Breast BOLD Correlates to Optical Breast Imaging During Respiratory Stimulus**

Colin Morehouse Carpenter[1,2], Rebecca Rakow-Penner[3], Shudong Jiang[2], Brian William Pogue[2], Keith David Paulsen[2], Gary H. Glover[3]

[1]Radiation Oncology, Stanford University School of Medicine, Stanford, CA, United States; [2]Thayer School of Engineering at Dartmouth, Hanover, NH, United States; [3]Radiology, Stanford University School of Medicine, Stanford, CA, United States

BOLD response in the breast was measured concurrently with MR-guided diffuse optical tomography (MRg-DOT) in 11 healthy volunteers during inspired gas changes. This approach utilized optical imaging to quantitatively identify the independent effects of oxy- and deoxyhemoglobin. A key factor in this study was characterization of the background physiological noise variations in individual subjects, which was measured via optical imaging during air breathing. The results from this work indicate that BOLD and optically-determined deoxyhemoglobin signals correlate significantly in the breast during an oxygen/carbogen respiratory stimulus, as long as only subjects that exhibit a significant response are included.

14:00 ***4547*. MR Breast Density Measurement: Comparison of Two Anatomic Landmarks for Breast Segmentation**

Jeon-Hor Chen[1,2], Shih-Ting Chen[2], Cheng-Ju Lin[2], Daniel Chang[1], Po-Pang Tsai[2], Ke Nie[1], Orhan Nalcioglu[1], M-Y Lydia Su[1]

[1]Center for Functional Onco-Imaging, UC Irvine, Irvine, CA, United States; [2]China Medical University Hospital, Taichung, Taiwan

Although breast density measurement showed high correlation using both anatomic landmarks, there was still an average of 20% difference for FV measurement. A significant number of women had the problem of being cut off of their fibroglandular tissue when the pectoris major muscle was used as the landmark. From our study, it was concluded that in women with dense breast such as the subjects included in this study, both anatomic landmarks, especially the one anterior to the pectoris major muscle, will have the problem of cut-off of the fibroglandular tissue, resulting in the acquired fibroglandular tissue underestimated.

14:30 ***4548*. Comparison of Breast Density Measured on Fat-Suppressed Versus Non-Fat-Suppressed MRI**

Daniel Han-en Chang[1], Jeon-Hor Chen[1,2], Shadfar Bahri[1], Hon J. Yu[1], Ke Nie[1], Orhan Nalcioglu[1], Min-Ying Lydia Su[1]

[1]Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Department of Radiology, China Medical University Hospital, Taichung, Taiwan

Mammographic density is known to be strongly associated with the risk of breast cancer development, but using mammography to characterize breast density does not provide true volumetric information. MRI-based methods on the other hand provide promising alternatives, but may be affected by technical factors such as the choice of pulse sequences. We imaged breasts with two commonly used pulse sequences, fat-suppression and non-fat-suppression, and calculated their densities with an MRI-based method developed previously by our lab. We found that their densities are highly correlated and that fat-saturated images tend to have stronger relative tissue contrast.

15:00 ***4549*. Correction of Skin Volume in the Breast Density Measured by MRI**

Ke Nie[1], Daniel Chang[1], Jeon-Hor Chen[1,2], Tzh-Ching Shih[1,2], Chieh-Chih Hsu[2], Orhan Nalcioglu[1], Min-Ying Lydia Su[1]

[1]Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, Irvine, CA, United States; [2]Department of Radiology, China Medical University, Taichung, Taiwan

There is a great interest to correlate between the density measured on MRI and mammogram, so the established role for mammographic density may be extended to MRI-based density. One problem specific to volumetric MRI analysis is the inclusion of skin as the dense tissue. In contrast this effect could be ignored on projection mammogram. In this study, we investigated the correlation between the volume of the skin and the breast on 3D MRI. We further provided two correction models aiming to provide an estimation of the skin volume and its effect on MRI based density measurement.

Breast MR

Hall B Monday 14:00-16:00 Computer 91

14:00 ***4550*. Contrast-Enhanced 1.5-T MR Imaging of the Breast: Association Between Asymmetric Increase of Whole Breast Vascularity and Ipsilateral Cancer on a Series of 384 Studies**

Luca Alessandro Carbonaro[1], Nicola Verardi, Henrida Kule, Giovanni Di Leo, Francesco Sardanelli[1]
[1]Unit of Radiology, Università degli Studi di Milano, IRCCS Policlinico San Donato, San Donato Milanese, Milan, Italy

We estimated the value of the breast vascular map asymmetry (BVMA) as a marker of ipsilateral tumors. Three-hundred-eighty-four patients underwent a dynamic study. We looked for BVMA. Pathologic examination or follow-up served as a reference standard. Pathology revealed 173 malignant lesions and 211 benign lesions. BVMA showed high diagnostic performance. Sensitivity was 76% for invasive cancers and 39% for in-situ cancers (P<0.001). Breast vascular map asymmetry was associated with ipsilateral cancer in 76% of invasive tumors, only in 39% of DCIS. For ¡Ý20-mm tumors, a 90% association was found.

14:30 ***4551*. Feasibility of the Usage of the Internal Mammary Artery as an Artery Input Function in Pharmacokinetic Analysis Using the Contrast Enhanced Dynamic MR Study in Breast Tumor**

In Chan Song[1], Nariya Cho[1], Yong Sik Bang[1], Woo Kyung Moon[1]
[1]Department of Radiology, Seoul National University Hospital, Seoul, Chongno-gu, Daehangno 101, Korea, Republic of

We evaluated a feasibility of the usage of internal mammary artery near chest wall as an artery input function in contrast enhanced dynamic MR study to obtain the permeability map in breast tumor. Ktrans and Kep were successfully measured using the internal mammary artery as an artery input function based on the Tofts model in all patients. In breast tumor, the good performance in fitting procedure and the acquired two parameters showed that the internal mammary artery may be used as an artery input function in pharmacokinetic analysis.

15:00 ***4552*. Breast MRI Using a Balanced Steady-State Free Precession Imaging with a Two-Point Dixon Fat-Water Reconstruction Algorithm: Preliminary Experience and Comparison with 2D FSE**

Christine Lee[1], Manoj Saranathan[2], Gina Hesley[1], Robert Maxwell[1], Kathy Brandt[1]
[1]Mayo Clinic, Rochester, MN, United States; [2]Applied Science Lab, GE Healthcare, Rochester, MN, United States

Clinical evaluation of an ultrafast T2-like acquisition with near isotropic resolution in breast MRI is compared to more conventional 2D Fast Spin Echo.

15:30 ***4553*. Breast MRI Using TWIST: Doubling the Spatial Resolution "for Free"**

Rolf Janka[1], Evelyn Wenkel[1], Christian Geppert[2], Berthold Kiefer[2], Michael Uder[1]
[1]Radiology, Universitity of Erlangen, Erlangen, Bavaria, Germany; [2]Siemens Medical Solutions

The TWIST sequence divides k-space in two radial regions and samples it using a pseudo-stochastic trajectory at adjustable density. While the central region is sampled at the full temporal resolution, the periphery is sampled with reduced density. Its main field of application is an increase of temporal resolution in MR-angiography. But it can also be used to increase spatial resolution in the dynamic sequence of breast MRI. We tested the new sequence in 61 women and think it is a reliable and powerful tool in breast imaging which fulfil the requirements of both high temporal and spatial resolution.

Tuesday 13:30-15:30 Computer 91

13:30 ***4554*. Using T2-Weighted MRI in the Automated Analysis of Breast Cancer Lesions**

Neha Bhooshan[1], Maryellen Giger[1], Li Lan[1], Angelica Marquez[2], Hui Li[1], Gillian Newstead[1]
[1]University of Chicago, Chicago, IL, United States; [2]Loyola University, Chicago, IL, United States

This study's purpose was to investigate the automated analysis of T2-weighted MR images in distinguishing malignant and benign breast lesions. Using 86 benign and 110 malignant lesions, our CADx scheme automatically performed lesion segmentation, feature extraction, and classification. T2 morphological features yielded an AUC of 0.78± 0.03 while T1 kinetic and morphological features achieved an AUC of 0.83± 0.03. When considering all features, two T2 features, three T1 features and one geometric feature were selected, giving an AUC of 0.85± 0.03. T2 MRI has the potential to improve the performance of CADx in distinguishing malignant and benign breast lesions.

14:00 *4555*. **Incidental Enhancing Lesions Found on Preoperative Breast MRI: Management and Role of Second Look Ultrasound**

Maria Laura Luciani[1], Federica Pediconi, Valeria Dominelli, Marianna Telesca, Valeria Casali, Federica Vasselli, Carlo Catalano, Roberto Passariello
[1]of Radiological Sciences, "La Sapienza" University of Rome, Rome, Italy

We evaluated the role of second look US for the study of occasional lesions detected on preoperative breast MRI and we proved it can be an helpful way to localize and study lesions depicted only on preoperative breast MRI.

14:30 *4556*. **Correlation of Prognostic Parameters and MR Perfusion Parameters in Dynamic Contrast Enhanced MRI (DCE-MRI) in Patients with Breast Cancers**

Nariya Cho[1], In Chan Song[1], Yong Sik Bang[1], Woo Kyung Moon[1]
[1]Department of Radiology, Seoul National University Hospital, Seoul, Korea, Republic of

Transfer constant obtained from DCE-MRI are well correlated with tumor size and histologic grade of breast cancer, which shows its potential as a noninvasive prognostic parameter in the breast cancer patient.

15:00 *4557*. **The Evaluation of the Disease Extent in Patient with Ductal Carcinoma in Situ: Comparison of Mammography, Sonography, and MRI**

Kyoung Eun Lee[1], Hak Hee Kim[1], Jeong-Hee Sohn[1], Hee Jung Shin[1], Gyungyub Gong[2], Se Hyun Ahn[3], Hyeon Sook Kim[4], Eun Suk Cha[4]
[1]Radiology, Asan Medical Center, Seoul, Korea, Republic of; [2]Pathology, Asan Medical Center, Seoul, Korea, Republic of; [3]General Surgery, Asan Medical Center, Seoul, Korea, Republic of; [4]Radiology, The Catholic University of Korea, Seoul, Korea, Republic of

We think that in patient with DCIS, complemented MRI may be best establish the presence and extent of disease.

Wednesday 13:30-15:30 Computer 91

13:30 *4558*. **Multifunctional MRI to Detect and Localize Multifocal and Multicentric Breast Cancer**

Elizabeth O'Flynn[1], Anna Kirby[2], Maria Schmidt[1], Ashutosh Nerurkar[3], Veronica A. Morgan[1], Erica Scurr[1], John Yarnold[2], Nandita M. deSouza[1]
[1]Cancer Research UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research & Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [2]Clinical Academic Radiotherapy, Institute of Cancer Research & Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [3]Histopathology, Institute of Cancer Research & Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

This pilot study demonstrates the accuracy of dynamic contrast-enhanced (DCE)-MRI and diffusion-weighted (DW)-MRI in detecting and localising multifocal and multicentric disease in patients with breast cancer by correlating imaging with histopathology findings at mastectomy. DCE-MRI alone was most accurate in detecting satellite lesions (sensitivity of 89%), DW-MRI was least accurate (sensitivity 55%). Satellite lesions were found up to 22 mm from the edge of the index lesion. Accurate identification of satellite lesions with multifunctional MRI offers potential for monitoring the effects of local therapies on multifocal and multicentric disease, and in defining the target volume for partial breast irradiation.

14:00 *4559*. **Magnetic Resonance Imaging for Axillary Staging in Breast Cancer Patients Receiving Neoadjuvant Chemotherapy: Comparison with Ultrasonography and Positron Emission Tomography**

Sun Mi Kim[1], Chae Yeon Lyou[1], Mijung Jang[1]
[1]Seoul National University Bundang Hospital, Seongnam-Si, Gyunggido, Korea, Republic of

The presence of axillary lymph node(LN) metastases in breast cancer is an important factor in assessing prognosis and determines management. Although surgical biopsy remains the gold standard for the diagnosis of axillary LN metastasis but standard for surgical biopsy in monitoring for chemotherapy response does not established yet. Comprehensive and sequential staging of axilla using noninvasive diagnostic modalities has been approached and which would represent an importance advance in the management of breast cancer patients. This presentation evaluate the accuracy of comprehensive pre- and post-neoadjuvant chemotheraphy axillary staging via MRI, ultrasound imaging and positron emission tomography.

14:30 *4560*. **MRI Findings of Triple Negative Breast Cancer: A Comparison with Non Triple Negative Breast Cancer**

Jae Jeong Choi[1], Sung Hun Kim[2], Eun Suk Cha[3], Hyun Suk Kim[4], Jae Young Byun[2], Bong Joo Kang[2], Ji Hye Lee[2]
[1]Radiology, Seoul St. Mary's Hospital, Catholic University of Korea , Seoul, Korea, Republic of; [2]Radiology, Seoul St. Mary's Hospital, Catholic University of Korea, Seoul, Korea, Republic of; [3]Radiology, St. Vincent's Hospital, Catholic University of Korea, Seoul, Korea, Republic of; [4]Radiology, St. Paul's Hospital, Catholic University of Korea, Seoul, Korea, Republic of

We would like to submit our report titled ¡°MRI Findings of Triple Negative Breast Cancer: A Comparison with Non Triple Negative Breast Cancer¡¯¡¯. Triple negative breast cancer is a subtype with aggressive clinical behavior which currently lacks effective targeted therapies. MRI characteristics of triple negative breast cancer could assist pretreatment planning and prognosis assessment. We evaluated MRI and clinicopathologic features of triple negative breast cancer, and compared them with those of non triple negative breast cancer.

15:00 ***4561***. **Multiparametric MR Measurement of Menstrual Variation in the Breast**

Sungheon Kim[1], Linda Moy[1], Malcolm C. Pike[2], Anne Zeleniuch-Jacquotte[3], Tess Clendenen[4]

[1]Center for Biomedical Imaging, Radiology, NYU School of Medicine, New York, NY, United States; [2]Preventive Medicine, USC Keck School of Medicine, Los Angeles, CA, United States; [3]Environmental Medicine, NYU School of Medicine, New York, NY, United States; [4]Epidemiology, NYU School of Medicine, New York, NY, United States

The purpose of this study was to develop a multiparametric MRI method to investigate magnitude and timing of various breast changes during the menstrual cycle. Five healthy premenopausal women were scanned once a week for four weeks. T2, ADC, and magnetization transfer rate were measured. T2 gradually increased throughout the cycle and was 5% higher in the menstrual phase than the follicular phase. In contrast, the median ADC was highest in the luteal phase (15% greater than the follicular phase) and began to decline during menses. The MTR was about 4% lower in the menstrual phase than the follicular phase.

Fetal & Female Pelvis

Hall B Thursday 13:30-15:30 Computer 91

13:30 ***4562***. **Time-Resolved MR Angiography in the Detection of Ovarian Venous Reflux**

Dal Mo Yang[1], Dong Ho Lee[2], Dong Wook Sung[2], Geon-Ho Jahng, Chang Woo Ryu

[1]Radiology, East-West Neo Medical Center, Kyung Hee University, Seoul, Korea, Republic of; [2]Radiology, Kyung Hee University Hospital

The purpose of this study was to compare the diagnostic accuracy of time-resolved MR angiography with that of conventional angiography for detection of ovarian venous reflux, which aid for a diagnosis of pelvic venous congestion. Retrospective analysis was performed with 19 consecutive patients who underwent time-resolved MR angiography and conventional angiography. There was no significant difference between time-resolved MR angiography and conventional angiography for detection of ovarian venous reflux ($P > 0.05$). The sensitivity, specificity, and diagnostic accuracy of time-resolved MR angiography were found to be 93.5%, 66.7%, and 89.5%, respectively. Time-resolved MR angiography is helpful for diagnosis of pelvic venous congestion.

14:00 ***4563***. **Magnetic Resonance Imaging and Ultrasonography in Diagnosis of Pelvic Vein Thrombosis During Pregnancy**

Michael R. Torkzad[1], Katarina Bremme[2], Margareta Hellgren[3], Maria J. Eriksson[4], Anna Hagman[5], Trine Jörgensen[2], Kent Lund[4], Gunnel Sandgren[6], Lennart Blomqvist[7], Peter Kälebo[8]

[1]Radiology Department, Uppsala University Hospital, Stockholm, Sweden; [2]Karolinska Institutet, Woman and Child Health, Stockholm, Sweden; [3]The Sahlgrenska Academy, University of Gothenburg, Institute for the Health of Women and Children, Gothenburg, Sweden; [4]Karolinska Institutet, Department of Clinical Physiology, Stockholm, Sweden; [5]The Sahlgrenska Academy, Institute for the Health of Women and Children, Gothenburg, Sweden; [6]Sahlgrenska University Hospital/Östra, Department of Clinical Physiology, Gothenburg, Sweden; [7]Department of Diagnostic Radiology, Karolinska University Hospital Solna, Department of Diagnostic Radiology, Stockholm, Sweden; [8]Sahlgrenska University Hospital/Östra, Department of Radiology, Gothenburg, Sweden

Purpose: The agreement between ultrasonography and magnetic resonance imaging (MRI) in diagnosing the extent of pelvic deep vein thrombosis (DVT) during pregnancy was measured. Materials and methods Pelvic veins of 27 pregnant women with DVT were examined with ultrasound and MRI. Results: Three cases (11.5%) of DVT in the pelvic veins were shown only on MRI. MRI was able to detect highr thrombus extension in 65% of cases. Proportion of agreement (ê) between ultrasound and MRI for DVT in individual veins was 0.33 (95% CI 0.27-0.40, i.e. fair agreement). Conclusion: MRI could be essential in diagnosis of pelvic DVT during pregnancy.

14:30 ***4564***. **Assessment of Placental Blood Flow Using a Navigator Echo Respiratory Gated Parallel Imaging Technique at 1.5 T**

Loredana Sorina Truica[1], Ian Cameron, [1,2], Leonard I. Avruch[2], Andre Gruslin[2]

[1]Carleton University, Ottawa, ON, Canada; [2]The Ottawa Hospital, Ottawa, ON, Canada

IVIM measurements of normal placenta at 1.5 T using a respiratory triggered DW_SS_EPI sequence are reported. Improvements in the acquisition and analysis techniques used in this study allowed us to obtain more consistent results for the perfusion fraction, f, the diffusion coefficient, D, and the pseudo-diffusion coefficient, D*, than previous studies. Parameter maps of D and f were reflective of placental structure and composition. Such maps can be useful tools in identifying tissue differences and give important insight into the placental hemodynamic systems. This technique could become instrumental in the assessment and management of abnormal pregnancies.

15:00 **_4565_. Isotropic 3D T2-Weighted MR Imaging for Female Pelvis with 3 Tesla MRI: Feasibility Study**

Junko Takahama[1], Satoru Kitano[1], Aki Takahashi[1], Nagaaki Marugami[1], Megumi Takewa[1], Takahiro Itoh[1], Toshiaki Taoka[1], Kimihiko Kichikawa[1]

[1]Radiology, Nara Medical University, Kashihara, Nara, Japan

The aim of this study was to compare the quality of images obtained with 3D T2-weighted sequence with the quality of conventional 2D T2-weighted images on 3.0-T MRI. Thirty consecutively registered patients were reviewed and analyzed quantitative measures of contrast and image quality. Three-dimensional volumetric T2-weighted images on 3.0T MRI are of content quality and give better anatomical recognition than conventional 2D images and have the added advantage of multiplanar and postprocessing capabilities.

MR Upper Abdomen I

Hall B Monday 14:00-16:00 Computer 92

14:00 **_4566_. Semi-Quantitative Analysis of Normal Pancreas and Pancreatic Carcinoma with Dynamic Contrast-Enhanced MR Imaging on a 3.0T System**

Xiao Hong Ma[1], Chun Wu Zhou[1], Fei Sun[2], Xin Ming Zhao[1], Han Ouyang[1], Hong Mei Zhang[1]

[1]Diagnostic Radiology, Cancer Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, China; [2]Shanghai Guided Medical Scientific Co. Ltd., Shanghai, China

Our study target to semi-quantify the perfusion parameters of normal pancreas and pancreatic carcinoma with three-dimension (3D) high spatial and time resolution dynamic contrast enhanced (DCE) MRI on a 3.0T MR system. 31 patients who need abdomen contrast enhancement scan but with normal pancreas and 34 pancreatic carcinoma patients underwent DCE-MRI on a 3.0T MR system with 8-channel body coil. The perfusion parameters were measure including signal enhancement ratio at 30 seconds and 90 seconds after injection (SER30, SER90), positive enhancement integral (PEI), time to peak (TTP) and maximum slope of increase (MSI). There is no regional perfusion difference between the head, body and tail of normal pancreas, while there is significant difference between lesion and non-lesion area of pancreatic carcinoma, and between normal pancreas and non-lesion area of pancreatic carcinoma.

14:30 **_4567_. Effects of Oxygen Inhalation on T1 Relaxation Times in Abdominal Solid Organ**

Kyung Ah Kim[1], Mi-Suk Park[1], Eun Ju Kim[2], Myeong-Jin Kim[1], Jin-Young Choi[1], Hye-Suk Hong[1], Ki Whang Kim[1]

[1]Radiology, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, Republic of; [2]Clinical science, MR, Philips Healthcare, Seoul, Korea, Republic of

We investigated the effect of the oxygen inhalation on relaxation times of T1 in abdominal solid organs, including liver, pancreas, spleen, and kidney. The inhalation of oxygen caused T1 shortening in the pancreas, kidney and spleen, which have predominant arterial blood supply, whereas no significant effect was noted in the liver, which has predominant portal venous blood supply. Our results indicate that MRI is feasible to detect changes with oxygen inhalation, which differs considerably among organs, in a noninvasive fashion. As a clinical application, the effect of oxygen on various normal and pathologic tissues may be used as a biomarker of arterial flow, oxygen delivery to organs, and hypoxic status.

15:00 **_4568_. Aged Vs. Fresh Blood for the Treatment of Hemorrhagic Shock; Differential Effect on Liver Outcome and Possible Mechanism**

Idit Matot[1], Miriam Katz[2], Orit Pappo[3], Nathalie Corchia[4], Gregory Barshtein[5], Shaul Yedgar[5], Rinat Abramovitch, [6]

[1]Department of Anesthesiology & Intensive Care, Tel Aviv, Sourasky Medical Center, Tel Aviv, Israel; [2]Department of Anesthesiology, Rabin Medical Center, Petach Tiqva, Israel; [3]Pathology, Hadassah Hebrew University Medical Center, Jerusalem, Israel; [4]he Goldyne Savad Institute of Gene Therapy, Hadassah Hebrew University Medical Center, Jerusalem, Israel; [5]Department of Biochemistry, Hebrew University, Jerusalem, Israel; [6]MRI/MRS lab HBRC, Hadassah Hebrew University Medical Center, Jerusalem, Israel

Concerns have recently been raised about the safety of transfusing stored-blood. Several studies have suggested that the risk of complications increases when transfused blood has been stored for long period. The liver is a target for injury in low flow states associated with trauma and hemorrhage. We studied the effect of blood resuscitation (fresh vs. Stored-blood) on liver injury. In rats, transfusion of blood stored longer than 4 days increased liver injury. This was associated with significant changes in the viscoelastic characteristics of the stored-blood and unrelated to the oxygen-carrying-capacity, cytokines in the stored-blood or the RBC/endothelial cells adherence properties.

15:30 **4569. Characterization of Cirrhotic Nodules with Gadoxetic Acid-Enhanced MR Imaging: The Efficacy of Hepatocyte-Phase Imaging**

Chen-Te Chou[1,2], Ran-Chou Chen[2,3]
[1]Radiology, Chang-Hua Christian Hospital, Chang-Hua, Taiwan; [2]Biomedical Imaging and Radiological Science, National Yang-Ming Medical University, Taipei, Taiwan; [3]Radiology, Taipei City Hospital, Taipei, Taiwan

The study was to evaluate the efficacy of hepatocyte-phase imaging in characterization of focal hepatic lesions among cirrhotic liver using gadoxetic acid enhanced MRI. Our results revealed SNRs/CNRs of HCC were significantly decreased in hepatocyte phase (P<0.05) and the benign DN showed no significant difference (P>0.05). Severe additional HCC were diagnosed by hepatocyte-phase imaging. The diagnostic performance is significantly higher in the imaging set with hepatocyte-phase imaging (P=0.016). In conclusion, combination of gadoxetic acid-enhanced dynamic study and hepatocyte-phase imaging could provide better diagnostic performance than dynamic study only in characterization of focal liver lesion among cirrhotic liver.

Tuesday 13:30-15:30 Computer 92

13:30 **4570. Gd-EOB-DTPA Enhanced MR Imaging of the Liver: Correlation with Morphological Severity of Cirrhosis and Hepatic Parenchyma Enhancement at Hepatobiliary Phase**

Atsushi Higaki[1], Tsutomu Tamada[1], Akihiko Kanki[1], Yasufumi Noda[1], Hiroki Higashi[1], Takenori Yamashita[1], Katsuyoshi Ito[1]
[1]Radiology, Kawasaki Medical School, Kurashiki, Okayama, Japan

We evaluated the relationships between enhancement effects of liver parenchyma in hepatobiliary phase of gadolinium ethoxybenzyl diethylenetriaminepentaacetic acid (Gd-EOB-DTPA) enhanced MR imaging and MR imaging findings of cirrhosis change. Hepatic parenchymal enhancement in the HP of Gd-EOB-DTPA enhanced MR imaging did not necessarily decrease according to the morphological severity of cirrhosis. This fact may suggest that the hepatic uptake of Gd-EOB-DTPA depends on the preserved hepatocytes function rather than the severity in morphologic changes in cirrhosis.

14:00 **4571. Diffusion-Weighted MR Imaging Improves Sensitivity of Lesion Detection Compared with Gadolinium Enhanced T1-Weighted Imaging in Patients with Suspected Liver Metastases from Neuroendocrine Tumours.**

Mark Ingram[1], Toni Wallace[2], Erica Scurr[2], David J. Collins[2,3], Val Lewington[4], Dow-Mu Koh[2]
[1]Department of Radiology, St George's Healthcare NHS Trust, Tooting, London, United Kingdom; [2]Department of Radiology, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [3]CRUK-EPSRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [4]Department of Nuclear Medicine, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

In patients with neuroendocrine liver metastases, imaging determination of the size and distribution of metastatic disease is of value as it could influence the choice of therapy. We compared diffusion-weighted MR imaging (DW-MRI) and gadolinium-DTPA enhanced MR imaging for the detection of focal liver lesions in patients with suspected liver metastases arising from neuroendocrine tumours. DW-MRI was found to have a significantly higher diagnostic sensitivity (88%) compared with gadolinium-DTPA enhanced MR imaging (77%) for lesion detection in this patient population (p = 0.001, McNemar test).

14:30 **4572. How to Reduce So-Called Ringing Artifacts in Primovist-Enhanced MR Imaging**

Akihiro Tanimoto[1], Nobuya Higuchi[2], Akihisa Ueno[2], Shigeo Okuda[2]
[1]Department of Diagnostic Radiology, School of Medicine, Keio University , Tokyo, Japan; [2]Department of Diagnostic Radiology, School of Medicine, Keio University, Tokyo, Japan

So-called gringing artifacts h are often associated with Primovist-enhanced dynamic MR imaging, aggravating the diagnosis for focal hepatic lesions. To analyze the cause of this phenomenon, various scan and data acquisition parameters were tested using a newly created simulation software on the personal PC. The simulation study revealed that square matrices, short scanning time, slow infusion rate, and sequential view ordering were effective measures to reduce the artifacts. These results were confirmed in the clinical practice of Primovist-enhanced MR imaging.

15:00 **4573. Initial Clinical Experience with FRFSE Triple Echo Dixon (FRFTED) for Breath-Hold Fast Dixon Abdominal MR Imaging**

Russell Norman Low[1,2], Jingfe Ma[3], Neeraj Panchal[1,2]
[1]Sharp and Children's MRI Center, San Diego, CA, United States; [2]San Diego Imaging, San Diego, CA, United States; [3]Department of Imaging Physics, The University of Texas MD Anderon Cancer Center, Houson, TX, United States

This study evaluates a prototype breath hold fast recovery fast spin echo (FSE) based Dixon pulse sequence that provides superior fat suppression less sensitive to magnetic field inhomogeneities.

Wednesday 13:30-15:30 Computer 92

13:30 ***4574*****.** **Evaluation of a Non-Enhanced MRI Protocol Compared to Gadolinium-Enhanced MRI for Hepatocellular Carcinoma**

Andrew Dean Hardie[1]
[1]Radiology, Medical University of South Carolina, Charleston, SC, United States

MRI is accurate for identifying hepatocellular carcinoma however gadolinium chelates are contraindicated in patients with severe renal dysfunction due to the risk of Nephrogenic Systemic Fibrosis. There is a need to develop clinically usefull non-contrast MRI techniques to image these patients. Diffusion-weighted imaging and T2* weighted imaging offer the ability to identify tumors in cirrhotic patients with an accuracy similar to gadolinium MRI.

14:00 ***4575*****.** **Evaluation of a New Multi-Modality Visualization Tool for Investigation of Hepatic Metastases from Colorectal Cancer**

Laurent Milot[1], Kayan Ma[2], Erin Efford[1], Gal Sela[2], Carolyn Maloney[1], Susan Crisp[1], Natalie Coburn[3], Masoom Haider[1], Cameron Piron[2], Calvin Law[3], Don Plewes[4]
[1]Department of Medical Imaging, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [2]Sentinelle Medical Inc, Toronto, Ontario, Canada; [3]Department of Surgical Oncology, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [4]Department of Imaging Research, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

Ultrasound and MRI provide complimentary information useful in pre-operative planning for surgical resection of hepatic metastases from colorectal cancer. This study investigates the value of real-time co-registration of preoperative MRI and ultrasound images to determine if this method improves the ability to localize suspicious targets under ultrasound, using MRI as a gold standard. Co-registered MRI/ultrasound imaging yielded a significant increase in the number of targets successfully localized compared to ultrasound examination alone. Co-registered imaging was particularly effective in localizing small lesions (less than 5 mm) which were difficult to identify under conventional ultrasound examination.

14:30 ***4576*****.** **Pharmacokinetics and Safety of Gadobenate Dimeglumine in Patients from 2 to 5 Years of Age**

Gianpaolo Pirovano[1], Mieczyslaw Pasowicz[2], Miles A. Kirchin[3], Ningyan Shen[4], John R. Parker[5], Alberto Spinazzi[1]
[1]Medical Affairs, Bracco Diagnostics Inc., Princeton, NJ, United States; [2]Radiology, John Paul II Hospital, Kracow, Poland; [3]Medical Communications, Bracco Imaging, Milan, Italy; [4]Biometrics, Bracco Diagnostics Inc., Princeton, NJ, United States; [5]Medical Communications, Bracco Diagnostics Inc., Princeton, NJ, United States

15 subjects aged 2-5 years were enrolled in a pharmacokinetic study and received 0.1 mmol/kg bw gadobenate dimeglumine. Pharmacokinetic parameters were calculated from the blood Gd concentration-time data using compartmental and noncompartmental techniques. At 6 hours after gadobenate dimeglumine administration, all subjects¡¦ residual Gd in blood was close to 1.0 ƒÝg/mL, indicating that Gd was successfully cleared from the blood. No differences in whole blood or urinary pharmacokinetic parameters were observed between pediatric subjects 2 to 5 years when compared to adult subjects studied in previously.

15:00 ***4577*****.** **MRI of Infiltrative HCC- Characterization of Imaging Features in Association with Clinical Presentation**

Bobby Kalb[1], Douglas Vander Kooi[2], Daniel Karolyi[1], Bhavika Patel[1], Khalil Salman[1], Diego R. Martin[1]
[1]Radiology, Emory University, Atlanta, GA, United States; [2]Radiology, Langley Airforce Base, Hampton, VA, United States

Infiltrative-type of HCC (I-HCC) is an incurable, less common growth pattern of HCC that may mimic fulminant CLD. Distinction of I-HCC on MRI is critical for optimal management and to avoid inadvertent transplantation of incurable disease, however imaging features may be atypical with poor visibility of tumor extent on postcontrast images. We have categorized MR imaging and pathologic features of I-HCC, and found tumor conspicuity to be most pronounced on T2-weighted images, with portal venous tumor thrombus present in all cases. These findings are important to help improved clinical application of MRI in the setting of CLD.

Thursday 13:30-15:30 Computer 92

13:30 ***4578*****.** **Computational Analysis of Flow in the Portal Vein of Normal Subjects and Patients Using MRI and CFD**

Stephanie M. George[1], Diego R. Martin[2], Don P. Giddens[1]
[1]Wallace H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology and Emory University, Atlanta, GA, United States; [2]Department of Radiology, Emory University School of Medicine, Atlanta, GA, United States

With the incidence of chronic liver disease (CLD) increasing the need for improved diagnostic measurements has increased. Magnetic resonance imaging (MRI) and phase-contrast MR offer noninvasive techniques which provide both high quality anatomical and hemodynamic data. The use of these data coupled with computational fluid dynamics (CFD) to provide detailed flow field

information is a novel approach. This study examines a small number of normal subjects and patients comparing PC-MR measured portal venous hemodynamic parameters including velocity and flow rate and computational results. This work demonstrates the feasibility of coupling MRI and CFD to investigate the altered hemodynamics in CLD.

14:00 **4579. Relationship Between Gd-EOB-DTPA MRI and Tc-99m-GSA for Quantitative Evaluation of Liver Function**

Jumpei Suyama[1], Shouei Sai[1], Masaaki Kawahara[1], Yoshimitsu Ohgiya[1], Noritaka Seino[1], Masanori Hirose[1], Takehiko Gokan[1]
[1]Department of Radiology, Showa University School of medicine, TOKYO, Japan

The purpose of this study is to evaluate relationship between Tc-99m-GSA scintigraphy and 3T-MRI using Gd-EOB-DTPA for quantitative liver function. Nineteen patients with liver tumor were included in this study. There was significant correlation between LHL15 and the increased ratio of signal intensity at 4min ($r=0.80$, $p<0.00005$), and the increased ratio at 20 min were also well correlated ($r=0.67$, $p<0.0005$). It could be possible to use Gd-EOB-MRI for quantitative liver function as well as Tc-99m-GSA scintigraphy.

14:30 **4580. In Vivo Imaging of Mouse Pancreas Utilizing Ultra High Field of 14T and Manganese Enhanced MRI**

Riikka J. Immonen[1], Smaragda Lamprianou[2], Laurent Lecomte[1], Laurent Vinet[2], Paolo Meda[2], Rolf Gruetter[1,3]
[1]Laboratory for functional and metabolic imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, CH-1015, Switzerland; [2]Department of Cell Physiology and Metabolism, University of Geneva, Geneva, CH-1210, Switzerland; [3]Department of Radiology, University of Geneva and Lausanne, Geneva/Lausanne, CH-1210/CH-1015, Switzerland

In vivo imaging of pancreas with high resolution is challenging. In diabetes pancreatic β–cell mass and function are gradually lost. MRI methodology to monitor this in vivo is needed. We utilized 14.1T and manganese enhanced MRI to image the mouse gland in vivo, and to examine the changes in manganese signal during β–cell stimulation by glucose. In multi-slice images with 50*50*300µm resolution, acquired <20min, we were able to distinguish pancreatic main vessels and exocrine ducts, and Mn highlighted spots, possibly pancreatic islets. We also demonstrated with T1-wt inversion recovery, lower resolution technique, the manganese enhancement before and after glucose stimulus.

15:00 **4581. Proton MRS of Hepatic Ischemia/Reperfusion Injury in an Experimental Rat Model**

April M. Chow[1,2], Kannie W.Y. Chan[1,2], Shu Juan Fan[1,2], Jerry S. Cheung[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Hepatic ischemia/reperfusion injury (IRI) occurs during liver transplantation, tumor resection, hemorrhagic shock and veno-occlusive disease. Biochemical changes caused by hepatic IRI lead to hepatocellular remodeling, including cellular regeneration or irreversible programmed cell death. In this study, we demonstrated that the alteration in the metabolism of choline-containing compounds (CCC) accompanied with hepatic IRI could be monitored using ^{1}H MRS. The CCC peak may be useful in evaluating the regeneration of hepatocytes upon hepatic IRI. ^{1}H MRS has shown to be a potential tool for identify and quantify metabolic changes in liver *in vivo* noninvasively.

MR Upper Abdomen II

Hall B Monday 14:00-16:00 Computer 93

14:00 **4582. Gd-EOB-DTPA Enhanced-MRI of the Liver: Dynamic Enhancement Compared with Gd-DTPA, Preliminary Experience**

Natasha Wehrli[1], Hersh Chandarana[1], Ely Felker[1], Bachir Taouli, [1,2]
[1]NYU Medical Center, New York, NY, United States; [2]Mount Sinai School of Medicine, New York, NY, United States

Gd-EOB-DTPA is a recently FDA approved liver-specific contrast agent which combines a dynamic and a delayed phase of enhancement, approved to be used at a lower dose compared to extracellular agents (0.025 vs. 0.1 mmol/kg). In this study, we compared hepatic vascular conspicuity obtained with single and double dose Gd-EOB vs. Gd-DTPA at the dynamic phase, and found significantly better liver-to-vessel contrast ratio with Gd-DTPA compared to single dose Gd-EOB-DTPA. The liver-to-vessel contrast ratio improved when using a double dose Gd-EOB-DTPA.

14:30 **4583. Tracer-Kinetic Analysis of Gd-EOB-DTPA in the Liver with a Dual-Inlet Two-Compartment Uptake Model**

Steven Sourbron[1], Wieland Sommer, Christoph Zech, Maximilian Reiser, Karin Herrmann
[1]Ludwig-Maximilian-University Munich, Munich, Bavaria, Germany

A dual-inlet one-compartment uptake model is developed for DCE-MRI with Gd-EOB-DTPA in the liver. The model generalizes the one-compartment model for the liver, providing one new parameter: the intracellular uptake rate (KI). Data in normal appearing liver tissue of 25 patients shows that the uptake model fitted all ROI curves accurately, and provided values in the expected range for all known parameters. The average value for KI was 1.7/100/min, with a relatively narrow range of normality. The method may present a new and practical paradigm in functional liver MRI, producing quantitative measures of both perfusion and hepatobiliary function.

15:00 ***4584*.** **Free-Breathing Dynamic Contrast-Enhanced Abdominal Imaging Using Navigator Gating and Adaptive Navigator Correction**

Anja C.S. Brau[1], Yuji Iwadate[2], Moritz Kircher[3], Shreyas Vasanawala[3], Robert Herfkens[3]
[1]Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [2]Applied Science Lab, GE Healthcare, Hino, Japan; [3]Radiology, Stanford University, Palo Alto, CA, United States

Dynamic contrast-enhanced (DCE) 3D T1w MRI is routinely used in abdominal imaging for characterization of liver lesions. Each contrast-enhanced phase is typically acquired within a breath-hold; however, this multi-breath-hold requirement faces several drawbacks. In this work, navigator gating is combined with adaptive navigator correction (“slab following”) to prospectively adjust slab location based on measured motion, with the goal of improving the image quality and acquisition efficiency of navigated 3D DCE liver imaging. Initial contrast-enhanced clinical results with this method are presented.

15:30 ***4585*.** **Predicting Differentiation of Hepatocellular Carcinoma at Pre-Transplant MRI in Patients Undergoing Orthotopic Liver Transplantation**

Stella K. Kang[1], Emma Robinson[1], Ramya Srinivasan[1], Bachir Taouli[1,2], Hersh Chandarana[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Radiology, Mount Sinai Medical Center, New York, NY, United States

In patients undergoing orthotopic liver transplantation, preoperative MR imaging characteristics in hepatocellular carcinoma were examined, including T1 and T2 signal intensity, diffusion weighted imaging, and dynamic contrast enhanced kinetics and their relationship with histopathologic grade was assessed. DynaCAD, commercially available software, was utilized to examine enhancement kinetics of each tumor. Poorly differentiated HCCs had lower time to peak and higher rate of enhancement. T1 hypointensity also showed correlation with poorly differentiated tumors. No other qualitative or quantitative feature including DWI was useful in predicting HCC differentiation.

Tuesday 13:30-15:30 Computer 93

13:30 ***4586*.** **Evaluation of Uptake and Excretion of Gd-EOB-DTPA in Normal and Cirrhotic Livers**

Tsutomu Tamada[1], Atsushi Higaki[1], Akihiko Kanki[1], Tomohiro Sato[1], Kazuya Yasokawa[1], Katsuyoshi Ito[1]
[1]Dept. of Radiology, Kawasaski Medical School, Kurashiki-city, Okayama, Japan

We assessed differences in enhancement effects of liver parenchyma and activity of biliary and renal excretion between normal and cirrhotic livers on Gd-EOB-DTPA-enhanced MR imaging. It will be important to know that hepatic enhancement effects in the HP are decreased in patients with severe cirrhosis, probably due to impaired uptake of Gd-EOB-DTPA by hepatocytes, and biliary excretion is impaired in cirrhotic livers in comparison with normal livers while renal excretion of Gd-EOB-DPTA can be increased, probably due to the compensatory mechanism.

14:00 ***4587*.** **MR Elastography of Peritoneal Tumor**

Russell Norman Low[1,2], Matthew J. Austin[3], Lloyd Estkowski[4], Richard Ehman[5]
[1]Sharp and Children's MRI Center, San Diego, CA, United States; [2]San Diego Imaging, San Diego, CA, United States; [3]Radiology, Universit y of California at San Diego, San Diego, CA, United States; [4]General Electric Healthcare; [5]Mayo Clinic

We present our intial clinical experience using MR elastography in oncology patients to depict peritoneal tumor. Peritoneal tumors in the upper abdomen demonstrated increased mean shear stiffness compared to the liver as was depicted on color encoded spatial maps. On a per patient basis MRE demonstrated a .87 sensitivity, .78 specifity, and .82 accurcy. In the quantitative anlysis the mean shear stiffness of peritoneal tumor was 4.43 kPA and the mean shear stiffness of the adjancent liver was 2.36 kPa.

14:30 ***4588*.** **T2-Weighted Liver MRI at 3T Using a BLADE Technique: Comparison with a Standard Rectilinear T2-Weighted Sequence for Image Quality and Lesion Detection**

Andrew B. Rosenkrantz[1], Lorenzo Mannelli[1], David Mossa[1], James Babb[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States

T2WI of the liver was performed in 28 patients at 3T using standard rectilinear and BLADE k-space trajectories. Compared with standard T2WI, BLADE demonstrated significant improvements in in-plane motion, other ghosting artifact, liver edge sharpness, vessel sharpness, and flow suppression, a trend toward improved B1-inhomogeneity artifact, and no difference in through-plane motion. BLADE demonstrated a significant improvement in specificity for liver lesion detection but no difference in sensitivity. ROI analysis showed significantly improved relative contrast between the liver and focal lesions with BLADE. We conclude that BLADE achieved significant improvements in artifacts, image quality, and specificity for liver lesion detection.

15:00 ***4589***. **Assessment of Liver Oxygenation with BOLD MRI at 3T. Feasibility Study**

Peter Beddy[1], Richard Black[1], Lorenzo Mannelli[2], Ilsa Joubert[1], Andrew Priest[1], David J. Lomas[1]
[1]Radiology, University of Cambridge and Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom; [2]Radiology, University of Cambridge and Addenbrookes Hospital, Cambridge, Cambridgeshire, United Kingdom

BOLD MRI is a potential non-invasive method for assessing tissue oxygenation in a wide range of tissues. This work develops a method for oxygen challenge based BOLD imaging of the liver at 3T in a group of volunteers and demonstrates that acceptable results and low variability can be achieved using both breath-hold and respiratory triggered multi-echo gradient echo acquisitions.

Wednesday 13:30-15:30 Computer 93

13:30 ***4590***. **Alteration in the Conjugation Pattern of Bile Acids in Human Bile During Cholestasis: A ^{1}H MRS Study**

Tedros Bezabeh[1], Omkar B. Ijare[1], Nils Albiin[2], Annika Bergquist[3], Urban Arnelo[4], Matthias Löhr[3], Johannes R. Hov[5], Ian CP Smith[1]
[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]Radiology, Karolinska Institutet, Stockholm, Sweden; [3]Gastroenterology and Hepatology, Karolinska Institutet, Stockholm, Sweden; [4]Surgery, Karolinska Institutet, Stockholm, Sweden; [5]Medicine, Oslo University Hospital Rikshospitalet, Oslo, Norway

Conjugation of bile acids with amino acids glycine and taurine is an important phenomenon in bile formation. In healthy humans, the ratio of glycine- to taurine-conjugated bile acids is generally 3:1, and this ratio is altered in cholestatic conditions. We analyzed bile samples from patients with various cholestatic diseases and found that the median of the above ratio was 2.23:1. This alteration could be attributed to the elevation in the levels of taurine-conjugates or reduction in the levels of glycine-conjugates. Such alterations can be easily detected by ^{1}H MRS and the technique could be valuable in the diagnosis of diseases related to bile acid synthetic defects.

14:00 ***4591***. **Are Dynamic First-Pass Enhancement Properties of Gadoxetic Acid (Gd-EOB-DTPA) Comparable to Gadopentetate Dimeglumine (Gd-DTPA) in Hepatocellular Carcinoma (HCC)?**

Mi-Suk Park[1], Myeong-Jin Kim[2], Ki Whang Kim[1]
[1]Department of Diagnostic Radiology, Yonsei University Health System Severance Hospital, Seoul, Korea, Republic of; [2]Severance hospital

In this abstract, we compared dynamic first-pass enhancement properties of gadoxetic acid with that of gadopentetate dimeglumine in the patients with HCC. Gadoxetic acid-enhanced MRI showed more rapid wash-out of HCC, stronger enhancement of hepatic parenchyma, and weaker enhancement of vessels than the standard Gd-chelate enhanced MRI.

14:30 ***4592***. **Diffusion-Weighted Imaging: Diagnostic Value in the Assessment of Intrahepatic Metastases of Hepatocellular Carcinoma**

Jeong-Sik Yu[1], Jae-Joon Chung, Joo Hee Kim, Ki Whang Kim
[1]Radiology, Gangnam Severance Hospital, Seoul, Korea, Republic of

For the hepatocellular carcinomas, the presence of small satellite lesions is an important determinant of a patient¡¯s prognosis and therapeutic planning. Through the results of our study DWI is superior to dynamic MRI in the detection and characterization of subcentimeter lesions and can be added to strengthen the accuracy in the MRI assessment of intrahepatic metastases of HCCs. DWI could overcome the inherent drawbacks of dynamic MRI for the hypervascular pseudolesions or obscured tumoral vascularities by the perfusional changes in the background parenchyma serve as a complementary tool for patients examined by dynamic MRI.

15:00 ***4593***. **Gd-EOB-DTPA Combined with Gd-DTPA: Hepatobiliary Contrast with Familiar Hepatic Dynamic Contrast Enhancement**

Jesse L. Wei[1,2], Kimiknu Mentore[1], Martin P. Smith[1,2], Neil M. Rofsky[1,2]
[1]Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States; [2]Harvard Medical School, Boston, MA, United States

Administration of Gd-EOB-DTPA using the recommended dose for hepatobiliary imaging results in an unfamiliar "washed out" appearance of the liver on dynamic contrast enhanced (DCE) imaging. This likely results from increased background hepatic enhancement due to early hepatobiliary uptake. Injection of a combination of Gd-EOB-DTPA in conjunction with an extracellular contrast agent provides the 20-minute delayed hepatobiliary phase, while preserving the familiar vascular contrast and lesion conspicuity compared to background liver on DCE images.

Thursday 13:30-15:30 Computer 93

13:30 ***4594*. Flow Vector Analysis of Portal Venous Flow Using Time-SLIP (Time-Spatial Labeling Inversion Pulse) with an Optical Flow Method**

Akiyoshi Yamamoto[1], Riichiro Nagashima[1], Kentaro Haraoka[1], Katsumi Nakamura[1], Mitsue Miyazaki[2]

[1]Radiology, Tobata Kyoritsu Hospital, Kitakyushu, Fukuoka, Japan; [2]Toshiba Medical Research Institute, USA, Vernon Hills, IL, United States

Flow vector analysis using optical flow can provide the useful information to assess portal venous hemodynamics enhancement using Time-SLIP.

14:00 ***4595*. *In Vivo* ^{1}H MRS of Gallbladder Bile Using an Optimized 8-Channel Phased Array at 3T: Towards Improved Diagnosis of Hepatopancreatobiliary Diseases**

Sanaz Mohajeri[1,2], Tedros Bezabeh[1], Scott B. King[1], Omkar B. Ijare[1], Gerald Y. Minuk[3], Jeremy Lipschitz[4], Ian C.P. Smith[1]

[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]Human Anatomy and Cell Science, University of Manitoba, Winnipeg, Manitoba, Canada; [3]Hepatology, University of Manitoba, Winnipeg, Manitoba, Canada; [4]Surgery, University of Manitoba, Winnipeg, Manitoba, Canada

Considering the key role of liver in body metabolism, the study of bile composition is of great importance. *In vitro* ^{1}H MRS of bile samples have shown diagnostic value in detecting various hepatopancreatobiliary disorders. Given the invasive nature of this procedure, we considered the possibility of gathering *in vivo* data. We present here our initial efforts to obtain bile spectra from pigs using a 3T clinical scanner comparing the use of a Siemens body array coil with an optimized home-built receive array coil.

14:30 ***4596*. Inhibited Hepatobiliary Excretion Is a Sign of Cholangiocarcinoma in Patients with Primary Sclerosing Cholangitis**

Lena M. Hallberg[1], Annika Bergquist[2], Nils Albiin[1]

[1]Radiology, Karolinska University Hospital, Karolinska Institutet, Stockholm, Sweden; [2]Gastroenterology and Hepatology, Karolinska University Hospital, Karolinska Insitutet, Stockholm, Sweden

Cholangiocarcinoma is a well known threat to patients with primary sclerosing cholangitis (PSC). Although, early diagnosis is crucial for curative surgical treatment, it is difficult to differentiate malignant strictures from benign. We wanted to see if excretion hepatobiliary contrast was inhibited in affected segments, as a sign of malignancy. Therefore, six patients with PSC and a histopathologically confirmed cholangiocarcinoma , were examined in a 1.5 T MRI and Gd-BOPTA i.v. administered. In five of these patients there was no sign of excretion in affected segments. Thus, inhibited hepatobiliary excretion is a sign of cholangiocarcinoma in patients with primary sclerosing cholangitis.

15:00 ***4597*. Gd-EOB-DTPA Enhanced MR Imaging: Evaluation of Enhancement Effects and Enhancement Patterns in Hepatic Hemangioma**

Tsutomu Tamada[1], Atsushi Higaki[1], Akihiko Kanki[1], Satoko Okamoto[1], Katsiyoshi Ito[1]

[1]Dept. of Radiology, Kawasaski Medical School, Kurashiki-city, Okayama, Japan

We assessed quantitatively and qualitatively the enhancement effects and the enhancement patterns of hepatic hemangioma and normal liver tissue on Gd-EOB-DTPA-enhanced MR imaging. It will be important to know that the dynamic enhancement pattern of hepatic hemangioma is similar to that of hepatocellular carcinoma, probably due to the washout of Gd-EOB-DTPA in the early stage after contrast media administration compared with extracellular Gd chelates.

Lung MRI

Hall B Monday 14:00-16:00 Computer 94

14:00 ***4598*. First Results from Clinical Sitings of a High Production Prototype Xenon Polarizer**

F. William Hersman[1,2], Jeff Ketel[2], Iulian Constantin Ruset, [1,2], Stephen Ketel[2], Isabel Dregely[1], Walter Porter[2], David W. Watt[2], John P. Mugler, III[3], Talissa A. Altes[3], Kai Ruppert[3], Jaime F. Mata[3], Samuel Patz[4], Hiroto Hatabu[4], Mirko Hrovat[5], Iga Muradian[4], Mikayel Dabaghyan[4], G. Wilson Miller[3], Chengbo Wang[3], James P. Butler[6], Jan H. Distelbrink[2]

[1]University of New Hampshire, Durham, NH, United States; [2]Xemed LLC, Durham, NH, United States; [3]University of Virginia, Charlottesville, VA, United States; [4]Brigham and Women's Hospital, Boston, MA, United States; [5]Mirtech, Inc, Brockton, MA, United States; [6]Harvard School of Public Health, Boston, MA, United States

Hyperpolarized xenon-129 is potentially the most viable contrast agent to be used for characterizing pulmonary function by MRI. Further improvements in polarizing technology yield production rates of up to 15 liters/hour with 50% polarization. This high production prototype polarizer was relocated to two clinical sites and demonstrated in pilot clinical studies. First fully engineered systems based on this design, XeBox-E10, will be available in 2010 for collaborative research.

14:30 **4599. Producing Hyperpolarized Gases Via Dynamic Nuclear Polarization and Sublimation**

Arnaud Comment[1,2], Sami Jannin[3], Jean-Noël Hyacinthe[4], Pascal Miéville[3], Riddhiman Sarkar[3], Puneet Ahuja[3], Paul Romeo Vasos[3], Xavier Montet[4], François Lazeyras[4], Jean-Paul Vallée[4], Joseph A. Konter[5], Patrick Hautle[5], Ben van den Brandt[5], Jean-Philippe Ansermet[2], Rolf Gruetter[1,6], Geoffrey Bodenhausen[3,7]

[1]Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Institute of Condensed Matter Physics, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [3]Laboratory of Biomolecular Magnetic Resonance, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [4]Department of Radiology, Université de Genève, Genève, Switzerland; [5]Paul Scherrer Institute, Villigen, Switzerland; [6]Departments of Radiology, Universités de Lausanne et Genève, Lausanne and Genève, Switzerland; [7]Department of Chemistry, Ecole Normale Supérieure, Paris, France

A method to produce hyperpolarized gases by dynamic nuclear polarization and subsequent sublimation was designed. The method was illustrated by applications to ^{129}Xe in xenon gas, leading to the enhancement of the nuclear magnetic resonance signal-to-noise by four orders of magnitude. The main advantage of this new hyperpolarization method lies in its ability to produce highly polarized gases with large throughputs, on the order of tens of several liters per hour.

15:00 **4600. A Dedicated Coil Configuration for Hyperpolarized 129Xe Imaging at 1.5 T**

Armin Purea[1], Kevin Teh[2], Michael Barlow[2], Dominik Berthel[1], Alexander Weisser[1], Ian Hall[3], Peter Morris[2]

[1]Rapid Biomedical GmbH, Rimpar, Germany; [2]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, United Kingdom; [3]IPSET, University of Nottingham, Nottingham, United Kingdom

Presented are preliminary results from a novel coil configuration for 129Xe lung imaging. A non-circular birdcage was used as a transmit coil and a 8 channel receive coil were proposed. The coils were designed to utilise the bore space as much as possible to enhance patient comfort whilst not compromising the image quality. Initial images obtained using a SPGR sequence shows great promise. Scan time for lung patients will potentially decrease with the use of parallel receivers which were designed for optimum signal as much as flexibility.

15:30 **4601. 3D Hyperpolarized 3He Imaging of Human Lung with Isotropic Spatial Resolution Using 3D-Cones**

Jian-Xiong Wang[1], Alexei V. Ouriadov[2], Jeffrey A. Stainsby[3], Grace E. Parraga[2], Giles Santyr[2,4]

[1]Applied Science Laboratory, GE HEALTHCARE, London, ON, Canada; [2]Robarts Research Institute, The University of Western Ontario, London, ON, Canada; [3]Applied Science Laboratory, GE HEALTHCARE, Toronto, ON, Canada; [4]Dept. of Medical Biophysics, The University of Western Ontario, London, ON, Canada

A true 3D isotropic spatial resolution imaging method for Hyperpolarized He-3 human lung imaging using 3D-cones sequence is presented. The isotropic voxel size improves accuracy for co-registration, lung volume measurement and analysis for abnormalities in the lung.

Tuesday 13:30-15:30 Computer 94

13:30 **4602. Evaluation of Global Surface-To-Volume Ratio of Rabbit Lung Using Hyperpolarized 129Xe Uptake Spectroscopy at 1.5T**

Yulin Chang[1], Jaime F. Mata[1], Talissa Altes[1], John P. Mugler III[1], Kai Ruppert[1]

[1]Radiology, University of Virginia, Charlottesville, VA, United States

Hyperpolarized xenon-129 dissolves into lung tissue and binds hemoglobin and the dissolved-phase (DP) xenon molecules exchange with the gas-phase molecules via diffusion. Therefore the initial rate of the signal replenishment of the DP xenon following a saturation is proportional to both square root of time and lung surface area. In this work we demonstrate the possibility of measuring lung surface-to-volume ratio using DP xenon signals at short delays after a complete saturation in a rabbit model.

14:00 **4603. Long-Range Diffusion of Hyperpolarized 3He in Normal and Emphysematous Rat Lungs**

Ignacio Rodriguez[1,2], Laura Carrero-Gonzalez, [1,3], Thomas Kaulisch[3], Detlef Stiller[3], Jose Manuel Perez-Sanchez[4], Jesus Ruiz-Cabello[1,2]

[1]Instituto de Estudios Biofuncionales, Universidad Complutense, Madrid, Spain; [2]CIBER de Enfermedades Respiratorias, Madrid, Spain; [3]Boehringer Ingelheim Pharma, Biberach an der Riss, Germany; [4]Univ. Paris-Sud, CNRS, Orsay, France

Using long-range diffusion MRI, ADC of rats with induced emphysema in one lobe has been performed. The results show a statistically significant increase of ADC in the emphysematous lobe at breath-hold, whereas no significant difference is seen at end expiration. Collateral ventilation could play a role in these results. The increase seen at breath-hold agrees with the results found by other workers.

14:30 ***4604*. Comprehensive Pulmonary Evaluation of Emphysematous Mice Using Hyperpolarized ^{129}Xe MRI/MRS Under Spontaneous Breathing Mode**

Hirohiko Imai[1,2], Atsuomi Kimura[2], Takuya Kitao[2], Emi Okubo[2], Yuki Hori[2], Satoshi Iguchi[2], Hideaki Fujiwara[2]

[1]Center for Advanced Research and Education in Drug Discovery and Development, Graduate School of Pharmaceutical Sciences, Osaka University, Suita, Osaka, Japan; [2]Department of Medical Physics and Engineering, Division of Health Sciences, Graduate School of Medicine, Osaka University, Suita, Osaka, Japan

Several techniques in hyperpolarized ^{129}Xe MRI and MRS were applied to spontaneously breathing mice for comprehensively evaluating pulmonary structures and functions in emphysematous mice. The abnormalities of pulmonary structure, perfusion and ventilation were successfully detected in emphysematous mice, while significant difference was not shown in gas exchange. Although further improvement was needed for evaluating gas exchange in spontaneous breathing condition, it was shown that the method described here could become useful for drug research and development using small rodents since this protocol was able to detect several important pathological changes non-invasively.

15:00 ***4605*. Hyperpolarized ^{3}He ADC Measurements: Left-Right and Dorsal-Ventral Differences as a Function of Lung Volume**

Ahmed F. Halaweish[1], Daniel R. Thedens[1], Jered P. Sieren[1], Eric A. Hoffman[1], Edwin J.R. vanBeek[1]

[1]University of Iowa, Iowa City, IA, United States

Hyperpolarized ^{3}Helium MRI Apparent Diffusion Coefficient (ADC) measurements enable probing of the lung microstructure and evaluation of pathological processes that affect airspace size. We successfully evaluated ADC measurements as a function of lung volume in 12 never-smoker subjects across three different lung volumes (20%, 60% & 100%VC). Significant differences between each lung volume were observed, along with significant ventral-dorsal gradients at the 20%VC volume and a more homogenous left-right distribution at 100%VC only. Results suggest that patterns of ADC throughout the lungs in the never-smoker subjects follow proper distribution and ventilation patterns and emphasize the importance of controlled lung inflation.

Wednesday 13:30-15:30 Computer 94

13:30 ***4606*. Dynamic O2-Enhanced MRI Vs. Quantitative Thin-Section MDCT: Capability for COPD Assessment in Smokers**

Yoshiharu Ohno[1,2], Hisanobu Koyama[1], Keiko Matsumoto[1,3], Yumiko Onishi[1], Daisuke Takenaka[1], Munebu Nogami[1], Nobukazu Aoyama[2], Hideaki Kawamitsu[2], Makoto Obara[4], Marc van Cauteren[4], Kazuro Sugimura[1]

[1]Radiology, Kobe University Graduate School of Medicine, Kobe, Hyogo, Japan; [2]Radiology, Kobe University Hospital, Kobe, Hyogo, Japan; [3]Radiology, Yamanashi University, Shimokatou, Yamanashi, Japan; [4]Philips Healthcare, Tokyo, Japan

Direct assessment of signal intensity - time course curve on dynamic O2-enhanced MRI have suggested as having potential for airway abnormality and oxygen transfer assessments. However, the literature shows no publications dealing with direct comparison of the capability of quantitatively assessed thin-section MDCT and of dynamic O2-enhanced MRI for COPD assessment in smokers. We hypothesized that dynamic O2-enhanced MRI may have potential for COPD assessment, and be considered at least as valuable as MDCT in smokers. The purpose of this study was to compare the capability for COPD assessment in smokers between dynamic O2-enhanced MRI and quantitatively assessed thin-section MDCT.

14:00 ***4607*. Oxygen-Enhanced MRI in Patients with Pulmonary Arterial Hypertension: Feasibility and Value**

Daniel Maxien[1], Olaf Dietrich[2], Sven Thieme[2], Maximilian Reiser[2], Konstantin Nikolaou[2]

[1]Department of Clinical Radiology, Ludwig Maximilian University, Munich, Germany; [2]Department of Clinical Radiology, Ludwig Maximilian University Munich, Germany

Oxygen-enhanced MRI of the lung has proved its feasibility in studies with healthy volunteers, but till now there is only limited experience in circumscribed patient cohorts. We wanted to determine the value and feasibility of oxygen-enhanced MRI in patients with pulmonary arterial hypertension. Therefore we evaluated the sensitivity and specificity of oxygen-enhanced MRI versus ventilation and perfusion scintigraphy. Furthermore, we made a quantitative comparison of the relative signal enhancement in defect areas with the relative signal enhancement in the whole lung to determine which signal difference is needed for a reliable visual detection of diseased lung areas.

14:30 ***4608***. **Improvement of Multislice Oxygen-Enhanced MRI of the Lung by Fully Automatic Non-Rigid Image Registration.**

Francesco Molinari[1,2], Grzegorz Bauman[3], Monika Eichinger[2], Bernhard Geiger[4], Lorenzo Bonomo[1], Hans-Ulrich Kauczor[5], Michael Puderbach[2]

[1]Department of Bioimaging and Radiological Sciences, Catholic University of Rome, Rome, Italy; [2]Department of Radiology, German Cancer Research Center, Heidelberg, Germany; [3]Department of Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany; [4]Siemens Corporate Research, Princeton, United States; [5]Department of Radiology, University of Heidelberg, Heidelberg, Germany

In oxygen-enhanced MRI, lung signal is measured repeatedly during different breathing cycles. Inconsistencies of respiratory phase may hamper the quality of the parametric O2-maps. In this study, fully automatic non-rigid registration was assessed as a postprocessing method to improve the quality of O2-MRI of the lung. This post-processing technique reduced spatial misalignment among images and signal variability within the lung. O2-induced signal enhancement was not influenced by image registration. Spatial heterogeneity of parametric O2-maps decreased significantly. As such, fully automatic non-rigid registration appears suitable for improving the quality of multislice O2-MRI of the lung.

15:00 ***4609***. **Ultra-Short Echo Time (UTE) MR Imaging of the Lung: Assessment of Tissue Density in the Lung Parenchyma**

Masaya Takahashi[1], Osamu Togao[1], Riki Tsuji[1], Ivan Dimitrov[1]

[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States

The utility of ultra-short TE (UTE) imaging in conjunction with projection acquisition of the free induction decay helps to acquire the MR signal from the lung parenchyma. We applied an UTE sequence for imaging of the murine lung at different positive end-expiratory pressures (PEEP) in a 3 T clinical MRI system. The signal intensity and T2* of the lung parenchyma measured with a UTE sequence reduced as the PEEP became higher where the lung volume increased. We found that both are highly correlated with the lung volume.

Thursday 13:30-15:30 Computer 94

13:30 ***4610***. **Automated Airway Lumen Segmentation and Characterization for Use in Patients with Traqueomalacya: A Feasibility Study**

Piotr Alfred Wielopolski[1], Pierluigi Ciet[2], Gabriel Paul Krestin[1], Martin H. Lequin[1], Harm Tiddens[3], Rashindra Manniesing[4]

[1]Radiology, Erasmus Medical Center, Rotterdam, Zuid-Holland, Netherlands; [2]Department of Medical-Diagnostic Sciences and Therapies, Policlinico Universitario di Padova, Padova, Italy; [3]Department of Pulmonology, Erasmus Medical Center, Rotterdam, Zuid-Holland, Netherlands; [4]Department of Informatics and Radiology, Erasmus Medical Center, Rotterdam, Zuid-Holland, Netherlands

The purpose of this work was to provide: first, a suitable acquisition scenario including static and dynamic 3D MRI sequences with sufficient temporal and spatial resolution to provide good morphological information and visualization of dynamic events in the central airways and, secondly, to provide the means for an automatic analysis program suitable to segment the airway lumen and a dynamic evaluation of cross-sectional areas of the central airways down to the 2nd generation branching.

14:00 ***4611***. **MRI Assessment of Dynamic Lung Volume Changes in Subjects Using a Nasal Expiratory Positive Airway Pressure (NEPAP) Device**

Ding Xia[1], Elan J. Grossman[1], D M. Rapoport[2], I Ayappa[2], A V. Patel[2], L Daugherty[3], Jian Xu[1], Kelly Anne Mcgorty[1], Qun Chen[1]

[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, United States; [2]Division of Pulmonary and Critical Care Medicine, NYU School of Medicine, New York, United States; [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

The purpose of the current study is to use a real-time MRI technique for measuring lung volume changes caused by using a nasal expiratory positive airway pressure (nEPAP) device, a new treatment for obstructive sleep apnea (OSA). This may help us better understand the mechanism by which it treats OSA. Our results show there is an increase in functional reserve capacity (FRC) while using the nEPAP device. Since end-expiratory hyperinflation is likely to produce increased traction in the trachea, this suggests the main action of the nasal expiratory device may be to stiffen the upper airway through increased longitudinal traction.

14:30 **_4612_. MRI Assessment of Distal Airway Heterogeneity for the Early Detection of Airway Disease with Normal Spirometry**

Ding Xia[1], Elan J. Grossman[1], Ke Zhang[1], Abram Voorhees[2], K I. Berger[3], R M. Goldring[3], B W. Oppenheimer[3], J Reibman[3], W N. Rom[3], L Rogers[3], A Helwig[3], L Daugherty[4], Jian Xu[1], Kelly A. Mcgorty[1], Qun Chen[1]

[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, United States; [2]Siemens Medical Solutions, Malvern, PA, United States; [3]Department of Medicine, NYU School of Medicine, New York, United States; [4]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

Clinical-pathologic correlation between patient illness and pulmonary disease is difficult to determine when airway abnormalities are localized only to distal airways of the lungs. The purpose of this study is to establish quantitative regional measurements of heterogeneity for distal airway dysfunction based on a tissue tracking MRI technique and apply them to early diagnosis of obstructive airway disease. Results show that in subjects with suspected distal airway disease MRI indicators of mean regional airflow are reduced despite presentation of normal spirometry. Thus, assessment of regional lung function by MRI may be a useful tool for early detection of airway disease.

15:00 **_4613_. Sensitivity of Viscosity and Elasticity in Preserved Pig Lung by Magnetic Resonance Elastography**

Roberta Santarelli[1], Xavier Maître[1], Ralph Sinkus[2], Luc Darrasse[1]

[1]Imagerie par Résonance Magnétique et MultiModalités (UMR8081), Univ Paris-Sud, CNRS, Orsay, France; [2]Institut Langevin (UMR 7587), ESPCI, Univ Denis Diderot, CNRS, Paris, France

Viscoelastic properties of lungs participate in the organ basic function. Their exploration in vivo is not attainable. Hyperpolarised helium-3 MR-elastography on lungs has been demonstrated in vivo. This new technique ex vivo quantitatively evaluated the comparison between helium-3 and hydrogen MRE: the fluid/structure coupling was found to be strong, validating helium-3 lung MRE as a consistent tool for lung exploration. This work focuses on viscoelastic properties behaviour of hydrogen MRE, applied on the preserved pig lung inflated at different volumes: performance of wavelength, elasticity, and viscosity distribution is discernible throughout the inner area and the outer peripheries of the lungs

Obesity & Metabolism

Hall B Monday 14:00-16:00 Computer 95

14:00 **_4614_. Abdominal Adipose Tissue Distribution: Regional Differences**

Min-Hui Cui[1], Jong Hee Hwang[1], Vlad Tomuta[1], Daniel T. Stein[1]

[1]Albert Einstein College of Medicine, Bronx, NY, United States

Fifty-eight non-diabetic subjects with a wide range of BMI were studied to evaluate the regional differences of SAT and VAT distribution and the correlations of them with intrahepatic lipid, plasma triglyceride, glucose and FFA levels. Both lean and overweight/obese subjects have most SAT in lower abdomen. However, lean subjects have more VAT while overweight/obese subjects have less VAT in lower abdomen. The relationships between SAT and VAT from different abdominal regions in the lean and overweight/obese subjects with IHL, TG and glucose are also different. Thus conclusions based on one specific AT region should be interpreted with cautions.

14:30 **_4615_. Whole Body Fat Water Imaging at 3 Tesla Using Multi-Echo Gradient Echo**

E. Brian Welch[1,2], Johan Berglund[3], Heidi J. Silver[4], Kevin D. Niswender[5], Morten Bruvold[6], Joel Kullberg[3], Lars Johansson[3], Malcolm J. Avison[1]

[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States; [2]MR Clinical Science, Philips Healthcare, Highland Heights, OH, United States; [3]Department of Radiology, Uppsala University, Uppsala, Sweden; [4]Vanderbilt Center for Human Nutrition, Vanderbilt University Medical Center, Nashville, TN, United States; [5]Vanderbilt Diabetes Research and Training Center, Vanderbilt University Medical Center, Nashville, TN, United States; [6]MR Clinical Science, Philips Healthcare, Best, Netherlands

The potential of whole body MRI for visualizing adipose tissue distribution has long been recognized. More recently, multi-gradient-echo MR acquisitions have been successfully used at 1.5 Tesla to quickly acquire whole-body data sets. Automated segmentation and quantification of such whole-body fat images into subcutaneous and visceral adipose tissue compartments shows great promise as a tool in studies of obesity and other metabolic syndrome diseases such as diabetes. Most whole-body fat-water imaging has been performed at 1.5 Tesla. However, the availability and prevalence of higher strength 3 Tesla scanners, especially in research settings, justifies the pursuit of robust multi-gradient-echo sequences designed to operate at 3 Tesla. Here we present initial results of a 3T multi-gradient echo whole-body fat-water sequence.

15:00 **4616. Rapid, Multi-Slice Fat Water Separated Imaging for Mapping Body Fat**

Peter Kellman[1], Diego Hernando[2], Saurabh Shah[3], Z-P Liang[2], David A. Bluemke[1], Andrew E. Arai[1]
[1]National Institutes of Health, Bethesda, MD, United States; [2]University of Illinois, Urbana, IL, United States; [3]Siemens Medical Solutions, Chicago, IL, United States

A rapid multi-slice fat/water separated imaging protocol has been developed for mapping body fat with application to obesity studies. The method combines a 3-echo GRE acquisition and parallel imaging to scan the abdomen and chest in <30 sec. A recently developed joint estimation method for water/fat separation is able to perform robustly in the presence of large B0 field inhomogeneities.

15:30 **4617. Automated Quantification of Adipose Tissue Distribution in Children Using a 2-Point Dixon Technique**

Joel Kullberg[1], Pär-Arne Svensson[2], Ann-Katrine Karlsson[3,4], Eira Stokland[2], Jovanna Dahlgren[3,4]
[1]Department of Radiology, Uppsala University, Uppsala, N/A, Sweden; [2]Department of Pediatric Radiology, The Sahlgrenska University Hospital, Göteborg, Sweden; [3]Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden; [4]The Queen Silvia Children's Hospital, Göteborg, Sweden

A method for assessment of adipose tissue distribution in children is presented. The method utilizes rapid water-fat imaging of 16 slices of the abdomen. A fully automated segmentation algorithm for assessment of visceral and subcutaneous adipose tissue volumes is described. The automatically measured results from 21 volunteer 5-year-olds are compared to those from semi-automated segmentation. Acceptable results were achieved despite the children's young age and the relatively small adipose tissue volumes measured.

Tuesday 13:30-15:30 Computer 95

13:30 **4618. Alterations on Hepatic Glycogen and Lipid Metabolism Following the Induction of Diabetes in the Rat**

Ana Francisca Soares[1,2], John Griffith Jones[1], Francisco Veiga[2], Rui Albuquerque Carvalho[1]
[1]Life Sciences, Faculty of Sciences and Technology and Center for Neurosciences and Cell Biology, University of Coimbra, Coimbra, Portugal; [2]Pharmaceutical Technology, Faculty of Pharmacy, University of Coimbra, Coimbra, Portugal

The liver stores carbohydrate and lipid after a meal under insulin stimulation. Using deuterated water, we assessed hepatic glycogen synthesis and de novo lipogenesis in healthy and streptozotocin-induced diabetic rats feeding overnight. Hepatic glycogen and lipid content were analyzed by 2H-NMR. Healthy animals showed similar direct and indirect pathway contributions to glycogen. Following Diabetes induction we observed a progressive loss of direct pathway capacity compared to the indirect and also a reduction of de novo lipogenesis. These observations may serve as valuable markers for assessing alterations in hepatic glucose and lipid metabolism during the progress Diabetes.

14:00 **4619. In Vivo Monitoring of Treatment Effect of Cryptotanshinone for Non-Alcoholic Fatty Liver Disease in Mice**

Hyeon Seung Lee[1], Quan Yu Cai[1], Ki Nam Min[2], Jong Kook Park[2], Tae Hwan Kwak[2], Kyeong Hoon Jeong[2], Kwan Soo Hong[1]
[1]MRI, Korea Basic Science Institute, Ochan-Eub, Chungcheonbuk-Do, Korea, Republic of; [2]Advanced Biological Research, Mazence Inc, Suwon, Gyeonggi-Do, Korea, Republic of

Treatment of Non-Alcoholic Fatty Liver by Cryptotanshinone in Mouse Models for Hepatic Steatosis

14:30 **4620. Functional Magnetic Resonance Imaging of Liver: Effect of Glucose**

muhammad E. Haque[1], Ioannis Koktzoglou[1], Wei Li[1], Jo Ann Carbray[1], Pottumarthi V. Prasad[1]
[1]Radiology, North Shore University Healthcare System, Evanston, IL, United States

One of the primary functions of insulin is disposal of glucose from the blood and inhibition of hepatic glucose production (HGP). Dysfunction of either of these processes can cause development of type II diabetes. Incomplete suppression of HGP is a strong indication of insulin resistance and may be an early marker for development of type II diabetes. Current methods to evaluate insulin resistance are complicated, invasive and hence not used in routine practice. Here we demonstrate feasibility of using BOLD MRI to monitor oxygenation changes in the liver following glucose which may be related to insulin sensitivity.

15:00 **4621. Two Site Water Exchange Analysis of Pancreatic T1 Relaxation Reveals the Kinetics and Mechanism of Beta Cell Labeling with Manganese: Implications for Imaging Beta Cell Mass in Diabetes**

Patrick Antkowiak[1], Moriel Vandsburger, Frederick Epstein
[1]University of Virginia, Charlottesville, VA, United States

The kinetics and mechanism of pancreatic β cell labeling with Mn2+ were investigated. Murine pancreatic T1 relaxation was measured in normals and after treatment with the Ca2+ channel blocker nifedipine. Two site water exchange analysis of pancreatic T1

relaxation provided the intracellular T1 and intracellular fraction, measures of β cell labeling. Increased intracellular T1 and lower intracellular fraction in nifedipine-treated mice confirmed Mn^{2+} enters β cells through Ca^{2+} channels. The timecourse of intracellular T1 and fraction in normal mice revealed 3 phases of Mn^{2+} kinetics: 1) labeling β cells, 2). washout from β cells, 3). nonspecific labeling of other cells.

Lung MRI

Hall B Wednesday 13:30-15:30 Computer 95

13:30 ***4622*. Dynamic Contrast Enhanced Pulmonary Perfusion with Undersampled Stack-Of-Stars and Iterative Highly Constrained Back-Projection**

Nathan S. Artz[1], Rafael L. O'Halloran[2], Mark Schiebler[3], James H. Holmes[4], Sean B. Fain[1,3]

[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States; [2]Radiology, Stanford University, Stanford, CA, United States; [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [4]Applied Science Laboratory, GE Healthcare, Madison, WI, United States

Pulmonary perfusion was assessed in two healthy volunteers using a contrast-enhanced 3D stack-of-stars GRE sequence. Consecutive groups of 32 projection angles were reconstructed with IHYPR for a temporal resolution of ~1s. The signal vs. time curves demonstrate an expected trend with the pulmonary artery peaking first, followed next by the parenchyma and later the left atrium. Mean transit time, relative pulmonary blood volume and relative pulmonary blood flow maps demonstrate expected results with mean transit times from 3-5 s after the main pulmonary artery trunk and shorter MTT's in the posterior region due to gravity related effects.

14:00 ***4623*. Comparison of Three Quantification Algorithms (RFM, TSVD, LCC) for Absolute Quantification of Pulmonary Perfusion in Patients with COPD and Pulmonary Embolism by MRI**

Mona Salehi Ravesh[1], Michael Puderbach[2], Sebastian Ley[3], Julia Ley-Zaporzhan[3], Frank Risse[1], Wilfried Schranz[4], Wolfhard Semmler[1], Frederik Bernd Laun[1]

[1]Department of Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany; [2]Department of Radiology, German Cancer Research Center, Heidelberg, Germany; [3]Diagnostic and Interventional Radiology, University Hospital Heidelberg, Heidelberg, Germany; [4]Nonlinear Physics Group, Faculty of Physics, University of Vienna, Vienna, Austria

Lung perfusion is a crucial prerequisite for effective gas exchange. An accurate quantification of pulmonary perfusion is therefore important for diagnostic considerations and treatment planning in various diseases of the lungs.The assessment of pulmonary perfusion by Dynamic Contrast-Enhanced Magnetic Resonance Imaging requires deconvolution of the arterial input function. In the presence of noise this is an ill-posed problem which leads to strongly oscillating, unphysical solutions when it is solved without regularization. In this study a novel method to quantify the pulmonary perfusion is used and compared to the singular value decomposition and L-curve criterion based on simulated and patient data.

14:30 ***4624*. Bronchial Perfusion in the Lungs Observed by Dynamic Contrast-Enhanced MRI**

Nabil Saouti[1], Anton Vonk Noordegraaf[1], Michael Ingrisch[2], J. Tim Marcus[1]

[1]VU University Medical Center, Amsterdam, Netherlands; [2]Ludwig-Maximilian University, Munich, Germany

The aim is to visualise the perfusion of the lungs by the pulmonary and bronchial system separately, based on the fact that a contrast bolus injected intravenously will arrive later in the bronchial than in the pulmonary system. Included were 7 patients with whole left or right pulmonary artery atresia, and 6 chronic thromboembolic pulmonary hypertension patients. Using 3D dynamic contrast-enhanced MRI with 1 s temporal resolution, a 5 s signal-intensity onset delay was measured between open lung or lung region, and obstructed lung (region), providing evidence for bronchial arterial supply after a pulmonary artery obstruction.

15:00 ***4625*. Ventilation/Perfusion MR Imaging of the Lung Using T1-Weighted Ultra-Short Echo Time (UTE) Imaging: Animal Experiment in a 3 T Clinical MRI System**

Osamu Togao[1], Marc van Cauteren[2], Yoshiharu Ohno[3], Ivan Dimitrov[1,2], Masaya Takahashi[1]

[1]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [2]MR Clinical Science, Philips Healthcare, Best, Netherlands; [3]Radiology, Kobe University Graduate School of Medicine, Kobe , Hyogo, Japan

We have demonstrated that an UTE sequence could bring inherent MR signal of the lung parenchyma that closely related to the parenchymal tissue anatomy. We hypothesize that the capability of the method to acquire inherent MR signal of the lung parenchyma should allow us to assess changes in SI due to inhalation of molecular oxygen or intravenous injection of gadolinium. In the present study, we tested the feasibility of a T1-weighted UTE sequence for assessment of regional pulmonary ventilation/perfusion which is essential for the evaluation of a variety of lung diseases in a 3T clinical MRI system.

Thursday 13:30-15:30 Computer 95

13:30 ***4626*. Self-Referenced Flip Angle Mapping for Hyperpolarized Gas MRI**

Eric Frederick[1,2], Mirko Hrovat[3], Samuel Patz[2]
[1]Applied Physics, University of Massachusetts in Lowell, Lowell, MA, United States; [2]Radiology, Brigham and Women's Hospital, Boston, MA, United States; [3]Mirtech Inc, Brockton, MA, United States

Hyperpolarized noble gas imaging is a non-equilibrium imaging method where gas magnetization is depleted by RF excitations. Due to B_1 field inhomogeneities, this depolarization may not be uniform and therefore a B_1 flip angle map is required to correct the images. This process is typically performed by acquiring an additional set of images. We propose an alternative method where the flip angle map is obtained from one set of images. To do this, we break up a fully sampled image into two undersampled images that are then used for B_1 flip angle mapping. We demonstrate these methods with simulations.

14:00 ***4627*. Towards a Better Understanding of Helium-3 MRI Manual Segmentation Error Using Fuzzy C-Mean Methods**

Mohammadreza Heydarian[1], Andrew Wheatley[1], Grace Parraga[1,2]
[1]Robarts research Institute, London, Ontario, Canada; [2]Medical Biophysics, University of Western Ontario, London, On, Canada

Hyperpolarized helium-3 MRI provides a way to visualize and quantify lung function based on segmentation of helium-3 ventilation images. Manual segmentation of 3He ventilation volumes is time consuming and prone to observer error. To address this limitation, we developed and applied a fully automated fuzzy c-mean (FCM) method for segmenting ventilated regions and observed significant associations between the automated and manual segmentation methods. FCM provides a fully automated, robust and efficient method for segmenting ventilated regions of hyperpolarized helium-3 images.

14:30 ***4628*. Optimisation of Velocity Encoding Gradients for Phase Contrast Gas Velocity Taking Diffusion Into Account.**

Lionel Martin[1], Xavier Maître[1], Mathieu Sarracanie[1], Marlies Friese[2], Ludovic de Rochefort[1], Rose-Marie Dubuisson[1], Emeline Boriasse[1], Emmanuel Durand[1]
[1]Imagerie par Résonance Magnétique Médicale et MultiModalités (UMR8081), Univ Paris-Sud, CNRS, Orsay, France; [2]Center for Magnetic Resonance, The University of Queensland, Brisbane, Queensland, Australia

MR flow measurement techniques have mostly been used in liquids. For coherent motion (flow), bipolar gradients induce a phase shift and a signal drop for incoherent motion (diffusion). This effect, negligible for liquids, cannot be neglected for gases. Competition between these two phenomena results in the existence of an optimal FOS that could be theoretically determined. 2D velocity maps of parabolic flows were acquired with different FOS and gases. Results show that velocity error is a function of the FOS and a different optimal FOS is reached for each gas. Thus, they validate our theoretical simulations.

15:00 ***4629*. Hyperpolarized 83Kr MR Relaxation Measurements in Excised Rat Lungs.**

Karl F. Stupic[1], Nancy D. Elkins[2], Galina E. Pavlovskaya[3], John E. Repine[2], Thomas Meersmann, [1,3]
[1]Department of Chemistry, Colorado State University, Fort Collins, CO, United States; [2]Health Science Center, Webb-Waring Institute, University of Colorado, Denver, CO, United States; [3]School of Medicine, University of Nottingham, Nottingham, United Kingdom

Hyperpolarized (hp) 83Kr has been previously shown to provide T1 relaxation weighted MRI contrast that is highly sensitive to the surface chemistry in low surface-to-volume model surface systems In the present work 83Kr T1 relaxation in excised rat lungs is investigated as a function of lung inflation. Surprisingly, the relaxation in ex vivo lungs does not change with increased lung inflation (when the effects of airways are eliminated) despite the presumably changing surface to volume ratios in the alveoli. The measured relaxation times are long enough to permit future in vivo studies.

Metabolism Liver & Other I

Hall B Monday 14:00-16:00 Computer 96

14:00 ***4630*. Reproducibility of MRI-Determined Proton Density Fat Fraction (PDFF) Across MR Scanner Platforms and Field Strength**

Geraldine Hye Won Kang[1], Michael Schroeder[1], Masoud Shiehmorteza[1], Benjamin Johnson[1], Tanya Wolfson[1], Anthony Gamst[1], Gavin Hamilton[1], Mark Bydder[1], Takeshi Yokoo[1], Claude Sirlin[1]
[1]Radiology, University of California, San Diego, San Diego, CA, United States

As a result of the growing epidemic of obesity, fatty liver disease has become the most common liver condition in the United States. Thus, there is an increasing need for a noninvasive fat quantification technique. We have developed a T1-independent, T2*-corrected, spectral modeled chemical shift based fat quantification technique, which permits estimation of the proton density fat fraction (PDFF). Here we show that PDFF measured by this technique is reproducible across field strength and vendor and has high accurt5acy using spectroscopy as the reference.

14:30 ***4631*. Association of Obesity with Fatty Infiltration of the Pancreas Diagnosed at MRI**

Ely Felker[1], Lorenzo Mannelli[1], Emilio Vega[1], Michael Bloom[1], Hersh Chandarana[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States

In addition to being associated with several metabolic disturbances, such as insulin resistance and diabetes mellitus, obesity causes fat infiltration of several organs, including the heart, liver, and skeletal muscle. The purpose of this study was to characterize the relationship between pancreatic fat infiltration and known markers of obesity. We showed that pancreatic fatty infiltration at MRI was significantly related to central fat volume, peripheral fat volume, and body mass index. Further study will enhance understanding of mechanisms that link obesity to its metabolic complications as well as, perhaps, provide an early marker for incipient insulin resistance and metabolic syndrome.

15:00 ***4632*. Non Alcoholic Fatty Liver Disease (NAFLD) and Visceral Fat: Accurate Spectroscopic and Volumetric Determinations Derived from MR**

Khalil N. Salman[1], Puneet Sharma[2], Bobby Kalb[1], Hiroumi Kitajima[2], Christina Lurie[1], Miriam Vos[3], Diego R. Martin[1]
[1]Radiology, Emory University, Atlanta, GA, United States; [2]Radiology, Emory Healthcare, Atlanta, GA, United States; [3]Pediatrics, CHOA, Atlanta, GA, United States

Non Alcoholic Fatty Liver disease(NAFLD) has become a serious problem in the USA. biopsy procedures are invasive and pose a high risk of morbidity. MRS of the liver along with volumetric visceral and subcutaneous fat measurement have shown to be an independent measure of fatty liver. This study investigates the correlation between volumetric fat measurements and hepatic fat fraction using HISTO technique.

15:30 ***4633*. Estimation of the Prevalence of Liver Fibrosis in Patients Receiving Chronic Methotrexate Therapy with MR Elastography**

Jun Chen[1], Deana Hoganson[2], Meng Yin[1], Kevin Glaser[1], Jayant Talwalkar[3], Eric Matteson[2], Richard Ehman[1]
[1]Department of Radiology, Mayo Clinic, Rochester, MN, United States; [2]Division of Rheumatology, Mayo Clinic, Rochester, MN, United States; [3]Division of Gastroenterology, Mayo Clinic, Rochester, MN, United States

Methotrexate (MTX) has become the most frequently prescribed disease modifying antirheumatic agent (DMARD) for rheumatoid arthritis (RA), due to its efficacy, low cost and tolerability. An ongoing primary concern of MTX treatment is its potential hepatotoxicity. Guidelines published in 1994 by the American College of Rheumatology (ACR) suggest that serum aspartate aminotransferase (AST), alanine aminotransferase (ALT), and albumin be monitored every 4-8 weeks for assessing hepatotoxicity in RA patients receiving MTX. If a patient develops 5 of 9 abnormal AST values within a 12 month time frame or if serum albumin decreases below the normal range, a liver biopsy is recommended. Because of the apparently low rate of clinically significance, MTX related hepatotoxicity, the usefulness and cost-effectiveness of such frequent monitoring, particularly in the absence of risk factors for liver disease have been brought into question. The unavailability of accurate non-invasive hepatic fibrosis detection methods other than biopsy has frustrated clinicians in addressing these important questions. Since its advent 15 years ago [8], Magnetic Resonance Elastography (MRE) has developed into a clinical useful diagnostic technology. This abstract reports interim results from a currently ongoing project using MRE to assess hepatic fibrosis in RA patients who are on MTX treatment seen at our institution.

Tuesday 13:30-15:30 Computer 96

13:30 ***4634*. Comparison of MR Elastography and DWI for Assessment of Hepatic Fibrosis**

James F. Glockner[1], Christine U. Lee[1], Richard L. Ehman[1]
[1]Radiology, Mayo Clinic, Rochester, MN, United States

Hepatic MR elastography and DWI with low and intermediate b-values were performed in 29 patients with suspected chronic liver disease. ADC measurements for both b-values demonstrated a negative correlation with hepatic stiffness as determined by MRE. The range of variation of in stiffness values is larger than that of ADC values, suggesting that MRE may be more sensitive to small variations in hepatic stiffness.

14:00 ***4635*. R2* as a Surrogate Measure of Ferriscan® Iron Quantification in Thalassemia**

Wesley Calvin Chan[1], Faisel Budhani[1], Zahra Tejani[1], Christine Massey[2], Masoom A. Haider[1]
[1]Joint Department of Medical Imaging, University Health Network, Mount Sinai Hospital, University of Toronto, Toronto, ON, Canada; [2]Dalla Lana School of Public Health, Princess Margaret Hospital, University Health Network, University of Toronto, Toronto, ON, Canada

Monitoring hepatic iron concentration is an important clinical concern in thalassemia patients. The aim of this study is to demonstrate a correlation between R2* relaxation rate and liver iron concentration determined by the FDA approved Ferriscan® method. We found a very strong linear correlation between R2* values and Ferriscan® determined liver iron concentration with the Spearman correlation = 0.976 (95% CI: 0.963, 0.984). The prediction equation from regression analysis was ([Fe])=0.80(R2*)-44.1(r=0.968, r2 = 0.937, p < 0.0001). Determination of liver iron concentration by R2* methods may be helpful as a diagnostic surrogate for Ferriscan® iron measurements.

14:30 **_4636_. Chronic Hepatitis and Fibrosis Assessed by Magnetic Resonance Elastography (MRE)**

Yi Wang[1], Frank H. Miller[1], Robert McCarthy, Zongming E. Chen, Laura Sternick, Daniel Ganger, Richard Ehman[2], Reed Omary[1], Josh Levitsky, Bradley D. Bolster, Jr. [3], Saurabh Shah[3], Sven Zuehlsdorff[3], Paul Nikolaidis[1], Vahid Yaghmai[1]

[1]Radiology, Northwestern University Feinberg School of Medicine, Chicago, IL, United States; [2]Mayo Clinic; [3]Siemens Healthcare

We proposed to evaluate the capability of MRE in detecting and distinguishing patients with inflammation and without fibrosis from patients without inflammation and fibrosis, and with various stages of fibrosis based on histopathologic analyses. Liver tissue with inflammation and without fibrosis can be seen with mildly elevated stiffness value on MRE, which was significantly higher than those that lack inflammation and fibrosis. Both mild hepatic fibrosis and inflammation was associated with mild elevation of stiffness, but a significant difference was not observed. Furthermore, tissue with moderate fibrosis and advanced fibrosis to cirrhosis showed significant increased stiffness values on MRE.

15:00 **_4637_. Diffusion Tensor Imaging of Liver Fibrosis in an Experimental Model**

Jerry S. Cheung[1,2], Shu Juan Fan[1,2], Darwin Shan Gao[1,2], Kwan Man[3], Ed X. Wu[1,2]

[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [3]Department of Surgery, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Early diagnosis of liver fibrosis could facilitate early interventions and thus alleviate its progression to cirrhosis and/or hepatocellular carcinoma. Several studies have shown that measurement of water diffusivity by diffusion-weighted imaging (DWI) was useful in the evaluation of liver fibrosis and cirrhosis. The aim of this study was to characterize longitudinal changes in diffusion properties of liver using diffusion tensor imaging (DTI) in an experimental model of liver fibrosis. The experimental results in this study demonstrated that DTI could detect longitudinal changes in diffusion properties of liver in an experimental model of liver fibrosis.

Wednesday 13:30-15:30 Computer 96

13:30 **_4638_. Diagnosis of Cirrhosis with MRI: Is Magnetization Transfer Contrast Worth Pursuing?**

Andrew B. Rosenkrantz[1], Pippa Storey[1], Ben Niver[1], Cristina Hajdu[2], Vivian S. Lee[1]

[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Pathology, NYU Langone Medical Center, New York, NY, United States

8 patients with liver cirrhosis and 8 volunteers underwent liver MRI at 1.5T that included repeated applications of an adjustable magnetization-transfer contrast (MTC) sequence, with the MT pre-pulse offset frequency varying from 1000Hz to 3000Hz and the MT pre-pulse flip angle varying from 100º to 900º. The magnetization transfer ratio measured over the right lobe showed substantial overlap between healthy and cirrhotic liver for all assessed MTC sequences, with none of the differences being significant (p-values from 0.092 to 0.819). Our data suggests that, unlike the results of previous studies, MTC imaging is unable to differentiate healthy and cirrhotic liver.

14:00 **_4639_. Breath-Hold Quantitative Liver MR Imaging: Assessment of Hepatic Fibrosis, Iron Content, and Fat Fraction**

Russell Norman Low[1,2], Huanzhou Yu[3], Ann Shimakawa[3], Lloyd Estkowski, Richard Ehman[4]

[1]Sharp and Children's MRI Center, San Diego, CA, United States; [2]San Diego Imaging, San Diego, CA, United States; [3]Applied Science Lab, General Electric Healthcare; [4]Mayo Clinic

Quantification of diffuse liver disease adds a new dimension to hepatic MR imaging which can provide critical information for diagnosis and for monitoring response to therapy. We explore the implementation of a rapid breath-hold MR evaluation of liver fibrosis using MR Elastography combined with a new multiecho Dixon technique known as IDEAL Quant which quantifies liver iron assessed by R2* values and fat fraction. In five breath holds this exam assesses liver fibrosis, R2* correlated with iron content, and the percentage of fatty infiltration.

14:30 **_4640_. Background Gradient Correction for Water and Fat Quantification in 2D Liver Imaging**

Yoon Ho Nam[1], Hahnsung Kim[1], Dong-Hyun Kim[1,2]

[1]Electrical & Electronic Engineering, Yonsei University, Seoul, Korea, Republic of; [2]Radiology, Yonsei University College of Medicine, Seoul, Korea, Republic of

Accurate quantification of the liver fat content is an important factor in detecting hepatic diseases. A multi-echo approach can be used effectively for liver fat quantification. However, the presence of macroscopic field inhomogeneities shortens T2* values and can lead to underestimated T2* values of fat content in liver. This study propose correcting method for these macroscopic inhomogeneities to accurately quantify T2* values and fat, water content using multi-echo 2D liver imaging.

15:00 **4641. Quantification of Hepatic Iron Overload: Usefulness of Echo-Planar Imaging Based Diffusion-Weighted Magnetic Resonance Imaging**

Tatsuyuki Tonan[1], Kiminori Fujimoto[1], Aliya Qayyum[2], Takumi Kawaguchi[3], Atsushi Kawaguchi[4], Koji Okuda[5], Shuji Nagata[1], Michio Sata[3], Naofumi Hayabuchi[1]

[1]Radiology, Kurume University School of Medicine, Kurume, Fukuoka, Japan; [2]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States; [3]Internal Medicine, Kurume University School of Medicine, Kurume, Fukuoka, Japan; [4]Biostatistics Center, Kurume University School of Medicine, Kurume, Fukuoka, Japan; [5]Surgery, Kurume University School of Medicine, Kurume, Fukuoka, Japan

MRI is sensitive to tissue iron overload because iron leads to a decline of magnetic resonance signal due to T2-shortening effect related to the paramagnetic properties, and recently has become suitable technique for quantifying hepatic iron overload noninvasively. The aim of this study is to assess the usefulness of echo-planar image based diffusion- weighted image (EPI-DWI) for quantifying subtle hepatic iron stores. We found a good correlation between EPI-DWI and hepatic iron concentration in patients with viral hepatitis, and demonstrated that EPI-DWI was more sensitive sequence for quantifying hepatic iron overload than gradient-recalled echo sequence.

Thursday 13:30-15:30 Computer 96

13:30 **4642. Multislice Multiecho T2* MRI for Detection of the Distribution of Hepatic Iron Overload.**

Antonella Meloni[1], Antongiulio Luciani[2], Alessia Pepe[1], Vincenzo Positano[1], Gennaro Restaino[3], Maria Chiara Dell'Amico[1], Brunella Favilli[1], Gianna Alberini[1], Giovanni Palazzi[4], Massimo Lombardi[1]

[1]MRI Lab, “G. Monasterio Foundation” and Institute of Clinical Physiology, CNR, Pisa, Italy; [2]Istituto di Radiologia Az. Osp. "Garibaldi", Catania, Italy; [3]Catholic University, Campobasso, Italy; [4]Policlinico di Modena, Modena, Italy

The goals of our study were to set up a MRI acquisition technique for the detection of the iron burden in the whole liver of thalassemia major patients. Significant differences in the segmental T2* values were found. Specifically, the mean T2* values over the segments VI and VIII were significantly lower than the mean T2* values over the other segments. However, T2* variations in liver are low and likely due to the artefacts effects and measurement variability.

14:00 **4643. Hepatic Lipid Quantification with MRS: BMI, T2, and Prandial Correlations.**

Robert D. O'Connor[1], Gary Skolnick[2], Nicole Nejedly[2], Adil Bashir[1], Samuel Klein[2]

[1]Radiology, Washington University, St. Louis, MO, United States; [2]Geriatrics and Nutritional Science, Washington University School of Medicine, St. Louis, MO, United States

MRS protocols for hepatic lipid quantification are examined. It is concluded that an optimal protocol can achieve a CV of at least 5%.

14:30 **4644. Three-Dimensional Two-Point Dixon Acquisition with Projections Onto Convex Sets (POCS) for Abdominal Imaging**

Agus Priatna[1], Vamsi Narra[2]

[1]MR R&D Collaborations, Siemens Healthcare, St Louis, MO, United States; [2]Mallinckrodt Institute of Radiology, Washington University, St Louis, MO, United States

Three-dimensional two-point Dixon technique has been routinely used for liver imaging to provide opposed and inphase images, as well as fat only and water only images. Phase partial Fourier and strong echo asymmetry are often employed to reduce the scan time. However, echo asymmetry and phase partial Fourier with zero filling result in blurring artifacts in the in-plane view. This abstract describes the use of phase correction with projection onto convex sets (POCS) to the three dimensional two-point Dixon sequence in order to reduce blurring artifact and improve image quality at short scan times

15:00 **4645. Contribution of Phase-Contrast Magnetic Resonance Imaging in the Study of Hepatic Fibrosis: Preliminary Results**

Thierry Yzet[1], Roger Bouzerar[2], Eric Nguyen-Khac[3], Brice Robert[1], Denis Chatelain[4], Hervé Deramond[1], Marc-Etienne Meyer[2], Olivier Baledent[2]

[1]Radiology, University Hospital, Amiens, France; [2]Imaging and Biophysics, University Hospital, Amiens, France; [3]Hepato-Gastroenterology, University Hospital, Amiens, France; [4]Pathological Cytology, University Hospital, Amiens, France

Hepatic fibrosis is secondary to many etiologies and quantification of this fibrosis is a key point for the clinician. In this work, we wanted to appraise the potential links between elastometry data and parameters measured using PC-MRI in 17 subjects developing hepatic pathologies. Three distinct groups, probably representative of the stage of hepatic fibrosis, clearly appear A statistically significant linear correlation between the elasticity modulus and the vessel area variations DS or the portal congestion index IC is clearly highlighted. PC-MRI could be a useful and complementary tool for the understanding of evolution mechanisms involved in hepatic fibrosis.

Metabolism Liver & Other II

Hall B Monday 14:00-16:00 Computer 97

14:00 ***4646*. Absolute Quantification of Liver Fat by MRI Fat Volume Fractions in Comparison to Histopathology**

Michael Alexander Fischer[1], Paul Stolzmann[1], Daniel Nanz[1], Cäcilia S. Reiner[1], Stefan Breitenstein[2], Matteo Montani[3], Borut Marincek[1], Hans Scheffel[1]
[1]Institute of Diagnostic Radiology, University Hospital Zurich, Zurich, Switzerland; [2]Clinic of Visceral and Transplant Surgery, University Hospital Zurich, Zurich, Switzerland; [3]Institute of Surgical Pathology, University Hospital Zurich, Zurich, Switzerland

A new approach for absolute quantification of liver fat content is presented by calculation of fat volume fractions (FVF-MRI) derived from a single-breathhold 3D spoiled dual gradient-echo MRI sequence yielding for in-/out-of-phase as well as fat-signal only images. Our results show that the absolute liver fat content equalling the actual weight per volume of liver lipid can be quantified accurately by FVF-MRI with surface-coil sensitivity correction compared to fat volume fractions derived from histopathology as the gold standard. Moreover fat-only images significantly reduce the measurement bias as compared to in/out-of-phase images.

14:30 ***4647*. Optimization of a 3D Dixon MR Imaging Techniques for Fat / Water Quantitation**

sunder s. rajan[1], David Thomasson[2], Ronald Ouwerkerk[3], songtao liu[3], Ahmed m. Gharib[3]
[1]Div of physics, fda/cdrh/osel, Silver Spring, MD, United States; [2]Radiology & Imaging Sciences, National Institutes of Health, MD; [3]National Institute of Digestive and Diabetes and Kidney Diseases

Using a well characterized serial dilution lipid-water phantom we were able to simulate signal intensity results to determine the appropriate range of sequence parameter values over which we could experimentally validate measured lipid-water ratios on existing clinical 2D technique as well as using a recently available 3D Dixon technique.

15:00 ***4648*. Measurements of the Abdominal Fat Area: Comparison with MR and CT Measurements in Medical Check-Ups**

Takayuki Masui[1], Motoyuki Katayama[1], Rie Takafuji[2], T Natume[1], S Nozawa[2], Hiroki Ikuma[1], Kimihiko Sato[1], Kenji Asano[3], Hasnine A. Haque[3], M Sugimura[1], S Imamura[2], Atsushi Nozaki[3]
[1]Radiology, Seirei Hamamatsu General Hospital, Hamamatsu, Japan; [2]Seirei Kenshin Center, Hamamatsu, Japan; [3]GEHC-Japan, Hino, Japan

As one of criteria for metabolic syndrome, measurements of abdominal fat area using CT have been suggested. MEDAL or LAVA flex can provide in-phase and fat images and, modification of these images can be utilized to set threshold to make semiautomatic calculation of fat area. Purpose was with semiautomatic demarcation of fat areas on MR to evaluate correlations between MR and CT measurements for abdominal fat area in subjects having medical check-ups. Good correlation was observed between in MR and CT measurements. CT measurements of abdominal fat can be replaced by MR without irradiation in large population for medical-checkups.

15:30 ***4649*. Hepatic Fat Quantification on 3T MRI Using a Dual-Flip Multi-Echo Sequence with MR Spectroscopy and Histopathologic Correlation**

Hero K. Hussain[1], Marko K. Ivancevic, Frank J. Londy, Susan Rohrer, Elif A. Oral, Barbara McKenna, Thomas L. Chenevert
[1]University of Michigan, Ann Arbor, MI, United States

The dual-flip multi-echo MRI method at 3T is reliable to measure hepatic fat. It correlates well with MRS and quantitative histopathologic measures, though unlike MRS, offers full-liver mapping of fat content and heterogeneity.

Tuesday 13:30-15:30 Computer 97

13:30 ***4650*. Multislice Multiecho T2* MRI Assessment of Regional Pancreatic Iron Overload and Correlation with Cardiac Biventricular Function and Myocardial Iron Overload in Thalassemia Major Patients.**

Gennaro Restaino[1], Antonella Meloni[2], Alessia Pepe[2], Vincenzo Positano[2], Massimiliano Missere[1], Pasquale Pepe[2], Daniele De Marchi[2], Giuseppina Secchi[3], Antongiulio Luciani[4], Giuseppina Sallustio[1], Massimo Lombardi[2]
[1]Catholic University, Campobasso, Italy; [2]MRI Lab, “G. Monasterio Foundation” and Institute of Clinical Physiology, CNR, Pisa, Italy; [3]Azienda USL n° 1, Sassari, Italy; [4]Istituto di Radiologia Az. Osp. "Garibaldi", Catania, Italy

The aims of this study were to describe the T2* values of the pancreas in patients with TM, to investigate the correlation between pancreatic and myocardial siderosis and to investigate the correlation between pancreatic iron overload and biventricular cardiac function. The mean T2* over the pancreatic head was significantly higher than the mean T2* value over the pancreatic body and tail.

Significant positive correlations of the pancreatic T2* were demonstrated for global heart T2* value and number of segments with normal T2*. Moreover, pancreatic iron overload was negatively correlated to biventricular systolic function.

14:00 ***4651*. The Use of Slope-Ratio Methods to Quantify Liver Perfusion from Dynamic Contrast-Enhanced MR Data: Comparison with Perfusion Quantification Using a Dual-Input Single Compartment Model**

Keiko Miyazaki[1], Matthew R. Orton[1], James A. d'Arcy[1], Val Lewington[2], Dow-Mu Koh[3], Martin O. Leach[1], David J. Collins[1]

[1]CR-UK and EPSRC Cancer Imaging Centre, The Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]Department of Nuclear Medicine, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [3]Department of Radiology, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

Dynamic contrast-enhanced (DCE-) MRI is a technique that enables non-invasive interrogation of tissue microvasculature environment. Different analysis approaches can be taken to quantify arterial and portal-venous hepatic perfusion from liver DCE-MRI data. In this study, two slope-ratio methods were used to quantify arterial and portal-venous perfusion from clinical MR data. Comparisons were made with perfusion quantified using a dual-input single compartment model. Perfusion quantified using the slope-ratio methods were found to be lower than those quantified using the dual-input model. High correlations were observed between the two approaches, especially in the estimates of arterial perfusion.

14:30 ***4652*. Does the Measurement of Liver and Vertebral Fat Content Influenced by R2* Effect in T2*-IDEAL: A Comparison Study with 3-Point IDEAL and MRS in Healthy Volunteers**

Chun-Jung Juan[1], Hing-Chiu Chang[2,3], Chih-Yung Yu[1], Chang-Hsien Liou[1], Cheng-Yu Chen[1], Chun-Jen Hsueh[1], Hung-Wen Kao[1], Chih-Wei Wang[1], Hsiao-Wen Chung[1,3], Guo-Shu Huang[1]

[1]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan; [2]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [3]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

By simultaneous acquisition of all echoes in one TR interval, T2* IDEAL is superior to 3-pt IDEAL by allowing either larger spatial coverage or higher resolution. Whether the fat content measured by the T2* IDEAL method is influenced by the R2* effect of tissue or not is an important concern but remains ambiguous. In this study, we verify the fat content measurements of liver (lower R2* value) and vertebra (higher R2* value) in both methods compared to the MRS method. Our results show no statistical difference of liver and vertebral fat content in T2* IDEAL and 3-pt IDEAL methods.

15:00 ***4653*. R2* Measurement Using Absolute SNR-Weighted Least Square Regression**

Xiaoming Yin[1,2], Saurabh Shah[3], Andrew C. Larson[1,2]

[1]Radiology, Northwestern University, Chicago, IL, United States; [2]Electrical Engineering and Computer Science, Northwestern University, Evanston , IL, United States; [3]Siemens Medical Solutions, Chicago, IL, United States

R2* is typically estimated via mono-exponential fitting of signal decay within a series of GRE images combined by the root sum-of-square (RSS) approach. However, RSS approaches rectify and bias noise in later TEs, resulting in systematic fitting errors for R2* estimation. Our work investigated the accuracy of low SNR R2* measurements for RSS reconstructed data. Through phantom, ex vivo, and volunteer studies, we compared the accuracy of R2* measurement using SNR-weighted least-square regression and SNR-based truncation methods. We found SNR-weighted least-square regression to be a simple and reliable approach to reduce R2* measurement error.

Wednesday 13:30-15:30 Computer 97

13:30 ***4654*. Differentiation of T1W Hyperintense Nodules Among Cirrhotic Liver: Comparison of Ferucarbotran-Enhanced MR Imaging with Accumulation Phase FS-T1WI and Gadolinium-Enhanced MR Imaging**

Ran-Chou Chen[1,2], Chen-Te Chou[3,4]

[1]Biomedical Imaging and Radiological Science, National Yang-Ming Medical University, Taipei, Taiwan; [2]Radiology, Taipei City Hospital , Taiwan; [3]Radiology, Chang-Hua Christian Hospital, Er-lin branch, Chang-Hua, Taiwan; [4]Department of Biomedical Imaging and Radiological Science, National Yang-Ming Medical University, Taipei, Taiwan

Our study was to evaluate ferucarbotran-enhanced MRI with accumulation-phase fat suppression T1-weighted imaging in comparison with gadolinium-enhanced MRI for characterization of T1W hyperintense nodules within cirrhotic liver. In the gadolinium-enhanced group, the MRI sensitivity, specificity and accuracy were 60%, 100% and 73%, respectively. In ferucarbotran-enhanced group, the sensitivity, specificity and accuracy were 100%, 83% and 94%, respectively. The ferucarbotran-enhanced MRI provided additional information of cellular function in differentiation of focal hepatic lesion and ferucarbotran-enhanced MRI is superior to gadolinium-enhanced MRI in characterization of T1W hyperintense nodules. T1W hyperintense nodule depicting hyperintense on ferucarbotran-enhanced accumulation-phase FS-T1WI should be investigated aggressively.

14:00 *4655*. **Utilizing Magnetic Resonance Elastography in the Evaluation of Liver Donors**

Tilina Hu[1], Alvin Silva[1], Leland Hu[1], Richard Ehman[2]
[1]Radiology, Mayo Clinic, Scottsdale, AZ, United States; [2]Radiology, Mayo Clinic, Rochester, MN, United States

To determine accurate biopsy-validated Magnetic Resonance Elastography threshold values that distinguish normal from abnormal liver (due to fibrosis and/or inflammation). We focus specifically on pre-operative evaluation of liver donors prior to transplant.

14:30 *4656*. **DTI and 2D MR Spectroscopy of Hepatitis C in 3T**

Rajakumar Nagarajan[1], Manoj K. Sarma[1], Charles Hinkin[2], Steven Castellon[2], Jason P. Smith[3], Homayoon Khanlou[4], Laveeza Bhatti[4], Jonathan Truong[5], Ann B. Ragin[6], Elyse Singer[7], M Albert Thomas[1]
[1]Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States; [2]Department of Psychiatry & Biobehavioral Sciences, UCLA School of Medicine and VA Greater Los Angeles Healthcare System, Los Angeles, CA, United States; [3]Veteran's Affairs Greater Los Angeles Healthcare Center; [4]AIDS Healthcare Foundation, Westside Clinic, Los Angeles; [5]Kaiser Permanente, Lancaster CA; [6]Northwestern University, Chicago, Illinois, USA; [7]Neurology, UCLA School of Medicine, Los Angeles, California, United States

Hepatitis C is a liver disease caused by the hepatitis C virus (HCV). HCV infection sometimes results in an acute illness, but most often becomes a chronic condition that can lead to cirrhosis of the liver and liver cancer. Hepatitis C may be detectable with MR diffusion tensor imaging (DTI), which is exquisitely sensitive to water diffusion and is used to quantify the magnitude of diffusivity and the orientation and linearity (that is, anisotropy) of water motility in microstructural level in brain. Combining two-dimensional (2D) localized correlated spectroscopic (L-COSY) technique with DTI provides more information about the cerebral metabolites, mean diffusivity and fractional anisotropy changes in patients with hepatitis C.

15:00 *4657*. **Estimation of Liver Iron Content with Different MRI Methods**

Arthur Peter Wunderlich[1], Holger Cario[2], Mathias Schmid[3], Markus Juchems[1]
[1]Dept. for Diagnostic and Interventional Radiology, Univ.-Clinic Ulm, Ulm, Baden-Württemberg, Germany; [2]Pediatrics, Univ.-Clinic Ulm, Ulm, Germany; [3]Hematology, Univ.-Clinic Ulm, Ulm, Germany

To compare the liver iron content (LIC) determined by different MR methods, we investigated 93 patients with protocols according to three published methods, two using gradient echo (GRE) sequences and one working with spin echo (SE). The methods correlate moderately with r=0.82. Weakpoints are the bad performance of one GRE method near its upper limit and the sensitivity to liver steatosis of the GRE method addressing high LIC. The latter leads to reduced correlation of SE vs. GRE in the high LIC range. Although GRE generally tends to overestimate LIC, both methods are suitable for decisions concerning patient management.

Thursday 13:30-15:30 Computer 97

13:30 *4658*. **Is Shear Viscosity a Sign for Malignancy in Liver Tumours?**

Jean Luc Daire[1], Ralph Sinkus[2], Mathilde Wagner[1], Nathalie Haddad[1], Valerie Vilgrain[1], Bernard van Beers[1]
[1]INSERM U773, CRB3 Centre de Recherches Biomédicales Bichat-Beaujon, Paris, France; [2]Institut Langevin, ESPCI, Paris, France

Liver tumours are very frequent. They include benign lesions and malignant primary or secondary tumours (metastases). Currently, there is no established non-invasive imaging Goldstandard available in order to characterize malignancy for liver tumours. Very often, the enhancement characteristics of a bolus are used in order to differentiate benign from malignant tumours. Here, we intend to prospectively evaluate the complex shear modulus as measured via MR-elastography in the assessment of malignancy or benignity of liver lesions and compare its performance to those of three enhancement characteristics of the bolus passage.

14:00 *4659*. **Evaluation of Nonalcoholic Liver Disease Using ^{23}Na MRI and Shift Reagent-Aided ^{23}Na and ^{31}P MRS**

Paige Nicole Hopewell[1,2], Navin Bansal[1,2]
[1]Radiology, Indiana University School of Medicine, Indianapolis, IN, United States; [2]Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, United States

Changes in signal intensity with disease progression in single quantum (SQ) and triple quantum-filtered (TQF) ^{23}Na MRI are validated with shift reagent-aided SQ and TQF ^{23}Na and ^{31}P MRS studies in a nonalcoholic fatty liver disease model. Changes in intracellular Na^+ concentration and fibrosis-associated macromolecule deposition in the extracellular space both contribute to an increased TQF ^{23}Na MRI signal with advanced disease progression.

14:30 *4660*. **Liver Fibrosis Grading Based on MR Elastography and 31P Spectroscopy**

Edmund Mark Godfrey[1], Anant S. Krishnan[1], Susan E. Davies[2], Nyree M. Griffin[3], Graeme J. Alexander[4], Mike E. Allison[4], Alexander E. Gimson[4], William H. Griffiths[4], David J. Lomas[1]
[1]Department of Radiology, Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom;
[2]Department of Histopathology, Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom;

[3]Department of Radiology, St Thomas' Hospital, London; [4]Department of Hepatology, Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom

Standard imaging techniques are insensitive to liver fibrosis. Current clinical assessment of liver fibrosis requires a biopsy, which risks complications and sampling error. This work describes our experience with 2 new MR techniques: MR elastography and 31P spectroscopy. MR elastography was found to correlate with histological grade of fibrosis in contrast to 31P PME/PDE ratio. Our findings do not correlate with previous work. This may be because histological grade in our study was based on the original report, rather than review of the biopsy material. We plan to repeat the analysis of our results with this data.

15:00 ***4661*. Use of a Two-Point Dixon VIBE Sequence for Post-Contrast Liver MRI: Comparison with Standard Chemically-Selective Fat-Suppressed VIBE for Image Quality and Lesion Detection**

Andrew B. Rosenkrantz[1], Lorenzo Mannelli[1], Sungheon Kim[1], James Babb[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States

In 30 consecutive patients at 1.5T, a breath-hold two-point Dixon VIBE acquisition was obtained of the liver immediately following a standard chemically-selective fat-suppressed VIBE acquisition, both performed during the equilibrium phase after intravenous contrast administration. Compared with the standard VIBE sequence, the Dixon VIBE sequence demonstrated significantly improved strength of fat suppression, homogeneity of fat suppression, vessel sharpness, and subjective overall image quality. There were no significant differences between the two sequences for sensitivity or PPV for focal liver lesion detection. We conclude that Dixon-VIBE achieved higher image quality with preserved diagnostic ability for post-contrast liver MRI.

Bowel

Hall B Monday 14:00-16:00 Computer 98

14:00 ***4662*. Fast 3D Tracking of 19F Labeled Small Capsules for Combined Morphology and Real-Time Flow Studies in the Gastrointestinal Tract**

Tobias Hahn[1], Sebastian Kozerke[1], Mark Fox[2,3], Werner Schwizer[2], Andreas Steingoetter, [1,4], Michael Fried[2], Peter Boesiger[1]
[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland; [2]Division of Gastroenterology and Hepatology, University Hospital Zurich; [3]Nottingham Digestive Diseases Centre and Biomedical Research Unit Queen's Medical Centre, University Hospital Nottingham; [4]Institute of Radiology, Klinikum rechts der Isar, Technische Universität München, Munich, Germany.

3D tracking of small-sized 19F labeled capsules is studied using fast modified balanced FFE sequences for concurrent measurements of gastrointestinal function and morphology. Perfluoro-15-crown-5-ether and Hexafluorobenzene are proposed and studied for use as tracking mediums. The proposed imaging protocol is shown to be reliable in tracking small capsules through realistic abdominal phantoms and might therefore bear potential of being a valuable tool in detecting abnormal gastric function and at the same time posing the basis for creating a 3D anatomical model of the complex bowel geometry.

14:30 ***4663*. MR Fluoroscopy for Gastrointestinal Malrotation in Unsedated Infants**

Owen John Arthurs[1], Ilse Joubert[1], Martin John Graves[1], Pat Set[1], David John Lomas[1]
[1]Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom

Gut malrotation is a congenital disorder of abnormal intestinal rotation, for which the current diagnostic technique is an upper GI X-ray contrast study. This study evaluated the feasibility of interactive MR fluoroscopy for defining the gastro-intestinal tract anatomy in un-sedated children with suspected malrotation. We imaged 9 children using both X-ray fluoroscopy, FIESTA and interactive SSFSE MR imaging. We confidently identified the DJ flexure (7/9; 77%), orientation of the SMA / SMV (8/9; 88%) and the caecum (9/9; 100% using MRI. Interactive MR Fluoroscopy is feasible for gut imaging in un-sedated children.

15:00 ***4664*. Customised Rotational Imaging Support for Paediatric MRI (CRISP-MRI)**

Owen John Arthurs[1], Erich Zammer[2], David John Lomas[1]
[1]Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom; [2]Department of Orthopaedics, University of Cambridge and Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom

Traditional X-ray fluoroscopy methods for upper gastro-intestinal (GI) tract imaging in children require postural alteration to help move contrast media to the required locations. In order to establish an equivalent MRI technique for imaging the paediatric gut, we have developed a custom-built coil insert which allows for gentle rotation of a child within a rigid surface coil. It has a Vitrothene polymer backing, with a Plastazote foam insert, which is currently for orthopaedic supports in our hospital. These materials are strong, non-ferromagnetic, easily cleanable, lightweight and breathable. This type of device should help facilitate MR fluoroscopy in small children.

15:30 **_4665_. Colonic Response to an Experimental Model of Human Diarrhoeal Disease**

Elisa Placidi[1], C. L. Hoad[1], L. Marciani[2], R. C. Spiller[2], P. A. Gowland[1]
[1]SPMMRC, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom; [2]Nottingham Digestive Diseases Centre Biomedical Research Unit, University of Nottingham, Nottingham, United Kingdom

MRI was used to investigate the colonic response to two contrasting test meals: a readily absorbable glucose drink (control) and a non absorbable mannitol drink, which acts as a model of acute diarrhoeal disease. Eight healthy volunteers were imaged on a 1.5 T Philips Achieva scanner with several sequences up to 8 hours after the drink, to assess changes in the ascending colon in terms of water content, volume, and image signal intensity. Differences between the two conditions have been quantified. A scoring system based on subjective assessment of colonic contents has also been developed.

Tuesday 13:30-15:30 Computer 98

13:30 **_4666_. Comparison Study on Differentiating Active from Remissive Crohn's Disease by 3.0T and 1.0T MRI**

Ambreen Sattar[1], J Zhu[2], Y Yu[2], L Hamm[2], Y Ye[2], Y Xuan[2], J Hu[2]
[1]Radiology, Wayne State University, Detroit, MI, United States; [2]WSU MR RESEARCH, Wayne State University, detroit, MI, United States

This study analyzes the abiltiy of 3.0 T MRI to better evaluate the activity of active vs remissive Crohn's disease over 1.0 T MRI.3.0 T magnet is better capable of detecting various signs of active Crohn's diseases such as Stenosis, bowel wall thickening and bowel wall enhancement. MRI is safer option because it does not uses ionizing radiation and provides better diagnostic outcome in staging disease which can significantly alter treatment options offered by the physician.

14:00 **_4667_. Performance of Non-Contrast MR Enterography to Localize and Predict Disease Activity in Crohn's Disease.**

Srigouri Yalamanchili[1], Michael Macari[1], Rafael Rivera[1], Danny Kim[1], Alec Megibow[1], James Babb[1], Joseph Levy[1], Kerry Zabriskie[1], Sooah Kim[2]
[1]New York University; [2]New York University, New York, NY, United States

Secific findings at MR imaging- mural T2 high signal intensity and contrast enhancement patterns- have been proposed as accurate markers of disease activity. The purpose of our study is to assess the performance using conventional non-contrast MR imaging sequences as a tool to localize and predict disease activity in Crohn's disease in comparison to post-contrast images. Thirty patients referred for MR enterography were evaluated at 1.5 T using steady state free precession, single shot fast spin echo, fat suppressed T2, and pre- and post contrast enhanced T1-weighted sequences. Images were reviewed by two radiologists in two separate sessions; the readers interpreted non-contrast images of MRI during the first session and whole images including post-contrast sequences during the second session. The readers evaluated the presence or absence of disease in regard to the presence of active inflammation using a six-point grading system (0, No evidence of disease; 1, definite absence of active inflammation; 2, probable absence of active inflammation; 3, equivocal; 4, probable presence of active inflammation; and 5, definite presence of active inflammation). Reference standard was constructed by combining surgical, endoscopy, physical, and all available imaging findings. There were 34 bowel segments with active inflammation on reference standard in 18 subjects (proximal ileum, n=1, distal ileum, n=4; terminal ileum, n=16; cecum, n=6; ascending colon, n=1; rectosigmoid, n=2). Inter-reader agreement was significantly higher for whole imaging including post-contrast images relative to non-contrast images (Kappa 0.31 for non-contrast and 0.41 for whole images). Although there is no significant difference localizing abnormal bowel segment involved with Crohn's disease using non-contrast images, inter-reader agreement, sensitivity, and accuracy are significantly higher in the assessment of active disease adding post-contrast images to non-contrast images for MRI interpretation.

14:30 **_4668_. The Effect of High Fat or High Carbohydrate Meals on the Gastrointestinal Tract: A MRI Study**

Eleanor F. Cox[1], Michael Mellows[2], Susan E. Pritchard[1], Mahamoud Hussein[1], Caroline L. Hoad[1], Carolyn Costigan[3], Luca Marciani[2], Robin C. Spiller[2], Penny A. Gowland[1]
[1]SPMMRC, Physics & Astronomy, University of Nottingham, Nottingham, Nottinghamshire, United Kingdom; [2]Nottingham Digestive Diseases Centre, NIHR BRU, Nottingham University Hospitals, Nottingham, United Kingdom; [3]Brain & Body Centre, University of Nottingham, Nottingham, United Kingdom

The effect of a high fat (HF) meal and an equicaloric high carbohydrate (HC) meal on satiety, gastric volumes, small bowel water content (SBWC) and gallbladder contraction (as a marker of CCK release) was investigated using MRI. The HF meal resulted in increased fullness and decreased hunger and appetite compared with the HC meal. Gastric emptying was initially faster for the HF meal. After 90 minutes, SBWC was greater after the HF meal than after the HC meal. This delayed increase may reflect delayed emptying of fat which stimulates pancreatic secretions.

15:00 ***4669***. **The Use of MR Thermometry in Legal Medicine: A Feasibility Study Utilizing Rat Rectal Temperature.**

Hideto Kuribayashi[1], Fanlai Cui[2], Keiko Hirakawa[2], Yoshimasa Kanawaku[3], Youkichi Ohno[2]
[1]Varian Technologies Japan Limited, Minato-ku, Tokyo, Japan; [2]Nippon Medical School; [3]National Defence Medical College

Proton resonance frequency-shift based MR temperature imaging was introduced into the rectal temperature measurement in cooling dead bodies in order to estimate the time of death in legal medicine. A series of MR temperature difference maps in cooling dead rats could be obtained. Moreover, distribution of cooling rates among pelvic tissues was observed and shown to be related to body position.

Female Pelvis MRI

Wednesday 13:30-15:30 Computer 98

13:30 ***4670***. **Clinical Significance of the 2 Ppm Resonance in In-Vivo 1H-MR Spectroscopy of Ovarian Tumors**

Mayumi Takeuchi[1], Kenji Matsuzaki[1], Masafumi Harada[1], Hiromu Nishitani[1]
[1]Department of Radiology, University of Tokushima, Tokushima, Japan

We evaluated 31 ovarian tumors including 8 mucinous tumors by 1H-MR spectroscopy at 3T. High to moderate 2 ppm peaks were observed in all 8 mucinous tumors, whereas low to slight 2 ppm peaks were observed in 14 of 23 non-mucinous tumors. The 2 ppm concentration in mucinous tumors (7.39+/-2.85 mM) was significantly higher than that in non-mucinous lesions (3.12+/-1.42 mM) ($p<0.005$). Using a cut off value of 4.45 mM for mucinous tumors had a sensitivity of 88%, specificity of 86%, PPV of 78%, and NPV of 92%.

14:00 ***4671***. **Differentiation of Benign and Malignant Uterine Corpus Tumors: Value of 1H-MR Spectroscopy at 3T**

Mayumi Takeuchi[1], Kenji Matsuzaki[1], Masafumi Harada[1], Hiromu Nishitani[1]
[1]Department of Radiology, University of Tokushima, Tokushima, Japan

We evaluated 32 uterine corpus tumors (14 malignant including 11 endometrial carcinomas and 3 myometrial tumors; 18 benign including 5 endometrial and 13 myometrial masses) by 1H-MR spectroscopy at 3T. Choline peaks were observed in all 32 lesions, and tended to show higher peaks in malignant tumors. The choline concentration in malignancy (8.77+/-1.91 mM) was significantly higher than that in benign lesions (4.82+/-2.23 mM) ($p<0.0001$). Using a cut off value of 7.00 mM for malignant lesions had a sensitivity of 93%, specificity of 83%, PPV of 94%, and NPV of 81%.

14:30 ***4672***. **23Na/1H MR Imaging of Female Pelvis at 7T Using a Dual-Tuned Multi-Channel Body Coil**

Kyongtae Ty Bae[1], Jung-Hwan Kim[1], Chan Hong Moon[1], Alessandro Furlan[1], Bumwoo Park[1], JinHong Wang[1]
[1]University of Pittsburgh, Pittsburgh, PA, United States

For the first time, we were able to demonstrate MR imaging of the female pelvis and distribution of sodium signal intensities in the female pelvic organs in normal subjects at 7T with a multi-channel dual-tuned body RF coil. Future development of 23Na MR imaging will concentrate on the clinical application of sodium MR imaging of the female pelvis to assess various physiological and pathological conditions accompanied with changes in sodium concentration.

15:00 ***4673***. **In Vivo ^{31}P MR Spectroscopy of Human Placenta**

Jan Weis[1], Kathrine Bjersand[2], Anna Karin Wikström[2], Mats Olovsson[2], Johan Wikström[3]
[1]Department of Oncology, Radiology and Clinical Immunology, Uppsala University, Uppsala, Sweden; [2]Department of Women's and Children's Health, Uppsala University, Uppsala, Sweden; [3]Department of Oncology, Radiology and Clinical Immunology, Uppsala University , Uppsala, Sweden

31P image-selected in vivo spectroscopy (ISIS) with proton decoupling and nuclear Overhauser effect enhancement was used for measurement the spectra of placental tissue in vivo. Major metabolites of normal human placenta and placentas from women with preeclampsia were quantified. Our results demonstrate that the 31P MRS is able to measure spectra of the placenta with acceptable quality and measurement time. 31P MRS is a promising tool to detect in vivo changes of human placental metabolites.

Thursday 13:30-15:30 Computer 98

13:30 ***4674*. Pre- And Postoperative Dynamic MRI: Evaluation of Pelvic Organ Prolapse in Symptomatic Women**

Céline D. Alt[1], Kerstin Brocker[2], Florian Lenz[2], Christof Sohn[2], Hans-Ulrich Kauczor[1], Peter Hallscheidt[1]
[1]Diagnostic and Interventional Radiology, University Hospital Heidelberg, Heidelberg, Germany; [2]Obstetrics and Gynecology, University Hospital Heidelberg, Heidelberg, Germany

Description: Evaluation of dynamic changes of pelvic organ prolapse by MRI. Method: Dynamic 1.5T MRI was performed preoperative and after surgery in women with pelvic organ prolapse. For measurement two referential lines and four anatomical landmarks were taken. Results: 77 women were yet included. Surgical treatment was anterior (43/62), posterior (15/62) and combined anterior/posterior mesh-repair (4/62). Median values of organ prolapse often showed significant changes ($p<0,05$) in short term follow-up compared to preoperative results. With posterior mesh-repair the changes weren´t significant. Conclusion: Dynamic MRI offers an accurate extent of prolapse and allows to evaluate the success after reconstructive surgery.

14:00 ***4675*. Development of MR Visible Mesh for Soft Tissue Reinforcement in Surgical Treatment of Genital Prolapse.**

Sébastien Blanquer[1,2], Olivier Guillaume[1,2], Laurent Lemaire[3,4], Florence Franconi[5], Xavier Garric[1,2], Jean Coudane[1,2]
[1]CNRS UMR 5247, Montpellier, France; [2]UFR Pharmacie - Université Montpellier I, Montpellier, France; [3]Université Angers, Angers, France; [4]INSERM U646, Angers, France; [5]PIAM, Université Angers, Angers, France

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14:30 ***4676*. Differentiation of Benign and Malignant Solid Components of Ovarian Masses by Diffusion-Weighted MR Imaging with ADC Measurement**

Mayumi Takeuchi[1], Kenji Matsuzaki[1], Hiromu Nishitani[1]
[1]Department of Radiology, University of Tokushima, Tokushima, Japan

We evaluated surgically proven 52 ovarian tumors (36 malignant; 6 borderline malignant; 10 benign). All 42 malignant/borderline malignant tumors showed homogeneous or heterogeneous high intensity on DWI, whereas 3 of 10 benign tumors (3 thecomas) showed high intensity. The ADCs in 42 malignant/borderline malignant tumors and in 10 benign tumors were 1.02 +/- 0.19 and 1.38 +/- 0.30, respectively ($p<0.001$). Using a cut off ADC of 1.15 had a sensitivity of 76%, specificity of 80%. The ADCs in high intense 3 thecomas on DWI were relatively low (1.08 to 1.20), possibly due to their abundant cellular nature as functioning tumors.

15:00 ***4677*. Functional MRI of the Uterus with Quantitative T2, Diffusion-Weighted, and Magnetization-Transfer Contrast Imaging**

Srigouri Yalamanchili[1], Genevieve L. Bennett[1], Pippa Storey[1], Andrew B. Rosenkrantz[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States

5 female volunteers underwent pelvic MRI at 1.5T that included T2-mapping, diffusion-weighted imaging, and magnetization-transfer contrast imaging, each performed through the uterus in the sagittal plane with matching slice positions. There were trends toward a longer T2 time within the endometrium, a lower ADC within the junctional zone, and a lower magnetization-transfer ratio within the myometrium. There was a moderate positive correlation between T2 and ADC, but poor correlation between T2 and MTR as well as between ADC and MTR, suggesting that MTR may reflect a characteristic of tissue not measured by either ADC or T2.

Renal MR Imaging

Hall B Monday 14:00-16:00 Computer 99

14:00 ***4678*. Renal Perfusion and Oxygen Bioavailability in Swine: Comparing Isoflurane to Propofol**

Logan Dance[1], Andrew Wentland[2], Nathan Artz[2], Sean Fain[1,2], Arjang Djamali[3], Elizabeth Sadowski[1]
[1]Radiology, University of Wisconsin, Madison, WI, United States; [2]Medical Physics, University of Wisconsin, Madison, WI, United States; [3]Nephrology, University of Wisconsin, Madison, WI, United States

Blood oxygen level dependent (BOLD) and arterial spin labeling (ASL) MR imaging can analyze the drug-specific effects of anesthetics on regional perfusion. Conflicting data currently exists regarding isoflurane's effect on renal perfusion. Using a swine model, we found that isoflurane decreased renal perfusion (ASL; microspheres) and renal oxygen bioavailability (BOLD MR) when compared to propofol. Isoflurane also caused a significant increase in heart rate and decrease in mean arterial pressure, compared to propofol. These effects should be considered when designing kidney perfusion studies.

14:30 ***4679***. **Blood Oxygen-Level Dependent (BOLD) MR Imaging of Diabetic Nephropathy-Preliminary Study**

Zhen Jane Wang[1], Rahi Kumar[1], Benjamin M. Yeh[1], Suchandrima Banerjee[2], Chi-yuan Hsu[3]

[1]Department of Radiology and Biomedical Engineering, University of California, San Francisco, San Francisco, CA, United States; [2]Global Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States; [3]Department of Medicine, Division of Nephrology, University of California, San Francisco, San Francisco, CA, United States

The preliminary data showed decreased medullary R2* values (corresponding to increased oxygen bioavailability) in patients with diabetic kidney disease compared to healthy volunteers; and the decrease in medullary R2* values appeared to be related to the degree of kidney disease.

15:00 ***4680***. **Free Breathing Renal BOLD Signal Frequency Assessment Following Diuresis**

Brendan Boyd[1], Michael D. Noseworthy[2]

[1]School of Biomedical Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada; [2]Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

Real time, free breathing, T2*-weighted (BOLD) images of the kidneys were retrospectively motion corrected and analyzed for physiologic spectral energies. Following induced diuresis a corresponding decrease in cardiac BOLD signal frequency energy was observed in the renal cortex. We hypothesize this corresponds to a decrease in O_2 utilization due to decreased renal H_2O reabsorption.

15:30 ***4681***. **Functional Renal Imaging with BOLD: Validation of a Model for R2* in Kidney Cortex and Medulla**

Jeff Lei Zhang[1], Henry Rusinek[1], Hersh Chandarana[1], Pippa Storey[1], Eric E. Sigmund[1], Pierre Hugues Vivier[1,2], Qun Chen[1], Hua Guo[1], Vivian S. Lee[1]

[1]Department of Radiology, New York University, New York, NY, United States; [2]Rouen University Hospital, Rouen, France

In this study we used a Monte Carlo simulation approach to explore the mechanism of BOLD R2* contrast in kidney. Kidney pO2 levels predicted based on R2* values by the simulation were in agreement with literature values for a healthy volunteer, and correlated well with pO2 values measured by microprobe for diabetic rats of a previous study. The results indicate that the approach is a promising tool for quantifying kidney oxygenation level based on BOLD data.

Tuesday 13:30-15:30 Computer 99

13:30 ***4682***. **Effect of Octreotide on Intra-Renal Oxygenation as Estimated by BOLD MRI in Rats**

Lu-Ping Li[1], Joann Carbray[1], Pottumarthi V. Prasad[1]

[1]Radiology, Northshore University Healthsystem, Evanston, IL, United States

Previous observations have shown lower intra-renal oxygenation as early as two days after induction of type I diabetes. In order to test the hypothesis that this may be related to the direct effect of hyperglycemia, the infusion of glucose solution was used in healthy rats. However comparable levels of blood glucose levels and R2* values in diabetic rats were observed only in animals pretreated with an insulin inhibitor (octeotride). Because octeotride is associated with vasoconstriction, it is necessary to know the magnitude of any direct effect of octeotride on renal oxygenation. That was the motivation for the present study.

14:00 ***4683***. **BOLD Changes After Revascularization in Renal Artery Stenosis Patients - Preliminary Results**

Iosif Alexandru Mendichovszky[1], Constantina Chrysochou[2], David L. Buckley[3], Alan Jackson[1], Phil A. Kalra[2]

[1]Wolfson Molecular Imaging Centre, The University of Manchester, Manchester, United Kingdom; [2]Renal Department, Salford Royal Hospital, Salford, United Kingdom; [3]University of Leeds, Leeds, United Kingdom

Atheromatous renovascular disease is a commonly encountered yet challenging disease to manage. The aim of the current study was to investigate renal parenchymal BOLD response to renal artery revascularization in patients with severe renal artery stenosis and correlate imaging findings with changes in SK-GFR (as measured by radioisotope techniques). No significant differences were found regarding baseline SK-GFR between kidneys that improved, remained stable, deteriorated or controls. R2* values were significantly higher in kidneys whose renal function subsequently improved vs. those who stayed stable, deteriorated or controls. In addition, the ratio of R2* to SK-GFR was significantly greater in improver kidneys.

14:30 ***4684*.** **Long Term Follow-Up of Human Transplanted Kidneys by DWI and BOLD Imaging**

Peter Vermathen[1], Tobias Binser[1], Chris Boesch[1], Ute Eisenberger[2], Harriet C. Thoeny[3]
[1]Dept. Clinical Research, University Bern, Bern, Switzerland; [2]Dept. of of Nephrology and Hypertension, University Hospital of Bern, Bern, Switzerland; [3]Dept. of Radiology, University Hospital of Bern, Bern, Switzerland

Previously, we performed a DWI and BOLD MRI study in renal allograft recipients with good allograft function and determined short term reproducibility of diffusion and oxygenation parameters. In the current study, nine patients of our initial study were measured again 32±2 months after the initial scan to assess long term effects on diffusion parameters and on R2*. The functional parameters were markedly stable after 32 months with a slight tendency towards reduced oxygenation in eight of the nine patients, who still had good allograft function. In contrast, one subject with decreased GFR indicative of renal dysfunction demonstrated strongly altered MR-parameters.

15:00 ***4685*.** **Performance of Generalized Factor Analysis of Dynamic Sequence (GFADS) in the Automated Characterization of Renal Function and Tissue Enhancement in Dynamic Magnetic Resonance Imaging (MRI)**

Ruth Lim[1], Jinsong Ouyang[1], Matthew D. Schmitz[1], Michael S. Gee[1], Ranu Shailam[1], Raul N. Uppot[1], Georges El Fakhri[1]
[1]Department of Radiology, Massachusetts General Hospital / Harvard Medical School, Boston, MA, United States

We assessed the performance of a novel generalized factor analysis of dynamic sequences (GFADS) in dynamic, contrast-enhanced renal magnetic resonance imaging (MRI). By detecting unique time-intensity curves for each renal tissue/compartment type, this technique automates the creation of regions of interest (ROIs) around and within the kidneys, and obviates the need for manually-drawn ROIs. These time factor curves are computed from entire factor images and are significantly less affected by noise than time-intensity curves computed within regions of interest that span a few voxels. In this study, we found that GFADS software can successfully, semi-automatically, and rapidly identify the renal cortex, medulla, and collecting system on dynamic contrast-enhanced renal MRI studies while obviating the need to use manually-drawn regions of interest. This enables detailed quantitative assessment of cortical and medullary renal function in normal and abnormal kidneys.

Wednesday 13:30-15:30 Computer 99

13:30 ***4686*.** **Contrast-Enhanced Kidney MRI at 7Tesla: Initial Results**

Lale Umutlu[1], Stephan Orzada[2], Sonja Kinner, Stefan Maderwald[2], Irina Brote[2], Andreas K. Bitz[2], Oliver Kraff[2], Susanne C. Ladd[2], Gerald Antoch, Mark E. Ladd[2], Harald H. Quick[2], Thomas C. Lauenstein
[1]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen , Essen, Germany; [2]Erwin L.Hahn Institute for Magnetic Resonance Imaging

Aim of this study was to assess the feasibility of contrast-enhanced kidney MRI at 7T. 8 healthy subjects were examined at a 7T whole-body MR system utilizing a custom-built 8-channel RF transmit/receive body coil. Qualitative analysis showed best overall image quality for T1w 2D FLASH imaging and strongest artifact impairment for T2w TSE imaging. Quantitative analysis showed continuous increase of SNR after iv. Gadolinium administration on T1w images and best corticomedullar differentiation in the arterial phase. This first attempt of 7T kidney imaging reveals the diagnostic potential, but also challenges of 7T abdominal MRI.

14:00 ***4687*.** **Renal Angiomyolipoma Fat Content Estimated on Pretreatment MRI as a Predictor of Response to Embolization**

Joseph Abrams[1], Timothy W. Clark[1], Rahmin A. Rabenou[2], Hersh Chandarana[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Nephrology, NYU Langone Medical Center, New York, NY, United States

Transarterial embolization prevents hemorrhage of renal angiomyolipoma (AML) by decreasing the tumor’s angiogenic component. Our aim was to determine whether baseline AML lipid content, as estimated by AML-to-psoas signal ratio on T1 fat-saturated non-contrast acquisition, could help predict embolization response, as measured by changes in volume and enhancement on gadolinium contrast enhanced MRI (CE-MRI). Moderately good correlations were seen between baseline lipid content and change in volume and change in enhancement. These results suggest that AMLs with higher fatty components, as determined on MRI, are less likely to respond to embolization.

14:30 ***4688*.** **MRI Characterization of Liver Involvement in Autosomal-Dominant Polycystic Kidney Disease**

Wei Zhang[1], Jon D. Blumenfeld[2], Stephanie Donahue[2], Honglei Zhang[3], Martin R. Prince[3]
[1]Radioloty, Weill Cornell Medical College, new york, NY, United States; [2]Internal Medicine, Weill Cornell Medical Center and The Rogosin Institute, new york, NY, United States; [3]Radioloty, Weill Cornell Medical College, new york, NY, United States

135 ADPKD patients underwent abdominal MRI using a body array coil. Organ volumes and cyst volumes were measured on T2 images.RESULTS: There is significant correlation between HV and HCV, HV and HCF, HV and SPV, HCF and age, HCF and GFR,

HCF and Sex, HCF and BRV, HCF and BECV, BRV and BCV at P=0.01 level. Hepatic cyst fraction was significantly higher in female.Discussion and Conclusion:Our research prove that hepatic cysts in ADPKD are more prevalent in women than men, and women experience a larger burden of hepatic cysts than men in a younger age, implicating gender-specific hormones works in the pathogenesis of hepatic cyst involvement in ADPKD.

15:00 ***4689***. **Intra-Observer and Inter-Observer Variability of Renal Volume Measurements in Polycystic Kidney Disease Utilizing a Semi-Automated MR Segmentation Algorithm with HASTE and TrueFISP Sequences**

Benjamin A. Cohen[1], Irina Barash[2], Danny Kim[1], Emilio Vega[1], Matthew D. Sanger[1], Michael Bloom[1], Hersh Chandarana[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Nephrology, NYU Langone Medical Center

In Polycystic Kidney Disease (PKD), total renal volume and changes in kidney volume have been identified as sensitive markers of disease progression and, perhaps, response to future novel therapeutics. The aim of this study was to assess the intra-observer and inter-observer variability of a semi-automated MR renal volumetric algorithm in PKD employing fluid sensitive pulse sequences emphasizing cyst conspicuity, specifically HASTE and TrueFISP. This algorithm provided excellent intra-observer (median agreement greater than 97-98%) and very good inter-observer (median agreement greater than 93%) reproducibility. Automated techniques, in development, will hopefully decrease inter-observer variability and processing time to support longitudinal analysis.

Thursday 13:30-15:30 Computer 99

13:30 ***4690***. **Sodium MR Imaging of Kidney and Other Abdominal Organs Using a Dual-Tuned Body RF Coil at 7T**

Kyongtae Ty Bae[1], Jung-Hwan Kim[1], Chan Hong Moon[1], Alessandro Furlan[1], Bumwoo Park[1], Tiejun Zhao[2]
[1]University of Pittsburgh, Pittsburgh, PA, United States; [2]MR Research Support, Siemens Healthcare, Pittsburgh, PA, United States

We performed dual-tuned 23Na/1H MR imaging of human abdominal organs at 7T and demonstrated the spatial distribution of sodium in the kidney using sodium MR imaging. Future development of 23Na MR imaging will be focused on clinical application of sodium MR imaging in the abdomen to assess a variety of physiological and pathological conditions accompanied with changes in sodium concentration.

14:00 ***4691***. **Quantitative Evaluation of Acute Renal Transplant Dysfunction with Low-Dose 3D MR Renography**

Akira Yamamoto[1], Jeff Lei Zhang[1], Henry Rusinek[1], Hersh Chandarana[1], James Babb[1], Thomas Diflo[2], Devon John[2], Judith Benstein[3], Pierre H. Vivier[1], David Stoffel[1], Vivian S. Lee[1]
[1]Radiology, New York University School of Medicine, New York, United States; [2]Surgery, New York University School of Medicine, New York, United States; [3]Medicine, New York University School of Medicine, New York, United States

60 patients (31 clinically normal-functioning transplanted kidney, 29 acute dysfunction transplanted kidney) were examined to assess quantitative low-dose 3D MR renography to diagnose acute transplant dysfunction. Acute rejection showed higher ratio of vascular mean transit time to whole kidney (MTT-A/K) and lower tubular transit time fraction (MTT-T/K) compared to ATN. In particular, the diagnostic test that classified patients as acute rejection when MTT-A/K 9.0% and as ATN otherwise achieved 100% diagnostic accuracy. Our method of MR renography is promising for the diagnosis of acute transplant renal dysfunction and can be performed as a component of routine anatomic imaging of the transplanted kidney.

14:30 ***4692***. **Evaluation of the Feasibility and Reproducibility of Renal DTI MRI in Healthy Volunteers**

Marica Cutajar[1], Stephen D. Marks[1], Jonathan D. Clayden[1], Christopher A. Clark[1], Isky Gordon[1]
[1]Radiology and Physics, UCL Institute of Child Health, London, United Kingdom

The aim of this study was to determine the reproducibility and robustness of Diffusion Tensor Imaging (DTI) in the kidney, to in turn justify the utility of this method in the clinical environment. DTI provides structural parameters relatively unstudied in kidney, the Apparent Diffusion Coefficient (ADC) and the Fractional Anisotropy (FA). The ADC gives an indication of the overall extent of diffusion, while the FA characterises the directionality of water diffusion in the tissue of interest. Initial studies have found a clear difference between the renal cortex and medulla for both ADC and FA values and both parameters were reproducible.

15:00 ***4693***. **Renal Blood Flow Changes in Autosomal-Dominant Polycystic Kidney Disease**

Wei Zhang[1], Jon D. Blumenfeld[2], Stephanie Donahue[2], Honglei Zhang[1], Martin R. Prince[1]

[1]Radiology, Weill Cornell Medical College, new york, NY, United States; [2]Internal Medicine, Weill Cornell Medical Center and The Rogosin Institute, new york, NY, United States

Purpose: To assess how renal blood flow changes in autosomal-dominant polycystic kidney disease (ADPKD) and its correlation with renal parenchymal volume and function.Methods: 41 ADPKD patients underwent MRA of the renal arteries using 2D cine Phase Contrast besides routine abdominal MRI.Results: GFR to both kidneys correlated directly with total blood flow.Conclusion:Our research suggest that measuring total flow to bilateral kidneys may represent an effective way to monitor renal function in ADPKD patients.

NSF & Body Diffusion

Hall B Monday 14:00-16:00 Computer 100

14:00 ***4694***. **Comparative Stability of Nonionic Linear and Ionic Macrocyclic Gadolinium Chelates in Renally-Impaired Rats**

Jean-Marc Idée[1], Nathalie Fretellier[1], Anne Dencausse[1], Nicolas Poveda[1], Gaëlle Jestin[1], Claire Hollenbeck[1], Marc Port[1], Jean-Sébastien Raynaud[1], Philippe Robert[1], Claire Corot[1]

[1]Research, Guerbet, Roissy-Charles de Gaulle cedex, France

In rats with subtotal nephrectomy receiving single injections (2.5 mmol/kg) of gadodiamide (Omniscan) for 5 consecutive days, 62 +15% of the total plasma gadolinium concentration measured at sacrifice was found to be free while the free Gd3+ concentration in plasma was < limit of detection for gadoterate (Dotarem). Relaxometry study of the skin and the bone indicate gradual in vivo dechelation and release of free Gd3+ in rats receiving the linear GC gadodiamide (increase in the r1 relaxivity constant over time in the skin and higher r1 value vs. ex vivo matrix in skin and bone), while gadoterate remained stable.

14:30 ***4695***. **Hyperphosphataemia Reveals Skin Lesions in Gadodiamide-Treated Rats with Low Renal Function**

Jean-Marc Idée[1], Nathalie Fretellier[1], Sylviane Guerret[2], Marie-Christine De Goltstein[1], Anne Dencausse[1], Nicolas Poveda[1], Claire Hollenbeck[1], Walter Gonzalez[1], Cécile Factor[1], Claire Corot[1]

[1]Research, Guerbet, Roissy-Charles de Gaulle cedex, France; [2]Novotec, Lyon, France

Rats with subtotal nephrectomy received a normal or high-phosphate diet and were allocated to single injections of 2.5 mmol/kg of gadodiamide (Omniscan) or saline for 5 consecutive days. Hyperphosphataemia enhanced histological lesions (increase in dermal cellularity, abnormalities in dermal collagen fibres and TGF-beta-1 immunostaining) and revealed macroscopic skin lesions. In the gadodiamide + high phosphate diet group, the total plasma gadolinium concentration was higher in the rats with skin lesions than in the rats without lesions as well as the free Gd3+ concentration.

15:00 ***4696***. **Mortality and Frequency of Nephrogenic Systemic Fibrosis**

Giles Roditi[1], Tara Collidge[2], Peter Thomson[2], Jamie Traynor[2], Patrick Mark[3], Scott Morris[2], Keith Simpson[2]

[1]Radiology, Glasgow Royal Infirmary, Glasgow, Scotland, United Kingdom; [2]Nephrology, Glasgow Royal Infirmary, Glasgow, Scotland, United Kingdom; [3]Nephrology, Western Infirmary Glasgow, Glasgow, Scotland, United Kingdom

Nephrogenic systemic fibrosis (NSF) mortality was compared to a matched renal replacement therapy (RRT) population. Records searched with NSF and GBCA exposure identified and onset of RRT with survival to death or census. 1826 patients with RRT, 1812 with outcome data. Total 17 cases of NSF. Survival for GBCA exposed and NSF cohort measured by RRT onset or post scan survival not significantly different between these groups. Frequency of NSF cases over years studied follows the number of CE-MRA scans performed suggesting GBCA exposure causally implicated in development of NSF

15:30 ***4697***. **A Retrospective Analysis of Nephrogenic Systemic Fibrosis in a Population Undergoing Renal Magnetic Resonance Angiography Stratified by EGFR**

Giles Roditi[1], Tara Collidge[2], Peter Thomson[2], Keith Simpson[2], Scott Morris[2], Brown Michaela[2], Anirudh Rao[2]

[1]Radiology, Glasgow Royal Infirmary, Glasgow, Scotland, United Kingdom; [2]Nephrology, Glasgow Royal Infirmary, Glasgow, Scotland, United Kingdom

NSF associates with the administration of gadolinium contrast in renal impairment. Of 481 patients who underwent renal CE-MRA 3 patients were identified as having NSF. 2 had AKI when imaged, third had deteriorating CKD (eGFR 16.1) and developed NSF three years later when on dialysis following further CE-MRA. All cases of gadodiamide-associated NSF from our unit (n=16) 13 were established on dialysis, 2 had AKI and one had eGFR of 8.3 ml/min. All patients developing NSF have AKI or stage 5 CKD, we found no NSF cases with an eGFR >15 ml/min.

Tuesday 13:30-15:30 Computer 100

13:30 ***4698*. Renal Cell Carcinoma: 3.0-T Diffusion-Weighted MR Imaging for Subtypes Differentiation**

Haiyi Wang[1], Aitao Guo[2], Dianjun Wang[2], Yuangui Gao[1], Xu Zhang[3], Huiyi Ye[1]
[1]Radiology, PLA General Hospital, Beijing, China; [2]Pathology, PLA General Hospital, Beijing, China; [3]Urology, PLA General Hospital, Beijing, China

Renal cell carcinoma (RCC) is the most common malignant renal tumor in adults, with the three major subtypes, clear cell RCC, papillary RCC, and chromophobe RCC. Because of clincal needs for RCC subtypes differentiation, this study explores the ADC values of pathologically-proved clear cell, papillary, and chromophobe RCC subtypes, and the conclusion is drawn that they possess different diffusion characteristics that can be distinguished using DWI on the basis of the ADC, with high sensitivity and specificity, potentially improving the accuracy of pretreatment diagnosis and selection of clinical therapy.

14:00 ***4699*. Evaluation of 3.0T MR Diffusion-Weighted Imaging in Diagnosis and Short-Term Therapeutic Effect of Renal Clear Cell Carcinoma**

Xiao-duo Yu[1], Meng Lin[1], Han Ouyang[1]
[1]Department of Diagnostic Imaging, Cancer Hospital,Peking Union Medical College,Chinese Academy of Sciences, Beijing, China

DWI and ADC value in 3.0T MRI has widely used in tumor, but applied to clinical practice limitedly for overlap between benign and malignant tumor. 51 cases with renal clear cell carcinoma proved by operation were studied. Set ADC value at 1.8×10-3mm²/s to divide the cohort into two groups. Significant differences were found between histological grade, clinical stage. After follow-up more than one year, tumor short-term control rate of the group with ADC value more than and equal to 1.8×10-3mm²/s was better than that of the group with ADC value less than 1.8×10-3mm²/s.Therefore DWI and ADC value help to evaluate prognosis potentially.

14:30 ***4700*. Diffusion Weighted Imaging with Biexponential Analysis of Intravoxel Incoherent Motion in Assessment of Renal Lesions: Preliminary Experience**

Hersh Chandarana[1], Vivian S. Lee[1], Elizabeth Hecht[1,2], Bachir Taouli[1,3], Eric E. Sigmund[1]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Radiology, University of Pennsylvania, United States; [3]Radiology, Mount Sinai Medical Center, New York, NY, United States

Movement of blood in microvasculature can be modeled as pseudo-diffusion also known as intravoxel incoherent motion. Perfusion effect can be separated if diffusion imaging is performed with low and high b values. The purpose of our study was to calculate perfusion fraction (fp) and tissue diffusivity (Dt) parameters obtained with biexponential analysis of multi-b DWI and determine if these parameters can distinguish enhancing from non-enhancing renal lesions. fp was higher and Dt lower in enhancing renal lesions; both these parameters had higher accuracy in detection of enhancing renal lesion compared to apparent diffusion coefficient (ADC) obtained with monoexponential fit.

15:00 ***4701*. Loss of Renal Diffusion Anisotropy in Patients with Chronic Kidney Disease**

Yu-Chun Lin[1,2], Koon-Kwan Ng[1], Tzung-Hai Yen[3], Yu-Min Chen[3], Hsiang-Yang Ma[2], Jiun-Jie Wang[4]
[1]Department of Diagnostic Radiology, ChangGung Memorial Hospital, KweiShan, Taoyuan, Taiwan; [2]Department of Electrical Engineering, ChangGung University, KweiShan, Taoyuan, Taiwan; [3]Department of Nephrology, ChangGung Memorial Hospital, Taiwan; [4]Department of Medical Imaging and Radiological Science, ChangGung University, KweiShan, Taoyuan, Taiwan

Diffusion Tensor Imaging in kidney for patients with chronic kidney disease indicated a significant reduction of diffusion anisotropy. Images from 6 CKD patients and 6 normal subjects were acquired in a 3 Tesla MR scanner. Regions of interest were located bilaterally in medulla and cortex. The results showed decreases in diffusion anisotropy and associated increase in radial diffusivity, noticeably in medulla in patients. We concluded that renal DTI is feasible in 3T MR scanner and furthermore, sensitive to changes in diffusivities in patients with chronic kidney disease.

Wednesday 13:30-15:30 Computer 100

13:30 ***4702*. Whole-Body MRI, Including Diffusion-Weighted Imaging, for Staging Malignant Lymphoma: Direct Comparison to CT**

Thomas Kwee[1], Malou Vermoolen[1], Erik Akkerman[2], Henriëtte Quarles van Ufford[1], Frederik Beek[1], Inge Ludwig[3], Marc Bierings[4], Rob Fijnheer[5], Marie-José Kersten[6], Joseph Zsiros[7], Willem Mali[1], Rutger-Jan Nievelstein[1]

[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands; [3]Department of Hematology, University Medical Center Utrecht, Utrecht, Netherlands; [4]Department of Pediatric Hematology, University Medical Center Utrecht, Utrecht, Netherlands; [5]Department of Hematology, Meander Medical Center, Amersfoort, Netherlands; [6]Department of Hematology, Academic Medical Center, Amsterdam, Netherlands; [7]Department of Pediatric Hematology, Academic Medical Center, Amsterdam, Netherlands

This study aimed to assess the equivalence of whole-body MRI, including diffusion-weighted imaging (DWI), to computed tomography (CT) for the initial staging of malignant lymphoma. To that end, 66 consecutive patients with newly diagnosed malignant lymphoma prospectively underwent whole-body MRI (T1-weighted and short inversion time inversion recovery [n=66], and DWI [n=62]) at 1.5T and CT. Whole-body MRI (both with and without DWI) was equal to staging using CT in the majority of patients, while whole-body MRI overstaging occurs more frequently than whole-body MRI understaging (relative to CT).

14:00 ***4703*. Contrast Edited T_2 SSFSE: A Potential Alternative to Diffusion Weighted EPI for MRI Screening**

Ananth J. Madhuranthakam[1], Aya Yassin[2,3], Jean H. Brittain[4], David C. Alsop[2,3], Neil M. Rofsky[2,3]

[1]MR Applied Science Lab, GE Healthcare, Boston, MA, United States; [2]Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States; [3]Harvard Medical School, Boston, MA, United States; [4]MR Applied Science Lab, GE Healthcare, Madison, WI, United States

MRI has gained increased attention for whole-body screening of tumor metastasis. The commonly used sequences are STIR and DW-EPI. However, both are SNR limited and require multiple signal averages increasing the total scan time. In addition, DW-EPI images are also subject to distortion in larger FOVs, and are typically limited to low resolution, axial plane imaging. The primary objective of whole-body screening is to minimize the background tissue signal while simultaneously highlighting tumor signal in a rapid acquisition. Such a technique is presented in this work using SSFSE readout while suppressing signal from fat, fluid and blood vessels.

14:30 ***4704*. Assessing the Advantages of Whole Body Diffusion Tensor Imaging for Screening of Bone Metastases**

Matthew David Blackledge[1], David J. Collins[1], Toni Wallace[1], Dow-Mu Koh[1], Martin O. Leach[1]

[1]CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom

We have demonstrated that the use of whole body DTI is feasible and practicable in the time required to obtain standard diffusion weighted whole body measurements of bone metastases without significant loss in image quality. Furthermore it is possible to measure useful biological parameters such as fractional anisotropy which may have direct clinical relevance in detecting spinal cord compression.

15:00 ***4705*. ADC Measurements in the Evaluation of Lymph Nodes in Patients with Non-Hodgkin Lymphoma**

Thomas Kwee[1], Inge Ludwig[2], Cuno Uiterwaal[3], Henriëtte Quarles van Ufford[1], Marc Bierings[4], Rob Fijnheer[5], Taro Takahara[1], Rutger-Jan Nievelstein[1]

[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands; [2]Department of Hematology, University Medical Center Utrecht, Utrecht, Netherlands; [3]Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, Netherlands; [4]Department of Pediatric Hematology, University Medical Center Utrecht, Utrecht, Netherlands; [5]Department of Hematology, Meander Medical Center, Amersfoort, Netherlands

This study aimed to investigate whether apparent diffusion coefficient (ADC) measurements allow discriminating normal lymph nodes from lymphomatous lymph nodes, and indolent lymphomas from aggressive lymphomas in patients with non-Hodgkin lymphoma (NHL). To that end, 18 healthy volunteers and 22 patients with newly diagnosed NHL (indolent: n=9; aggressive: n=13) prospectively underwent diffusion-weighted imaging at 1.5 T. Our results suggest that ADC measurements may be a highly specific method for discriminating normal lymph nodes from lymphomatous lymph nodes in patients with NHL. However, ADC measurements appear to be of no utility in differentiating indolent from aggressive lymphomas.

Thursday 13:30-15:30 Computer 100

13:30 ***4706*. Optimization of the B-Sampling for Bi-Exponential Analysis of Diffusion-Weighted Imaging**

Jeff Lei Zhang[1], Eric E. Sigmund[1], Hersh Chandarana[1], Henry Rusinek[1], Hua Guo[1], Pippa Storey[1], Qun Chen[1], Vivian S. Lee[1]
[1]Department of Radiology, New York University, New York, NY, United States

Synopsis: To improve precision of bi-exponential parameters of diffusion weighted imaging (DWI), we proposed a method for optimizing b values for DWI acquisition. Monte Carlo simulation was performed to explore whether the optimized b values would improve the bi-exponential parameters' ability in differentiating benign and malignant renal lesions. Results showed that, using the optimized b values, the differentiability of perfusion fraction for the two types of lesions improved by 22%±7%, compared with uniformly distributed b values. The method should be applicable to DWI of any other tissues or organs where bi-exponential analysis is used.

14:00 ***4707*. Signal to Noise Ratio of High B-Value Diffusion Weighted Images Is Improved Using Computed Diffusion Weighted Imaging**

Matthew David Blackledge[1], David J. Collins[1], Dow-Mu Koh[1], Martin O. Leach[1]
[1]CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom

AAn acquisition scheme optimized for computed Diffusion Weighted Imaging (cDWI) is discussed and a theoretical model for diffusion weighted image noise is presented. It is demonstrated through theory and experimental studies that noise is reduced in calculated high b-value images compared to conventional acquired high b-value DWI using this method.

14:30 ***4708*. Comparison of Liver ADC Measurements Using Breath-Hold, Free Breath-Hold and Respiratory Gating Echoplanar Diffusion-Weighted Imaging Sequences Using Parallel Imaging Technique with Different Acceleration Factors**

Chun-Jung Juan[1], Hing-Chiu Chang[2,3], Hsiao-Wen Chung[1,3], Chi-Hong Chu[4], Cheng-Chieh Cheng[1,3], Su-Chin Chiu[1,3], Hui-Chu Chiu[5,6], Cheng-Hsien Hsu[7], Cheng-Yu Chen[1], Guo-Shu Huang[1]
[1]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan; [2]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [3]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan; [4]Section of General Surgery, Department of Surgery, Tri-Service General Hospital, Taipei, Taiwan; [5]Department of Nuclear Medicine, Tri-Service General Hospital, Taipei, Taiwan; [6]EMBA in Global Chinese Management, Department of Business Administration, College of Management, Tamkang University, Taiwan; [7]Division of Software Design, Notebook Unit 5, Quanta Computer Inc., Taiwan

Inter-experimental comparison of the liver apparent diffusion coefficient (ADC) value remains challenging. In this study the effect of repetition time (TR) and acceleration factors on the liver ADC measurement is examined. Our study shows that free-breath method allows ADC measurement consistent with breath-hold method with the TR. The ADC values measured at a longer TR in both free-breath and respiration-triggered methods are significantly higher than breath-hold method. Our results also depict significant differences in liver ADC values when different acceleration factors are chosen. Our results highlight the important of TR and acceleration factors in liver ADC measurements for inter-experimental comparison.

15:00 ***4709*. Assessment of Variability of Region of Interest (ROI) Delineation on Diffusion Weighted MRI (DW-MRI) Using Manual and Semi-Automated Computer Methods**

Nina Tunariu[1], James A. d'Arcy, Veronica A. Morgan[1], Michael Germuska, Catherine G. Simpkin, Sharon L. Giles[2], David J. Collins, Nandita M. deSouza
[1] CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research and Royal Marsden Hospital, United Kingdom

A major challenge for implementing diffusion-weighted magnetic resonance imaging (DW-MRI) as tumour response biomarker in multicentre clinical trials is in measuring changes in individual patients reliably and reproducibly. The delineation of the region of interest (ROI) has a great impact on final reproducibility. This study compares ADC values obtained using in-house computer ROI drawing software (Diffusion View) to segment tumour with those obtained from a manual drawing technique. Computer generated ROIs have the advantage of less variability, operator independence and significant time saving and support the feasibility of use of automated DWI measurements in clinical trials.

Body Diffusion

Hall B Monday 14:00-16:00 Computer 101

14:00 **_4710_. Liver DTI of Obese Insulin Resistant Subjects with Fatty Liver Disease**

Lan Lu[1], Jacob M. Haus[2], John P. Kirwan[2], Chris A. Flask[1,3]
[1]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States; [2]Department of Pathobiology, Cleveland Clinic, Cleveland, OH, United States; [3]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

Recent studies suggest diffusion-weighted (DWI) and diffusion tensor MRI (DTI) as a promising tool in studying hepatic diseases including hepatitis and cirrhosis. Similarly, Non-Alcoholic Fatty Liver Disease (NAFLD) progresses from fatty liver (steatosis) to fibrosis (steatohepatitis), but diffusion MRI studies on NAFLD subjects are limited. In this study, we used DTI to investigate the diffusion parameters in obese, insulin resistant adults with fatty liver in comparison with healthy volunteers. Our results demonstrate diffusional changes indicative of hepatic adipocyte accumulation and not fibrosis. Therefore, hepatic lipids can complicate the utility of DWI/DTI in the study hepatic fibrosis associated with NAFLD/NASH.

14:30 **_4711_. The Reproducibility of Apparent Diffusion Coefficient Measurement in Liver of Healthy Volunteers at 3.0T and 1.5T Diffusion Weighted Imaging**

Jiayin Gao[1], Jinning Li[1], Zhenghan Yang[1], Yuan Fu[1], Liang Xu[1], Min Chen[1], Cheng Zhou[1]
[1]Radiolgical Department, Beijing Hospital, Beijing, China

The aim of this study is to evaluate the reproducibility of ADC measurement in liver of healthy volunteers at 1.5T and 3.0T MR scanner. DWI of the liver was performed in 30 healthy volunteers with both 1.5T and 3.0T MR scanner in the same day. The mean ADC value of liver was 1.57¡Á10-3 mm2/s at 1.5T, while 1.35¡Á10-3 mm2/s at 3.0T (P<0.001). The result indicates that there is significant variability of ADC measurement in hepatic parenchyma at between 1.5T and 3.0T.

15:00 **_4712_. Application of Diffusion Weighted Proton MRI for Evaluating Molecular Diffusion of Water and Tissue Perfusion in Diethylnitrosamine Induced Rat Liver Fibrosis**

Beena George[1], Andriy Babsky[1], George E. Sandusky[2], Navin Bansal[1]
[1]Radiology, Indiana University, Indianapolis, IN, United States; [2]Pathology and Laboratory Medicine, Indiana University, Indianapolis, IN, United States

The effect of hepatic fibrosis produced by diethylnitrosamine (DEN) was examined by fat and water MRI and diffusion weighted (DW) 1H MRI, separating water molecular diffusion and tissue perfusion. DEN caused an increase in liver water MRI signal intensity but no change in fat content. Fast apparent diffusion coefficient (ADC), which represents perfusion, was lower in DEN treated fibrotic livers compared to control livers. Slow ADC, which represents molecular diffusion, was same in both groups. Measurement of perfusion by DW 1H MRI may be a useful marker for diagnosis of liver fibrosis.

15:30 **_4713_. Biexponential Study in Diffusion Weighted Imaging of Liver Tumours**

Jean-Luc Daire[1], Ralph Sinkus[2], Mathilde Wagner[1], Nathalie Haddad[1], Valérie Vilgrain[1], Bernard Van Beers[1]
[1]CRB3 Centre de Recherches Biomédicales Bichat-Beaujon, INSERM U773, Paris, France, Metropolitan; [2]Institut Langevin, ESPCI, Paris, 75005, France, Metropolitan

The aim of this project was to prospectively evaluate a DW MR imaging sequence combined with parallel acquisition to allow the calculation of pure molecular-based (D) and perfusion related (D*, f) diffusion parameters based on IVIM theory, in liver lesions according to their enhancement behaviour on 3D gradient-echo contrast-enhanced MR sequences. We have shown that D* and f values can reflect liver lesions perfusion since hypervascular liver lesions had significantly greater D* and f values than intermediate and non hypervascular lesions. A biexponential approach might be useful for the characterization of liver lesions and the assessment of tumour response.

Tuesday 13:30-15:30 Computer 101

13:30 **_4714_. Value of Diffusion-Weighted MR Imaging as an Early Surrogate Parameter for the Response of Colorectal Metastases to Interstitial 192Ir-High-Dose-Rate Brachytherapy**

Oliver Dudeck[1], Christian Wybranski[1], Martin Zeile[1], David Löwenthal[1], Frank Fischbach[1], Maciej Pech[1], Gero Wieners[1], Jens Ricke[1]
[1]Radiology and Nuclear Medicine, Otto-von-Guericke University, Magdeburg, Sachsen-Anhalt, Germany

Forty colorectal liver metastases in 30 patients were evaluated with MRI including diffusion-weighted imaging (DWI) immediately before, 2 days after and 90 days following CT- and MR-guided brachytherapy. Tumor diameter (TD) and ADC were evaluated by two radiologists. On early postprocedural MRI, mean TD sligthly incresed while mean ADC decreased significantly (p<0,001). On follow-up MRI, a decrease in mean TD correlated with an increase of mean ADC (p<0,001 both; r=-0,565). In conclusion, changes in ADC can be assessed as soon as 2 days following brachytherapy. Early ADC decrease most likely reflected cell swelling, late increase reduction of tumor cell density.

14:00 ***4715*.** **Diffusion Weighted Imaging in Differentiating Malignant from Benign Intraductal Papillary-Mucinous Neoplasm of the Pancreas**

Atsushi Nakamoto[1], Tonsok Kim[1], Masatoshi Hori[1], Hiromitsu Onishi[1], Takahiro Tsuboyama[1], Mitsuaki Tatsumi[1], Noboru Maeda[1], Hiroki Higashihara[1], Keigo Osuga[1], Kaname Tomoda[1]

[1]Department of Radiology, Osaka University Graduate School of Medicine, Suita, Osaka, Japan

We retrospectively evaluated the diagnostic performance of diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) value for differentiating malignant intraductal papillary-mucinous neoplasm (IPMN) of the pancreas from benign IPMN. The mean minimum ADC value of malignant IPMN was lower than that of benign IPMN ($P < 0.001$). Mean Az value, sensitivity, specificity and accuracy of MR imaging with DWI were higher than those of MR imaging without DWI, although differences were not significant. We conclude that DWI and measurement of minimum ADC value would be helpful for differentiating malignant IPMN form benign IPMN.

14:30 ***4716*.** **New Application Screening for Malignant Tumors Using the Lesion to Spinal Cord Ratio (LSR) in Diffusion Weighted Images**

Mamoru Takahashi[1], Yasuo Takehara[2], Takahiro Natsume[3], Norihiro Tooyama, Katsutoshi Ichijo, Harumi Sakahara[2], Atsushi Nozaki[4]

[1]Seirei Mikatabara General Hospital, Hamamatsu, Shizuoka, Japan; [2]Hamamatsu University of Medicine; [3]Seirei Hamamatsu General Hospital; [4]GE Healthcare Japan

Problem: Tumor detection based on apparent diffusion co-efficient (ADC) is not always efficient and accurate on the high b-value diffusion weighted image (DWI). Method: The signal intensity ratio between lesions and spinal cord signal (LSR) were measured on DWI. The LSR was higher in malignant tumors than in other lesions. Tumor screening application gLSR map h was developed based on the signal intensity ratio between the lesions and the spinal cord signal on DWI. Results: With the cut-off of 0.45 for LSR, sensitivity for malignant tumor was 100%. Using the color map, effective and robust tumor screening was feasible on DWI.

15:00 ***4717*.** **Nodal Volumetric Histographic ADC Changes Associated with Successful Chemotherapy of Adolescent and Childhood Lymphoma**

Shonit Punwani[1], Alan Bainbridge[1], Stuart Taylor[1], Steven Daw[2], Ananth Shankar[2], Paul Humphries[1]

[1]Radiology, University College London Hospital, London, United Kingdom; [2]Paediatrics, University College London Hospital, London, United Kingdom

Cellular density should decrease following successful chemotherapy of lymphomatous tissue and a corresponding rise of ADC is expected. This study investigates the extent and nature of histographic post treatment ADC changes associated with a successful treatment outcome in childhood and adolescent patients with lymphoma.

Wednesday 13:30-15:30 Computer 101

13:30 ***4718*.** **Distortion Correction of Body Diffusion Weighted Images Using Three Point-Dixon Method**

Saori Mori[1], Isao Muro[1], Hisamoto Moriguchi[1], Tomohiko Horie[1], Masatoshi Honda[1], Tesuo Ogino[2], Makoto Obara[2], Yutaka Imai[1]

[1]Radiology, Tokai university, Isehara, Kanagawa, Japan; [2]Philips Healthcare Asia Pacific, Shinagawa, Tokyo, Japan

Significant distortion can often be observed in body diffusion weighted images using single shot EPI. In this study, we demonstrate that a B0 map obtained using three point-Dixon method is useful to correct for distortion. The correlation coefficients of corrected images were increased by 0.02 or greater from those of the uncorrected images. In this method, although prescan is required, it requires about a minute and a B0 map obtained from the prescan can be applied to 50 images. This method is quite useful in practice since a B0 map created using this method enables good distortion correction.

14:00 ***4719*.** **Motion Induced Signal Non-Uniformity Correction with Asymmetric Bipolar MPG on Liver DWI**

Tetsuo Ogino[1], Tomohiko Horie[2], Isao Muro[2], Marc Van Cauteren[3], taro takahara[4]

[1]Clinical Science , Philips Electronics Japan, LTD, Minato-ku, Tokyo, Japan; [2]Tokai Univ. Hospital, Japan; [3]Philips Healthcare Asia Pacific, minato-ku, Tokyo, Japan; [4]Division of Radiology, Radiotherapy and Nuclear Medicine (RRN), University Medical Center (UMC) Utrecht, Utrecht, Netherlands

Respiratory and Cardiac motion affects DWI IQ on liver. A voxel deformation due to motion under Motion Probing Gradient(MPG) induces spin phase dispersion in a voxel and results signal loss. By replacing conventional MPG with a pair of bipolar gradient, the signal loss is reduced significantly. However, minimum TE and TR are prolonged due to low efficiency of such type of MPG. We propose a novel MPG method which is formed as hybrid of conventional MPG and bipolar MPG. Image quality of liver diffusion is significantly improved with slight scan time prolongation from conventional respiratory triggered DWI.

14:30 **_4720_. Comparison of Simulation-Based and Measurement-Based RF Shimming for Whole-Body MRI at 7 Tesla**

Andreas K. Bitz[1,2], Irina Brote[1,2], Stephan Orzada[1,2], Oliver Kraff[1,2], Stefan Maderwald[1,2], Harald H. Quick[3], Klaus Solbach[4], Achim Bahr[5], Hans-Peter Fautz[6], Franz Schmitt[6], Mark E. Ladd[1,2]

[1]Erwin L. Hahn Institute for MRI, University Duisburg-Essen, Essen, Germany; [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Germany; [3]Institute for Medical Physics, Friedrich-Alexander-University, Erlangen-Nuernberg, Germany; [4]High Frequency Technique, University Duisburg-Essen, Duisburg, Germany; [5]IMST GmbH, Kamp-Lintfort, Germany; [6]Siemens Healthcare Sector, Erlangen, Germany

The aim of this study was to compare RF shimming procedures based on RF simulations and measured B1+ maps for different ROIs in the thorax and abdomen of volunteers with varying physique. Simulation-based RF shims were computed by use of heterogeneous body models. In vivo B1+ mapping was performed during breath hold by utilization of a pre-saturation turboFLASH. ROIs in the heart, liver, and kidney were considered. Appropriate simulation-based shims could be derived which function in the majority of considered volunteers. If the numerical body model inadequately describes the subject's body, measured shims should be preferred to achieve higher image quality.

15:00 **_4721_. Combinatorial Fat Suppression for Diffusion Weighted Imaging at 3.0T**

Matthew David Blackledge[1], David Higgins[2], Dow-Mu Koh[1], Nandita M. deSouza[1], Martin O. Leach[1], David J. Collins[1]

[1]CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]Philips Healthcare, Guildford, Surrey, United Kingdom

A variety of fat suppression techniques including STIR, SPIR, SPAIR and SSGR used alone or in combination are investigated for use in large field of view Diffusion Weighted Imaging at 3.0T. We conclude that a combinatorial approach improves results. A combination of STIR and SPIR works well and can be further improved used in combination with SSGR. All methods would benefit from improved shimming over large field of view to reduce off-resonance attenuation effects.

Thursday 13:30-15:00 Computer 101

13:30 **_4722_. DTI at Different B-Values in Kidneys in Children with Unilateral Pylonephritis**

Claudia Testa[1], Laura Miglio[2], David Neil Manners[1], Caterina Tonon[1], Emil Malucelli[1], Bruno Barbiroli[1], Andrea Pasini[2], Giovanni Tani[2], Raffaele Lodi[1]

[1]MR Spectroscopy Unit, Department of Internal Medicine, Aging and Nephrology, University of Bologna, Bologna, Bo, Italy; [2]Paediatric Radiology Unit, Department of Woman, Child and Adolescent Health, University of Bologna, Bologna, Italy

DTI was used to evaluate renal damage in patients with chronic pyelonephritis. In 12 children affected by unilateral pyelonephritis as assessed by renal scintigraphy (Tc99-DMSA), axial DT images were acquired at b-values of 0, 100, 300, 600, 800 s/mm2. The mean diffusivity (D) and fractional anisotropy (FA) maps were generated for each b-value. We found that FA discriminated values from cortex and medulla better than D in healthy kidneys. D and FA decreased in affected kidneys at each b-values, in particular in the cortex of kidney poles. Changes of D and FA correlated with the degree of functionality damage found by scintigraphy.

14:00 **_4723_. Effect of Nutritional State on IVIM Parameters Measured with Multiple B Value Diffusion MRI**

Clifford R. Weiss[1], Atilla Peter Kiraly[2], Ralph Strecker[3]

[1]Department of Radiology, The Johns Hopkins Univeristy School of Medicine, Baltimore, MD, United States; [2]Imaging and Visualization, Siemens Corporate Research, Princeton, NJ, United States; [3]MR Oncology, Siemens Healthcare, Erlangen, Germany

Existing liver diffusion MR studies have moderate variability in computed ADC values. Reasons from transient changes in portal venous flow to noise have been attributed to this variability. However, the massive increase in splanchnic/portal blood flow after eating does not seem to be taken into account. We present a study comparing diffusion data before and after fasting that shows a large increase in ADC values after eating. Although it is a small study, results suggest that patient feeding state should be factored into future studies.

14:30 **_4724_. High Directional Coherence in Renal Cortex as Shown in Diffusion Tensor Imaging**

Ming-Cherng Wu[1], Yu-Chun Lin[1,2], Chung-Huang Hsieh[1], YauYau Wai[1,3], JiunJie Wang[1,3]

[1]Department of Medical Imaging and Intervention, Chang Gung Memorial Hospital, LinKou, Tao Yuan, Taiwan, Taiwan; [2]Department of Electrical Engineering, Chang Gung University; [3]Department of Medical Imaging and Radiological Sciences, ChangGung University

Renal cortex is the part of renal columns that contain the renal corpuscles and the renal tubules. The direction of water diffusion is consistent, which was properly reflected in the map of InterVoxel Diffusion Coherence. Diffusion Tensor Imaging in kidney were acquired from a 3T scanner. InterVoxel Diffusion Coherence detected high uniformity of the eigenvector distribution in the renal cortex. In the other hand, low Fractional Anisotropy in the corresponding regions suggested diffusion isotropy within cortex.

MRS - Body Applications

Hall B Monday 14:00-16:00 Computer 102

14:00 ***4725*.** **[1]H-MRS Links Adipose Tissue Fat Composition to Liver Fat Content in Men with Metabolic Syndrome**

Jesper Lundbom[1], Antti Hakkarainen[1], Sanni Söderlund[2], Nina Lundbom[1], Marja-Riitta Taskinen[2]
[1]HUS Medical Imaging Centre, University of Helsinki, Helsinki, Finland; [2]Department of Medicine, University of Helsinki

We used 1H-MRS to study adipose tissue fat composition and liver fat content in men with the metabolic syndrome. Adipose tissue methylene/methyl, an index of saturated fats, correlated negatively with liver fat content.

14:30 ***4726*.** **In-Vivo Determination of the Full[1]H MR Spectrum of Liver Fat**

Gavin Hamilton[1], Michael S. Middleton[1], Takeshi Yokoo[1], Mark Bydder[1], Irene W. Mwangi[1], Michael E. Schroeder[1], Claude B. Sirlin[1]
[1]Department of Radiology, University of California, San Diego, San Diego, CA, United States

Accurate proton (^{1}H) MRS fat quantification of liver fat requires determination of signal from fat peaks that are near or under the water peak. A theoretical triglyceride model was developed to characterize the liver fat spectrum, using number of -CH=CH- and -CH=CH-CH_2-CH=CH- bonds, and average fatty acid chain length. In vivo, the relative areas of the different fat peaks are strongly correlated suggesting the fat profile is uniform regardless of the level of fat deposition in the liver. The model gives that 8.6% of the total liver fat underlies the water peak.

15:00 ***4727*.** **Comparison of Liver Steatosis Quantification by MRS at 4.7 T and Histology on Ob/ob and Db/db Mice**

Fanny Noury[1,2], Alain Fautrel[3,4], Eric Hitti[1,2], Pascale Bellaud[3], Hervé Saint-Jalmes[1,2], Bernard Fromenty[4], Pierre-Antoine Eliat[2]
[1]LTSI - INSERM U642 - Université Rennes 1, Rennes, France; [2]PRISM - IFR 140 BiogenOuest - Université Rennes 1, Rennes, France; [3]Plate-forme d'Histopathologie - IFR 140 BiogenOuest - Université Rennes 1, Rennes, France; [4]FMC - INSERM U991 - IFR 140 - Université Rennes 1, Rennes, France

Murine models of obesity such as ob/ob (leptin deficient) and db/db (leptin receptor deficient) mice are extensively used in different scientific fields including pharmacology and toxicology. Besides increased body fatness, hyperlipidemia and insulin resistance these mice develop moderate (db/db) or massive (ob/ob) steatosis. In some studies a longitudinal follow-up of steatosis may be warranted, to assess the beneficial (or deleterious) effects of chronic drug administration. In this preliminary study, db/db and ob/ob mice were used to determine whether magnetic resonance spectroscopy could be a reliable non-invasive method to evaluate fatty liver, using statistical comparison with histological results.

15:30 ***4728*.** **Validation of [1]H Magnetic Resonance Spectroscopy ([1]H-MRS) for Quantification of Hepatic Triglyceride Content**

Estee Fleischman[1], Lauren Dutcher[1], David Thomasson[2], Adeline Louie[2], Haresh Mani[3], David Kleiner[3], Caryn Morse[1], Colleen Hadigan[1]
[1]National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD, United States; [2]Diagnostic Radiology Department, National Institutes of Health, Bethesda, MD, United States; [3]National Cancer Institute, National Institutes of Health, Bethesda, MD, United States

There is growing interest in the application of 1H-MRS as a non-invasive approach to quantify hepatic triglyceride. This study was designed to establish the ability of 1H-MRS to accurately assess hepatic fat compared to histological scoring. Fifty subjects completed 1H-MRS of the liver within 30 days of diagnostic biopsy. The mean hepatic triglyceride content by 1H-MRS for each histologic grade was 9%, 23%, 40% and 56%, respectively. The correlation between the two methods was $r=0.88$, $p<0.0001$. With the phantom data we achieved an $r=0.98$ ($p=0.02$) over a range of fat-water fractions of 10 to 20 % using the standardized formula.

Tuesday 13:30-15:30 Computer 102

13:30 ***4729*.** **A Simple Approach for Improving Lipid SNR for Hepatic Fat Measurement with 1H MRS**

Giulio Gambarota[1], Mark Tanner[1], Johanna Berg[2], Robert V. Mulkern[3], Rex D. Newbould[1]
[1]GlaxoSmithKline, London, United Kingdom; [2]Radiology, University Hospital of Malmö, Sweden; [3]Radiology, Children's Hospital Boston, Boston, MA, United States

Magnetic resonance spectroscopy (MRS) is becoming the method of choice for non-invasive assessment of lipids in liver. To avoid artifacts due to liver motion, MRS is often performed with a breath-hold approach. Given the limited amount of time available to perform the acquisition, it is of interest to maximize the signal-to-noise ratio (SNR) of the lipid resonances. Here, we show that it is possible to substantially improve the SNR of the in liver, by choosing an appropriate TR. The current approach has the advantage of experimental simplicity and can be applied to all basic sequences routinely used in clinical settings.

14:00 **4730. Proton MRS of Changes of Lipid Unsaturation During Liver Regeneration**

Kannie W. Y. Chan[1,2], April M. Chow[1,2], Shu Juan Fan[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Post-operative diagnosis is important in partial hepatectomy (PHx) to determine the best time for interventions or therapeutic measures. We studied changes in unsaturated lipids verse saturated lipids as a mean to follow liver regeneration. The amount of unsaturated lipid at different time points showed a related trend with liver regeneration. A high level was found at 24h post-PHx, and was correlated with the maximum liver regeneration, and the saturated lipid stayed at a high level during the first day of regeneration. Thus, this pilot study shows that 1H-MRS could provide us with more information on the degree of regeneration.

14:30 **4731. The Effect of Meal and Exercise on the in Vivo 31P-NMR Liver Spectrum: Initial Findings**

Antti Hakkarainen[1], Jesper Lundbom[1,2], Esa K.J. Tuominen[1], Marja-Riitta Taskinen, Kirsi Hannele Pietiläinen[3], Nina Lundbom[1]
[1]Helsinki Medical Imaging Centre, University of Helsinki, Helsinki, Finland; [2]Department of Medicine, Division of Cardiology, University of Helsinki, Helsinki, Finland; [3]Obesity Research Unit, Department of Psychiatry, Helsinki University Central Hospital, Helsinki, Finland

We studied the effects of a normal high-fat meal and subsequent exercise on the 31P MR spectrum of healthy volunteers using a proton-decoupled 31P MR spectroscopy at 3 T. We found a trend of rising ATP resonance at postprandial state suggesting that the physiological state may have an impact and should be standardized in phosphorus studies.

15:00 **4732. Reproducibility Evaluation of Spatially Resolved Liver ^{31}P Metabolism Using a Dual Tuned 8-Channel ^{31}P/^{1}H Coil**

Anshuman Panda[1,2], Scott Ray Jones[1,2], 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

Regional changes in the ^{31}P metabolite concentration of the whole liver can be acquired using a multi-channel phased-array ^{31}P coil. However, changes in coil placement, separation between anterior and posterior coil, and spectroscopic imaging setup can significantly affect the reproducibility of the data. Methods to maximize data reproducibility including reproducible coil placement and spectroscopic planning, correction of coil sensitivities, and evaluation of the data variability from one scan to another for a whole liver ^{31}P 2D MRSI experiment is presented for a dual tuned 8-channel ^{31}P/^{1}H coil.

Wednesday 13:30-15:30 Computer 102

13:30 **4733. In Vivo Proton MRS of Liver in an Experimental Liver Fibrosis Model**

Jerry S. Cheung[1,2], Shu Juan Fan[1,2], Darwin Shan Gao[1,2], Kannie W.Y. Chan[1,2], April M. Chow[1,2], Kwan Man[3], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [3]Department of Surgery, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

Carbon tetrachloride (CCl_4) intoxication is a well-characterized, reproducible and the most commonly used experimental model of liver fibrosis. Proton magnetic resonance spectroscopy (^{1}H MRS) can provide insights into in vivo liver metabolism noninvasively, yet detailed in vivo MRS study of CCl_4-induced liver fibrosis model has been limited. The aim of this study was to characterize early metabolic changes in CCl_4-induced liver fibrosis in rodents by means of single-voxel ^{1}H MRS. Our experimental results demonstrated that ^{1}H MRS at high field may be valuable in characterizing metabolic changes in liver, in particular those related to lipid and glutamine metabolism, after CCl_4 insult.

14:00 **4734. Can Localised 19F MRS Pharmacokinetics of 5FU in Colorectal Metastases Predict Clinical Response?**

Dominick John McIntyre[1], Franklyn Arron Howe[2], Christophe Ladroue[2], Fiona Lofts[2], Marion Stubbs[1], John Richard Griffiths[1]
[1]CRUK Cambridge Research Institute, Li Ka Shing Centre, Cambridge, United Kingdom; [2]St George's, University of London, United Kingdom

We have applied 19F MRS to measure the pharmacokinetics of 5FU metabolism in the livers of 32 patients with colorectal cancer. 15 of the subjects had liver metastases. 5FU half-lives ranged from 4 to 15 minutes and were not significantly different between patients with and without liver metastases. In the group with metastases, high levels of toxic fluoronucleotides, primarily produced in tumour cells, were associated with poorer survival. This may be due to higher metastatic load giving higher concentrations of fluoronucleotides and poorer survival.

14:30 ***4735.*** **Proton Magnetic Resonance Spectroscopy (^{1}H-MRS) of Adrenal Gland Masses Using a Multiple Array Coil (32 Channels) at 1.5T**

Aude Fregeville[1], Stephane Silvera[1], Lionel Groussin[2], Olivier Vignaux[1], Victoria Cavero Machado[3], Nashiely Pineda Alonso[3], Paul Legmann[1]

[1]Department of Radiology, University René Descartes Paris V, Hôpital Cochin, Paris, France; [2]Service des Maladies Endocriniennes et Métaboliques, University René Descartes Paris V, Hôpital Cochin, Paris, France; [3]Siemens Healthcare, Paris, France

A size up to 3 cm lesion in the adrenal glands leads the patient to surgery. MRS is a promising tool for the classification of adrenal masses. We evaluated the advantages of multiple channel phased array (32-channel) coil in the respiratory-triggered proton single-voxel MR spectroscopy technique at 1.5 T for the diagnosis of adrenal masses and the differentiation between them. The gain in signal of the 32 channel coil gave an excellent spectral quality even in a free breathing acquisition at 1.5 Tesla. It is possible in deed to differentiate the types of masses by their spectral characteristics and ratios.

15:00 ***4736.*** **Can Regurgitation of Pancreatic Juice Into the Biliary Tract Be Detected by ^{1}H MR Spectroscopy?**

Omkar B. Ijare[1], Tedros Bezabeh[1], Nils Albiin[2], Annika Bergquist[2], Urban Arnelo[2], Mathias Lohr[2], Espen Melum[3], Ian C.P. Smith[1]

[1]National Research Council Institute for Biodiagnostics, Winnipeg, Manitoba, Canada; [2]Karolinska University Hospital, Karolinska Institutet, Huddinge, Stockholm, Sweden; [3]Deparment of Medicine, Oslo University Hospital, Oslo, Norway

Regurgitation of pancreatic juice into the biliary tract and the subsequent mixing with bile is frequently observed in patients with pancreaticobiliary maljunction (PBM), which is a potential risk factor for the carcinogenesis of bile duct and gallbladder. The mixing of bile with pancreatic juice is generally diagnosed by measuring the amylase activity in bile. We propose that pancreaticobiliary reflux can be detected by ^{1}H MR spectroscopy as an alternative to the measurement of amylase activity. Moreover, it may be possible to detect non-invasively the regurgitation of pancreatic fluids into the gallbladder using *in vivo* spectroscopy.

Renal & Prostate

Hall B Thursday 13:30-15:30 Computer 102

13:30 ***4737.*** **MR Voiding Cystourethrography (MRVC) for Vesicoureteric Reflux in Unsedated Infants**

Owen John Arthurs[1], Ilse Joubert[1], Martin John Graves[1], Pat Set[1], David John Lomas[1]

[1]Department of Radiology, University of Cambridge and Addenbrooke's Hospital, Cambridge, Cambridgeshire, United Kingdom

Vesico-ureteric reflux is a congenital disorder of the paediatric renal tract, for which the current gold standard is the Micturating Cystourethrogram (MCUG). This study evaluated the feasibility of MR voiding cystourethrography using dilute intravesical gadolinium in unsedated infants. Real time interactive switching between gradient echo (SPGR) and SSFSE based pulse sequences allowed 6 children with urinary tract abnormalities to undergo both MCUG and MRI. There was 83% concordance between MCUG and MRVC regarding vesicoureteric reflux, and complete agreement regarding the urethra and bladder. Fluoroscopic MR assessment of the complete paediatric renal tract is possible in unsedated infants.

14:00 ***4738.*** **Carr-Purcell-Meibom-Gill T2 Mapping of Prostate at 3 T.**

Giulio Gambarota[1], R L. Janiczek[1], Robert V. Mulkern[2], Rex D. Newbould[1], Brandon Whitcher[1]

[1]GlaxoSmithKline Clinical Imaging Center, London, United Kingdom; [2]Radiology, Children's Hospital Boston, Boston, United States

In clinical MR examinations of the prostate, a multiparametric approach (T1- and T2-weighted images, quantitative measurement of the apparent diffusion coefficient (ADC) of water, dynamic contrast-enhanced MRI) is becoming standard procedure. The Carr-Purcell-Meiboom-Gill (CPMG) approach has recently been proposed for T2 mapping of the prostate at 1.5 T. No such studies have been performed at 3 T. Translating the CPMG sequence to 3 T is not straightforward and involves compromises in clinical implementation. Here we have shown high quality measurements of T2 may be obtained over the entire prostate by careful design of the clinical acquisition.

14:30 ***4739.*** **Ultra Short Gradient Echo Imaging of the Prostate at 7T**

Gregory John Metzger[1], Steen Moeller[1], Patrick J. Bolan[1], Eddie J. Auerbach[1], Jang-Yeon Park[1], Michael Garwood[1]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

The purpose of this study was to investigate the potential of an ultra-short TE 3D radial sequence, for imaging the prostate at 7T. This technique is desirable for DCE-MRI because it would greatly reduce both the large T2* effect of paramagnetic contrast agents at high field, and the inflow artifacts that can bias the measurement of the arterial input function. Furthermore the sequence gives spatially isotropic resolution and, when combined with sparse temporal sampling methods, can provide very high temporal resolution. This work demonstrates the feasibility and imaging quality of this technique and discusses its strengths and weaknesses.

15:00 ***4740*.** **Histopathological Composition of Prostate Tissues and Their Impact on DCE MRI Measures**

Susan M. Noworolski[1,2], Kyle Kuchinsky[3], Michelle Nystrom[1], John Kurhanewicz[1,2], Daniel B. Vigneron[1,2], Peter R. Carroll[4], Kirsten Greene[4], Jeffry Simko[3]

[1]Radiology and Biomedical Imaging, University of California, San Francisco, CA, United States; [2]The Graduate Group in Bioengineering, University of California, San Francisco and Berkeley, CA, United States; [3]Pathology, University of California, San Francisco, CA, United States; [4]Urology, University of California, San Francisco, CA, United States

Validation of MR measures of the prostate are challenging due to heterogeneity. Tissue compositions by histopathology and their impact on DCE MRI measures were evaluated and compared in high and moderate grade prostate cancers. Fourteen men had DCE MRI before prostatectomy. High Gleason Grade (≥4+4) lesions had higher %cancer than Gleason 3+3 lesions (87% vs. 58%, $p<0.00001$). Normalizing DCE MRI measures to %cancer led to higher measures versus healthy peripheral tissues and greater separations between 3+3 and 4+4 cancers. Heterogeneity of tissues and %cancer may impact DCE MRI measures, with potentially different effects in Gleason Grade 3+3 versus 4+4 cancers.

MR Breast Cancer

Hall B Monday 14:00-16:00 Computer 103

14:00 ***4741*.** **Shutter-Speed Model Dynamic Contrast-Enhanced MRI to Reduce Unnecessary Surgeries of Atypical Breast Lesions: A Preliminary Study**

Luminita Alina Tudorica[1], Stephanie Hemmingson[1], Karen Oh[1], Arpana Naik[1], Sunitha Thakur[2], Elizabeth A. Morris[2], Mark Kettler[1], Ian J. Tagge[1], Jason A. Koutcher[2], Charles S. Springer[1], Wei Huang[1]

[1]Oregon Health & Science University, Portland, OR, United States; [2]Memorial Sloan Kettering Cancer Center, New York, NY, United States

Three of 28 core needle biopsy-proven high-risk atypical breast lesions were upgraded to malignancies following surgical excisions as standard care. Correlations with pre-biopsy quantitative DCE-MRI results show that the Shutter-Speed Model (SSM) analyses of DCE-MRI data discriminate the atypical lesions between those completely benign and those containing malignancies with high accuracy. SSM DCE-MRI can potentially be used to reduce unnecessary surgeries of atypical lesions.

14:30 ***4742*.** **Characterizing Suspicious Lesions with MR Guided Diffuse Optical Breast Imaging**

Colin Morehouse Carpenter[1,2], Shudong Jiang[2], Steven P. Poplack[3], Roberta M. diFlorio-Alexander[3], Brian William Pogue[2], Keith David Paulsen[2]

[1]Radiation Oncology, Stanford University School of Medicine, Stanford, CA, United States; [2]Thayer School of Engineering at Dartmouth, Hanover, NH, United States; [3]Radiology, Dartmouth Hitchcock Medical Center, Lebanon, NH, United States

Breast MR has high sensitivity, yet suffers from comparatively low specificity. Optical imaging may aid MR mammography by providing spatial maps of disease-specific tissue properties such as total hemoglobin, oxygen saturation, water content, and tissue microstructure scatter, which have been shown in several studies to offer high specificity to malignant cancer. A multimodality MR-guided optical breast imaging instrument (MRg-OBI) has been developed and validated through numerous phantom and healthy volunteer studies. This study examined the ability of MRg-OBI in characterizing malignant from benign lesions in five patients. The results show that total hemoglobin is a good indicator of malignancy, with tumor to background contrast varying greatly from 1.25 up to 8.0, compared to less than 1 for the benign/fully responded lesions.

15:00 ***4743*.** **Associations Between MR Derived Vascular, Shape and Texture Parameters with Histological Descriptors**

Martin D. Pickles[1], Peter Gibbs[1], Martin Lowry[1], Lindsay W. Turnbull[1]

[1]Centre for MR Investigations, University of Hull, Hull, East Yorkshire, United Kingdom

Features such as shape (round, irregular), enhancement (homogeneous, heterogeneous), and kinetic curve assessment (persistent, plateau and washout) have been used to aid in the classification of breast lesions. These features may also help to highlight patients who subsequently have a reduced overall and disease free survival intervals. The aim of this work was to determine if there were any associations between pre-treatment MR derived quantitative descriptors (shape, enhancement and kinetic curve assessment) and traditional prognostic indicators. This work has demonstrated that when comparing traditional prognostic indicators (nodal ± hormonal status) significant differences in shape, texture and vascular kinetics are apparent.

15:30 ***4744*.** **Evaluation of Sentinel Node with High Resolution Magic Angle Proton Magnetic Resonance Spectroscopy in Breast Cancer Patients: A Pilot Study**

Surender Kumar[1], Raja Roy[2], Sandeep Kumar, Madhumati Goel, Ankita Rathore

[1]General Surgery, King George's Medical University, Lucknow, Uttar Pradesh, India; [2]CBMR, Centre of Biomedical Magnetic Resonance, Lucknow, Uttar Pradesh, India

The extent of axillary lymph node involvement in patients with cancer breast is an important prognostic marker. Prophylactic axillary dissection is associated with significant morbidity in clinically negative axilla. The intra-operative sentinel node biopsy (SNB)

provides a basis for omitting the routine axillary dissection. However, it has limited sensitivity and requires complicated training and infrastructure. We report the use of high resolution magic angle proton magnetic resonance spectroscopy (HRMAS) in assessing the axillary nodal status with increased sensitivity.

Tuesday 13:30-15:30 Computer 103

13:30 ***4745*. Magnetization Transfer Imaging of Breast Cancer at 3T**

Sungheon Kim[1], Anne Zeleniuch-Jacquotte[2], Malcolm C. Pike[3], Silvia Formenti[4], Linda Moy[1]
[1]Center for Biomedical Imaging, Radiology, NYU School of Medicine, New York, NY, United States; [2]Environmental Medicine, NYU School of Medicine, New York, NY, United States; [3]Preventive Medicine, USC Keck School of Medicine, Los Angeles, CA, United States; [4]Radiation Oncology, NYU School of Medicine, New York, NY, United States

This study was to investigate the feasibility of using MTR to differentiate breast tissues with the patients undergoing diagnostic MRI scans at 3T. The MTR of muscle (41.8 ¡¾ 8.1 %) was significantly ($p < 0.01$) higher than that of fibroglandular tissue (33.1 ¡¾ 5.6 %). The MTR of fibroglandular tissue was significantly ($p < 0.01$) higher than that of FCC (23.6 ¡¾ 3.4 %). The difference in MTR between FCC and tumor (20.1 ¡¾ 4.2 %) was marginally significant (p=0.04). In addition, MT images were able to accentuate the signal differences in normal structures in the breasts.

14:00 ***4746*. The Role of Magnetisation Transfer Imaging in the Differentiation of Malignant and Benign Tissues**

R. G. Sah[1], U. Sharma[1], R. Prashad[2], N. R. Jagannathan[1]
[1]Departmet of NMR and MRI facility, All India Institute of Medical Sciences, New Delhi, India; [2]Departmet of Surgical Disciplines, All India Institute of Medical Sciences, New Delhi, India

This study evaluates the potential role of magnetization transfer imaging (MTI) in the differentiation of malignant and benign breast lesions at 1.5 T. The MT ratio was determined in 72 women; 57 locally advanced breast cancer patients (mean age, 43.8 ± 9.0); 10 benign breast cases (mean age, 28.3 ± 9.5) and 5 normal volunteers (mean age, 37.8 ± 15.4). The mean MTR of malignant lesions was statistically significantly higher (p=0.01) compared to the benign lesions and the fibroglandular tissues of normal volunteers suggesting the possible utility of MT imaging in the differentiation of various breast tissues.

14:30 ***4747*. Metabolomic Analysis of Human Breast Cancer**

Leo L. Cheng[1], Elita DeFeo, Yannick Berker, Elena Brachtel
[1]Radiology/Pathology, Massachusetts General Hospital, Charlestown, MA, United States

Research and technology has lead to an increase of early breast cancer detections, however there are still some controversies involving disease management. Traditional mastectomy followed by chemotherapy and radiotherapy is no longer standard protocol. Using HRMAS we have shown that metabolomic spectra from various pathological features can provide enough information to distinguish between cancerous vs. benign tissue, and tumor type and grade. We hope to use these findings to design new MRS paradigms aimed at non-invasive diagnosis, characterization and monitoring of breast tumors that will optimize patient survival and comfort, while reducing healthcare costs.

15:00 ***4748*. Effects of Temporal Resolution on Breast Cancer Diagnostic Accuracy by Quantitative Dynamic Contrast-Enhanced MRI**

Ian J. Tagge[1], Xin Li[1], Luminita Alina Tudorica[1], Yiyi Chen[1], Stephanie Hemmingson[1], Elizabeth A. Morris[2], Charles S. Springer[1], Wei Huang[1]
[1]Oregon Health & Science University, Portland, OR, United States; [2]Memorial Sloan Kettering Cancer Center, New York, NY, United States

High temporal-resolution research DCE-MRI data from 66 suspicious breast lesions were resampled to mimic typical clinical protocols with low temporal-resolution. The Standard Model (SM) and Shutter-Speed Model (SSM) pharmacokinetic analyses show that both Ktrans and ¦¤Ktrans [¡Ô Ktrans(SSM) ¨C Ktrans(SM)] are significantly underestimated at the lower temporal resolution, and the diagnostic accuracies of both parameters are considerably compromised.

Wednesday 13:30-15:00 Computer 103

13:30 ***4749*. Fat Water Ratio and Diffusion-Weighted MRI Applied to the Measure of Breast Density as a Cancer Risk Biomarker**

Ted Trouard[1,2], Patricia Thompson[3], Chuan Huang[4], Maria Altbach[2], Matthew Kupinski[2], Denise Roe[3], Kimberly Fitzpatrick[2], Per Granstrom[2], Georgette Frey[3], Scott Squire[2], Veronique Poulin[3], Alison Stopeck[3]
[1]Biomedical Engineering, University of Arizona, Tucson, AZ, United States; [2]Radiology, University of Arizona, Tucson, AZ, United States; [3]Arizona Cancer Center, University of Arizona; [4]Mathematics, University of Arizona

Breast density, as measured by mammography, is associated with elevated risk of breast cancer. Decreases in mammographic breast density have also been linked with beneficial effects of chemoprevention. However, the low precision and reproducibility of mammography, as well as exposure to ionizing radiation, limits the use of mammographic breast density as a biomarker for risk and

prevention. In this study we have employed Fat Water Ratio (FWR) MRI for assessment of breast density and compared the results to conventional mammography and to apparent diffusion coefficients (ADCs) measured by diffusion-weighted (DW) MRI.

14:00 ***4750*.** **Possible Prognostic Value of Contralateral Normal Breast Enhancements in DCE-MRI of Breast Cancer Patients Undergoing Chemotherapy**

Hon Yu[1], Jack Hsu[1], Ke Nie[1], Muqing Lin[1], Siwa Chan[2], Jeon-Hor Chen[1,2], Rita S. Mehta[3], Orhan Nalcioglu[1], Min-Ying Lydia Su[1]

[1]Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Department of Radiology, China Medical University Hospital, Taichung, Taiwan; [3]Department of Medicine, University of California, Irvine, CA, United States

The suggested association between the chemotherapy-induced ovarian suppression and a positive prognostic impact for more favorable treatment outcome in pre-menopausal women with breast cancer was investigated. Using the enhancement values of DCE-MRI measured from the fibroglandular tissue of contralateral normal breast as a measure of ovarian suppression effect, our retrospective study indicates a possible prognostic value of such measurement via an association between an early onset of chemotherapy-induced ovarian suppression and positive treatment outcomes among the younger group of women (< 55 yr.). The observed association between early onset of reduced perfusion and poor treatment outcome among the older group of women (¡Ý 55 yr.) may represent an additional potential of the prognostic value in treatment-induced effects measured from the normal breast.

14:30 ***4751*.** **MR Spectroscopy of Breast Cancer Patients for Prediction of Treatment Response – Combining in Vivo and Ex Vivo Analysis**

Beathe Sitter[1], Mariann Gjervik Heldahl[1], Tone Frost Bathen[1], Anna Bofin[2], Steinar Lundgren[1,3], Ingrid Susann Gribbestad[1]

[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway; [2]Department of Laboratory Medicine, Children's and Women's Health, Norwegian University of Science and Technology, Trondheim, Norway; [3]Department of Oncology, St. Olavs University Hospital

In vivo and *ex vivo* ^{1}H MR spectroscopic data were obtained prior to treatment from 19 patients assigned to neoadjuvant chemotherapy. Comparing findings obtained *in vivo* and *ex vivo* showed that concentrations of total choline (tCho) determined by *ex vivo* MRS were significantly higher in tissue from patients with detectable tCho by *in vivo* MRS compared to those without detectable choline by *in vivo* MRS. We also found that patients with complete response to treatment had significantly higher levels of GPC (p=0,037) than patients not having complete response.

Thursday 13:30-15:30 Computer 103

13:30 ***4752*.** **Role of Choline as a Biomarker of Cell Proliferation to Differentiate HER2/neu Positive and Negative Breast Cancers Patients**

Naranamangalam R. Jagannathan[1], Rani G. Sah[1], Uma Sharma[1], Rajinder Parshad[2]

[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India; [2]Department of Surgery, All India Institute of Medical Sciences, New Delhi, Delhi, India

The choline concentration and tumor volume were determined using in-vivo MRS and MRI in 53 invasive ductal carcinoma patients at 1.5 T with known HER2/neu status. The tCho concentration for HER2/neu positive cases was 4.8 ± 3.3 mmol/kg which was statistically significantly higher compared to HER2/neu negative cases (2.7 ± 0.7 mmol/kg; p=0.007). However, the tumor volume for the Her2/neu positive cases (47.9±56.1) and negative cases (45.6±48.3) were similar (p=0.84). The increase in tCho concentration observed in Her2/neu positive patients may be attributed to the high proliferative activity of the Her2neu positive tumors.

14:00 ***4753*.** **Choline as a Biomarker a Better Predictor of Early Response of Breast Cancer Than Tumor Volume? Sequential Study of the Therapeutic Response of Locally Advanced Breast Cancer Patients Undergoing Neo-Adjuvant Chemotherapy (NACT)**

R. G. Sah[1], U. Sharma[1], R. Prashad[2], N. R. Jagannathan[1]

[1]Departmet of NMR and MRI facility, All India Institute of Medical Sciences, New Delhi, India; [2]Departmet of Surgical Disciplines, All India Institute of Medical Sciences, New Delhi, India

We report here that tCho concentration as a useful biomarker for early prediction of tumor response compared to tumor volume. tCho and volume were calculated in 30 locally advanced breast cancer patients undergoing NACT using MRS and MRI. In clinical responders, pre-therapy tCho was 5.1 (0.48) mmol/kg which significantly decreased to 2.6 (0.51) after I NACT and showed gradual decrease thereafter, while volume showed significant decrease only after II NACT. Reduction in tCho and tumor volume after I NACT was 39.8% and 6.5% respectively in responders. Non-responders showed an increase of tCho by 52.9% and 7% reduction in volume.

14:30 *4754*. **Correlation Between Estrogen Receptor Positive (ER+) and Estrogen Receptor Negative (ER-) Status with TCho Concentration and Tumor Volume in Breast Cancer Patients.**

Naranamangalam R. Jagannathan[1], *Rani G. Sah*[1], *Uma Sharma*[1], *Rajinder Parshad*[2]
[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, Delhi, India; [2]Department of Surgery, All India Institute of Medical Sciences, New Delhi, Delhi, India

The tCho concentration and tumor volume were calculated using in-vivo MRS and MRI in estrogen positive and negative patients (n=46) with confirmed invasive ductal carcinoma at 1.5 T. The tumor volume for the estrogen positive patients was (33.57 ± 45.7) significantly higher (p=0.03) compared to estrogen negative patients (67.2 ± 60.8). However, the tCho concentration was similar in estrogen positive (4.2 ± 2.3 mmol/kg) and estrogen negative patients (4.1 ± 3.5) mmol/kg. The increase in the tumor volume may be attributed to the higher microvessels density in ER negative cancer patients.

15:00 *4755*. **SER Volume Predicts Malignancy in DCE MRI-Detected Secondary Occult Breast Lesions**

Vignesh Arasu[1], *Ryan Cheng-Ying Chen*[1], *David Caryl Newitt*[1], *Belinda Chang*[1], *Hilda Tso*[1], *Nola M. Hylton*[1], *Bonnie Nancy Joe*[1]
[1]Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States

Breast MRI, although sensitive for identifying cancer extent, has been criticized for its poor specificity in staging preoperative patients, leading to unnecessary biopsies and changes in surgical management. Signal enhancement ratio (SER) of contrast-enhanced breast MRI lesions characterizes neoangiogenesis in cancer, with high values predicting malignancy. We investigated if SER also predicts malignancy in new lesions found secondary to the known primary cancer when staging preoperative patients. Our results show that high total tumor SER volume, washout SER volume, and high peak SER significantly predict secondary malignant lesions. These results potentially improve the efficacy of preoperative MRI for surgical management.

Pelvic Cancers (Clinical Studies)

Hall B Monday 14:00-16:00 Computer 104

14:00 *4756*. **Impact of T1 Estimate Variation on DCE-MRI Derived Pharmacokinetic Values in Rectal Tumours**

Moreno Pasin[1,2], *Gloria Castellazzi*[1], *Paul Summers*[2], *Roberto Di Filippi*[2], *Luke Bonello*[2], *Giuseppe Petralia*[2], *Massimo Bellomi*[2]
[1]Struttura Complessa di Radiologia/Diagnostica per immagini, Istituto Neurologico IRCCS- Fondazione Casimiro Mondino, Pavia, Lombardia, Italy; [2]Radiology, Istituto Europeo di Oncologia, Milan, Lombardia, Italy

Variability in two-point T1 estimation may lead to uncertainty in derived DCE parameters. We examined the impact of T1 estimate noise on Ktrans, Kep, Ve, using two, low flip angle scans combined with a single dynamic DCE measurement and ROI definition in 9 rectal adrenocarcinoma patients at pre- and post- neoadjuvant treatment examinations. Ktrans and Ve variations attributable to T1 estimates were less than 5%, though variability in Ve may be exaggerated by peristaltic motion. The variation in Kep was not value dependent. We recommend the use of an aniperistaltic agent for rectal DCE to reduce variation in Ve.

14:30 *4757*. **Initial Observations from Multimodal Imaging Assessment of Rectal Tumors with Dynamic Contrast Enhanced and Diffusion Weighted Magnetic Resonance Imaging, Perfusion Computed Tomography and Positron Emission Tomography.**

Giuseppe Petralia[1], *Paul Summers*[1], *Luke Bonello*[1], *Stefano Viotti*[1], *Roberto Di Filippi*[1], *Laura Traviani*[2], *Maria Giulia Zampino*[3], *Dow-Mu Koh*[4], *Maria Cristina Leonardi*[5], *Antonio Chiappa*[6], *Massimo Bellomi*[1]
[1]Radiology, Istituto Europeo di Oncologia, Milan, Lombardia, Italy; [2]Nuclear Medicine, Istituto Europeo di Oncologia, Milano, Italy; [3]Medical Care Unit, Department of Medicine, Istituto Europeo di Oncologia, Milan, Lombardia, Italy; [4]Radiology, Royal Marsden Hospital, Sutton, United Kingdom; [5]Radiotherapy, Istituto Europeo di Oncologia, Milan, Lombardia, Italy; [6]General and Laparoscopic Surgery, Istituto Europeo di Oncologia, Milan, Lombardia, Italy

Functional imaging techniques have potential in monitoring neoadjuvant chemoradiation therapy and predicting therapy outcome in locally advanced rectal cancers. We compared four different functional modalities (DCE-MR, DW-MR,CTp and PET) in patients with locally advanced rectal cancer who underwent imaging with all modalities before and after neoadjuvant treatment. From our small patient population we observed a correlation between Kep and PS, both estimates of capillary permeability (R=0.93), and a trend to correlation between Ktrans and PS (R= 0.47), whereas negative correlations were observed between Ktrans and SUV (R=-0.78), Ve and SUV (R=-0.86), and a negative trend for ADC and SUV (R=-0.50).

15:00 **4758. Quantitative Analysis of Indexes from DWI and PET/CT in Primary Rectal Cancer**

Jing Gu[1], Pek-lan Khong[1], Silun Wang[1], Queenie Chan[2], Wailun LAW[3], Rico Kingyin Liu[3], Jingbo Zhang[1]
[1]Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong; [2]Philips Healthcare, Philips Electronics Hong Kong Limited, Hong Kong, Hong Kong; [3]Division of Colorectal Surgery, The University of Hong Kong, Hong Kong, Hong Kong

We aim to assess the correlations between parameters apparent diffusion coefficient (ADC) measured by DWI and standardized uptake value (SUV) measured by 18F-FDG PET in rectal caner. Significant negative correlations were found between ADC and SUV in primary rectal adenocarcinomas. ADC may thus have the potential as a useful biomarker in oncologic imaging.

15:30 **4759. Dynamic Contrast-Enhanced MRI of Primary Rectal Cancer at 3T: Correlation with Positron Emission Tomography**

Jing Gu[1], Pek-lan Khong[1], Silun Wang[1], Queenie Chan[2], Wailun LAW[3], Rico Kingyin Liu[3], Jingbo Zhang[1]
[1]Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong; [2]Philips Healthcare, Philips Electronics Hong Kong Limited, Hong Kong, Hong Kong; [3]Division of Colorectal Surgery, The University of Hong Kong, Hong Kong, Hong Kong

We aim to assess the correlations between parameters measured on DCE-MRI and 18F-FDG PET in rectal cancer. We found positive correlations between kep measured by DCE-MRI and SUV values measured by PET/CT. Our findings may indicate that kep during contrast washout phase is better associated with tumor metabolism than Ktrans which is influenced by multiple factors during contrast uptake phase. kep may have the potential as a useful biomarker to reflect biological characteristics of rectum cancer

Tuesday 13:30-15:30 Computer 104

13:30 **4760. Functional Imaging of Peritoneal Disease in Ovarian Cancer: Changes in Apparent Diffusion Coefficients Predict Biochemical Response to Chemotherapy**

Stavroula Kyriazi[1,2], David J. Collins[1], Veronica A. Morgan[2], Catherine J. Simpkin[2], Nandita M. deSouza[1,2]
[1]CR-UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]Royal Marsden Hospital NHS Foundation Trust, Sutton, Surrey, United Kingdom

Biochemical (Ca125) monitoring of chemotherapeutic efficacy in advanced ovarian cancer has limited sensitivity early in the course of treatment. Diffusion-Weighted Imaging of peritoneal disease improves anatomical delineation but its role in quantification of treatment response has not been established. This study explores the value of Apparent Diffusion Coefficients calculated for the entire metastatic tumour burden in identifying biochemical response to platinum-based chemotherapy. Although pretreatment ADC values were not predictive, an ADC increase after the first cycle of treatment was highly indicative of chemosensitivity. ROC analysis for %ADC change after the first cycle yielded an area under curve AUC=0.933. These findings may facilitate individualised treatment strategies in advanced ovarian cancer.

14:00 **4761. Diffusion-Weighted Imaging of Uterine Endometrial Cancer Using the Apparent Diffusion Coefficient Value at 3.0 T MRI: Differentiation Endometrial Cancer from Normal Endometrium and Endometrial Benign Lesions**

Takuro Kamiyama[1], Yoshihiko Fukukura[2], Koji Takumi[2], Toshikazu Shindo[2], Yuichi Kumagae[2], Akihiro Tateyama[2], Takahiro Tsuji[3], Tsutomu Douchi[3], Masayuki Nakajo[2]
[1]Department of Radiology, National Hospital Organization Kagoshima Medical Center, 8-1 Shiroyama-cho, Kagoshima City, Kagoshima, Japan; [2]Department of Radiology, Kagoshima University Graduate School of Medical and Dental Sciences, 8-35-1 Sakuragaoka, Kagoshima City, Kagoshima, Japan; [3]Department of Reproductive Pathophysiology and Obstetrics-Gynecology, Kagoshima University Graduate School of Medical and Dental Sciences, 8-35-1 Sakuragaoka, Kagoshima City, Kagoshima, Japan

Uterine endometrial cancer is the most common gynecological malignancy. The development of MR scanner with high field strength resulted in improvement in diffusion-weighted (DW) imaging. Apparent diffusion coefficient value of the tissue which is derived from DW imaging has been known to characterize malignant or benign lesions. The goal of this study is to evaluate the feasibility of DW imaging at 3T MRI for uterine endometrial cancer. The results of our study suggest that DW imaging of uterine endometrial lesions is feasible in differentiating endometrial cancer from normal endometrium and endometrial benign lesions such as endometrial hyperplasia and polyps.

14:30 **4762. Increasing Registration Accuracy by Sub-Volume Based Mutual Information Registration**

Joakim Jonsson[1], Mikael Karlsson[1], Magnus G. Karlsson[2], Tufve Nyholm[2]
[1]Department of Radiation Sciences, Radiation Physics, Umeå University, Umeå, Sweden; [2]Department of Radiation Physics, Umeå University Hospital, Umeå, Sweden

In many cases where an organ of interest is free to move within the patient anatomy, e.g. the prostate gland, normal image registration techniques are insufficient. The patient external contour and bony anatomy will heavily influence the registration, causing the actual organ of interest to be misaligned. In order to overcome this problem, the registration can be performed in such a way that the

information available in the organ of interest and regions in close proximity to it is more important to the registration algorithm. This study evaluates the accuracy of such a sub-volume based approach.

15:00 ***4763*. Effect of Field Strength and Peripheral Zone Fraction on T2 from Tumor and Non-Tumor Prostate Regions**

Sophie F. Riches[1], Veronica A. Morgan[2], Sharon Giles[2], Catherine Simpkin[2], Nandita deSouza[1]
[1]Cancer Research UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research & Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [2]Cancer Research UK and EPSRC Cancer Imaging Centre, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

Tumor detection within the prostate depends on T2-weighted contrast. This study compares T2 values at 3T and 1.5T and investigates differences in T2 contrast with fractional volume of the peripheral zone (PZ). T2 values obtained at 3T were not significantly different to those at 1.5T for any prostate region. Patients with a low PZ to whole prostate volume showed significantly reduced T2 in PZ compared to those with larger PZ fractions. In patients with low fractional PZ volume, therefore, T2 values of PZ may be indistinguishable from tumor, reducing the ability to detect tumor within the PZ in these patients.

Wednesday 13:30-15:30 Computer 104

13:30 ***4764*. A New Harvesting Method to Provide High Quality Prostate Cancer Tissue Suitable for ^{1}H HR MAS MR Spectroscopy and Gene Expression.**

Helena Bertilsson[1,2], May-Britt Tessem[3], Ingrid Gribbestad[4], Haakon Skogseth[1], Trond Viset[5], Anders Angelsen, [2,6], Jostein Halgunset[1]
[1]Dept. of Laboratory Medicine and Children's and Women's Health, NTNU, Trondheim, Norway; [2]Dept. of Urology, St Olav University Hospital, Trondheim, Norway; [3]Dept. of Circulation and Medical Imaging , Norwegian University of Science and Technology (NTNU), Trondheim, Norway; [4]Dept. of Circulation and Medical Imaging, Norwegian University of Science and Technology (NTNU), Trondheim, Norway; [5]Dept. of Pathology and Medical Genetics, St Olav University Hospital, Trondheim, Norway; [6]Dept. of Cancer Research and Molecular Medicine, NTNU, Trondheim, Norway

New research on the genetic and metabolic level of prostate cancer is important for future disease management in diagnostics, choice of treatment and prognosis. This study describes a highly standardized method for snap-freezing of a whole prostate slice that is safe (without interfering with the routine diagnostics), easy to practise, and results in tissue with highly intact molecular content suitable for ex vivo MR spectroscopy and gene expression of the same sample. The present harvesting method is applicable to all prostate cancer patients and stores the snap-frozen tissue without fixatives, leaving it available for all kinds of future research technologies.

14:00 ***4765*. Volumetric Reconstruction with Superimposed MRS Metabolic Map for the Assessment of Prostate Cancer**

Angel Alberich-Bayarri[1], Luis Marti-Bonmati[1,2], Roberto Sanz-Requena[1], Javier Sánchez-González[3], Gracián García-Martí[1], Rosario Pérez[1]
[1]Radiology, Quiron Valencia Hospital, Valencia, Spain; [2]Radiology, Dr. Peset University Hospital, Valencia, Spain; [3]Clinical Science, Philips Healthcare, Madrid, Spain

The diagnosis and accurate localization of prostatic carcinoma by 3D multivoxel MR spectroscopy (MRS) analysis is often complicated on a slice-by-slice basis. A semi-automated individualized method was developed to obtain a 3D reconstruction of the prostate with superimposition of metabolic results for an intuitive depiction and rapid localization of the suspicious malignant zones. The (Cho+Cr)/Cit ratio was calculated in a voxel-by-voxel basis and used as a metabolic index to be combined with the 3D reconstructions of the prostate.

14:30 ***4766*. Comparison of Look-Locker and Variable Flip Angle T1 Mapping for DCE-MRI in Prostate Patients at 3T**

Wei Liu[1,2], Baris Turkbey[2], Julien Senegas[3], Stefanie Remmele[3], Christian Stehning[3], Dagane Daar[4], Yuxi Pang[5], Marcelino Bernardo[4], Peter Choyke[2]
[1]Clinical Sites Research Program, Philips Research North America, Briarcliff Manor, NY, United States; [2]Molecular Imaging Program, National Cancer Institute, Bethesda, MD, United States; [3]Sector of Tomographic Imaging, Philips Research Europe, Hamburg, Germany; [4]Molecular Imaging Program, National Cancer Institute, SAIC-Frederick Inc., Bethesda, MD, United States; [5]Philips Healthcare, Cleveland, OH, United States

T1 maps from variable flip angle (VFA) approach were compared with Look-Locker T1 maps to investigate the accuracy of the VFA T1 mapping in prostate cancer patients. Despite larger variations and lower SNR, VFA T1 mapping demonstrated a good correlation with the Look-Locker technique for prostate T1. Pharmacokinetic parameters based on VFA and Look-Locker T1 maps demonstrated similar performance in differentiation of tumor tissues. Our results suggest that with actual flip angle correction and slice oversampling to suppress inflow, VFA approach can generate satisfactory T1 maps for DCE MRI in patients undergoing MRI for prostate cancer.

15:00 **_4767_. DCE-MRI for the Detection of Patients with Recurrent Prostate Cancer After Radiotherapy; a Matched Case-Control Study.**

Maaike R. Moman[1], Greetje Groenendaal[1], Marco van Vulpen[1], Gijsbert H. Bol[1], Uulke A. van der Heide[1]

[1]Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands

The interpretation of DCE-MRI of the prostate can be difficult after radiotherapy, because of changes in microvasculature. This study demonstrates that DCE-MRI shows differences between patients with recurrent prostate cancer after radiotherapy, compared to matched control patients. These differences can be utilized for the detection of patients with recurrent prostate cancer in the follow-up after treatment.

Thursday 13:30-15:30 Computer 104

13:30 **_4768_. Dynamic Contrast Enhanced MRI Post-Prostatectomy for a Rising PSA: Implications for Radiotherapy**

Radka Stoyanova[1], Raj Rajpara[1], Elizabeth Bossart[1], Victor Casillas[2], Jill Palma[1], May Abdel-Wahab[1], Alan Pollack[1]

[1]Radiation Oncology, University of Miami, Miami, FL, United States; [2]Diagnostic Radiology, University of Miami, Miami, FL, United States

We present analysis of Dynamic Contrast-Enhanced Magnetic Resonance Imaging for identification of local recurrence of prostate cancer in men who underwent radical prostatectomy and had a subsequent rising Prostate-Specific Antigen (PSA). Our results indicate that we can detect abnormalities suggestive of residual tumor in the prostate bed in nearly 75% of patients evaluated for radiation therapy (RT). Because patients treated with salvage RT often develop a rising PSA later and there is some evidence for a RT dose response, targeting of the contrast-enhancing areas specifically may improve tumor control and limit toxicity.

14:00 **_4769_. Effect of External Beam Radiotherapy on Prostate ADC Values**

Daniel Wilson[1], Sarah Bacon[1], Brendan Carey[2]

[1]Medical Physics, Leeds Teaching Hospitals NHS Trust, Leeds, West Yorkshire, United Kingdom; [2]Radiology, Leeds Teaching Hospitals NHS Trust, Leeds, West Yorkshire, United Kingdom

Prostate ADC values were calculated using a variety of b-value combinations from b=0, 50, 300 and 500 s/mm2. The calculated ADC depended on the combination of b-values used. All combinations showed a decrease in ADC post radiotherapy compared to pre radiotherapy. This difference was statistically significant for all combinations except b=300 and 500 s/mm2 combined. This decrease in ADC may be a result of radiation induced cellular changes.

14:30 **_4770_. Prostate MRS in the Presence of Gold Seed Fiducial Markers**

Ralph Noeske[1], Beat Werner[2], Charlie Ma[3], Murshed Hossain[3], Mark Buyyounouski[3], Timo Schirmer[4]

[1]Applied Science Laboratory, GE Healthcare, Potsdam, Germany; [2]Kinderspital Zurich, Switzerland; [3]Fox Chase Cancer Center, Philadelphia, PA, United States; [4]Applied Science Laboratory, GE Healthcare, Germany

MR Spectroscopy (MRS) has great potential for guiding radiotherapy of prostate cancer by identifying bulky and/or high grade tumors suitable for dose escalation. However, image guided therapy typically employs permanently implanted gold seed fiducial markers (GSFM) which aid in daily prostate localization prior to treatment. The impact of GSFM on the quality of MRS is unknown. This phantom study presents the potential impact of GSFM on the quality of ^{1}H MRS data. Signal drops in the vicinity of GSFM up to 47% were observed. Further investigation will show if advanced processing tools allow evaluation of areas with larger signal drops.

15:00 **_4771_. MRI Method Developments for Stand-Alone MRI and CT Fiducial-Based Registration**

Warren Foltz[1], Vickie Kong[1], Siddharta Baxi[1], Varadarajan Kumar[1], Peter Chung[1], David Jaffray[1], Cynthia Ménard[1]

[1]Radiation Medicine Program, Princess Margaret Hospital, Toronto, Ontario, Canada

MRI and CT fiducial-based registration for prostate radiation therapy requires MR images which clearly display both implanted gold fiducial markers and the prostate boundary. However, stand-alone acquisitions of standard diagnostic techniques do no accomplish both of these tasks reliably at 1.5 Tesla. Consequently, fiducial-sensitive images and anatomical images for contouring are acquired in separate acquisitions, which increases protocol duration and compromises the registration process to prostate motion. This abstract introduces strategies which provide T2 or T2-like contrast for contouring, yet provide a moderate amplification of gold fiducial markers, utilizing the frequency response of ssfp and the off-resonance blur function of spiral imaging. A preliminary experiment validated an inconsistent visualization of gold 'seeds' in standard diagnostic T2-weighted images via retrospective review. A second experiment demonstrated that spiral and ssfp strategies provide consistent fiducial visibility with an adequate contrast for contouring.

Prostate Cancer

Hall B Monday 14:00-16:00 Computer 105

14:00 ***4772*. Assesing Prostate Cancer Growth with Intact Tissue MRS and MRNA of Spermine Anabolic Enzymes**

Leo L. Cheng[1], David Kaul[2], Chin-Lee Wu[3], Christen Adkins, Kate Jordan, Piet Habbel[4], Randall Peterson[5], W. Scott McDougal, Ute Pohl

[1]Radiology/Pathology, Massachusetts General Hospital/Harvard Medical School, Charlestown, MA, United States; [2]Pathology/ Center for Anatomy, Institute of Cell Biology and Neurobiology, Massachusetts General Hospital/Charite - Universitatsmedizin; [3]Pathology/Urology, Massachusetts General Hospital; [4]Center for Anatomy, Institute of Cell Biology and Neurobiology, Charite - Universitatsmedizin; [5]Medicine, Massachusetts General Hospital

The inability of current pathology to distinguish between a latent form of prostate cancer and a fast growing tumor necessitates new assays that can determine tumor biological activity. We measured concentrations of spermine, an endogenous PCa growth inhibitor, from prostatectomy tissue with HRMAS 1HMRS, and quantified the expression levels of mRNA for enzymes in the spermine synthesis and degradation pathways for different pathological features. Our findings suggest the presence of PCa activates spermine production, which delays PCa progression. These enzyme related mRNA results could potentially be implemented in the clinic, allowing patients to make a more informed decision about treatment.

14:30 ***4773*. Automated Quality Control of Prostate Cancer MRSI Using Independent Component Analysis**

Alan James Wright[1], Thiele Kobus[1], Thomas Hambrock[1], Tom W. Scheenen[1], Arend Heerschap[1]

[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Magnetic Resonance Spectroscopic Imaging (MRSI) of prostate cancer patients can provide information on the detection and localization of prostate cancers. Automatic processing of MRSI data requires an automated quality control step. We present a method for quality control of 3T MRSI data from prostate cancer patients that separates raw spectral data as voxels of acceptable and unacceptable quality. This is done with a feature extraction method based on independent component analysis. The separation achieved is comparable to the gold standard of expert decision.

15:00 ***4774*. Rapid 5-Minute Echo-Planar Spectroscopic Imaging of Prostate Cancer Patients at 3T**

Galen Durant Reed[1,2], Peder E. Larson[1], John Kurhanewicz[1,2], Daniel B. Vigneron[1,2]

[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States; [2]Joint Graduate Group in Bioengineering, UCB / UCSF, Berkeley, CA, United States

The long acquisition times for the 3D phase encoding traditionally employed in proton magnetic resonance spectroscopic imaging (MRSI) of the prostate can be prohibitively long. A 3T MRSI sequence with a flyback echo-planar readout recently developed and clinically implemented at UCSF shows greatly reduced scan times. This time reduction allows for larger acquisition matrices and longer repetition times to avoid metabolite saturation. Comparison with a 1.5T 3D phase-encoded sequence showed that the flyback sequence can achieve comparable spatial resolution, improved spectral resolution, and significantly improved SNR in a shorter scan time.

15:30 ***4775*. Diagnostic Performance of 1.5 Tesla Endorectal MR Imaging and MR Spectroscopic Imaging for the Detection of Locally Recurrent Prostate Cancer After External Beam Radiation Therapy**

Antonio Westphalen[1], Fergus V. Coakley, Vivian Weinberg, Mack Roach III, Jane Z. Wang, John Kurhanewicz

[1]University of California, San Francisco, San Francisco, CA, United States

The addition of MR spectroscopic imaging to T2-weighted MR imaging significantly improves the detection of locally recurrent prostate cancer after definitive external beam radiotherapy. The resulting information may assist the clinician to advise patients about subsequent clinical evaluation, selecting those for whom targeted hemi-prostate biopsy is appropriate to confirm disease. Although targeted therapies may be offered to patients in whom very minimal recurrent disease is diagnosed, hemi-prostate imaging evaluation is sufficiently accurate to obviate the need for sextant localization, since the most commonly recommended salvage treatments (radical retropubic prostatectomy and permanent LDR brachytherapy) treat the entire gland.

Tuesday 13:30-15:30 Computer 105

13:30 ***4776*. Differentiation Between Malignant and Benign Prostatic Diseases: Evaluated by MR Diffusion Tensor Imaging at 3.0T**

Saying Li[1], Chunmei Li[1], Min Chen[1], Xuna Zhao[2], Cheng Zhou[1]
[1]Radiology, Beijing Hospital, Beijing, China; [2]Philips Medical System, China, China

To investigate the characteristcs of DTI at 3.0T in differentiating prostate cancer and benign prostatic diseases. DTI was performed in 30 patients with prostate cancer, prostatitis and /or BPH , and in 20 healthy volunteers. Decreased ADC and increased FA values were found in the central gland , compared with the peripheral zone. We also observed reduced ADC and higer FA values in cancer. The sensitivity and specificity of two values for differentiating prostate cancer and benign diseases were 94.4%, 70.3% and 81.1%, 66.7% respectively. In conclusion, DTI may be a potential tool in differential diagnosis of prostatic diseases.

14:00 ***4777*. Prostate Cancer : Are There Differences Between Native Diffusion-Weighted Images and the Apparent Diffusion Coefficient Map in Tumor Detection and Characterization?**

Andrew B. Rosenkrantz[1], Xiangtian Kong[2], Ben Niver[1], Samir S. Taneja[3], Jonathan Melamed[2]
[1]Radiology, NYU Langone Medical Center, New York, NY, United States; [2]Pathology, NYU Langone Medical Center, New York, NY, United States; [3]Urology, NYU Langone Medical Center, New York, NY, United States

21 patients with prostate cancer underwent prostate MRI including DWI at 1.5T prior to prostatectomy. The native diffusion-weighted images (nDWI) and ADC map were compared, using prostatectomy as reference standard. Compared with nDWI, the ADC map demonstrated significantly more tumor foci as well as greater relative contrast between tumor and benign PZ. Among tumors visible on the ADC map, there was a trend toward greater Gleason score and tumor size for those also visible on nDWI. Our data supports the importance of review of the ADC map in addition to nDWI given possible greater tumor visibility on the ADC map.

14:30 ***4778*. Intravoxel Incoherent Motion MR Imaging on Prostate Cancer**

Yuxi Pang[1,2], Baris Turkbey[2], Marcelino Bernardo, [23], Wei Liu, [2,4], Vijay Shah, [23], Peter Choyke[2]
[1]Philips Healthcare, Cleveland, OH, United States; [2]Molecular Imaging Program, National Cancer Institute, Bethesda, MD, United States; [3]SAIC-Frederick, Frederick, MD, United States; [4]Philips Research North America, Briarcliff Manor, NY, United States

Intravoxel incoherent motion (IVIM) MR imaging has the potential to separate perfusion (active blood microcirculation) from pure diffusion in DWI studies. This perfusion information is intrinsically linked with angiogenesis in tumor growth, thus, it is expected that different perfusion patterns would be found in tumors in comparison to normal tissues. In this retrospective study, we have analyzed 22 DWI data from patients with prostate cancers, and found significant increases in IVIM-related perfusion in tumors. This result suggests that the DWI-derived perfusion be a possible surrogate biomarker and a potential additional MRI parameter for accurate diagnosis of prostate cancer.

15:00 ***4779*. T2-Weighted MR Imaging Combined with Diffusion Weighted MR Imaging for Selection of True Active Surveillance Patients Based on Stage and Gleason Score Criteria: A Retrospective Multireader Study.**

Caroline Hoeks[1], Pieter Vos[1], Diederik Somford[2], Derya Yakar[1], Thomas Hambrock[1], Stijn Heijmink[1], Jurgen Futterer[1], Henk Vergunst[3], Christina Hulsbergen-van de Kaa[4], Fred Witjes[2], Henkjan Huisman[1], Jelle Barentsz[1]
[1]Department of Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Gelderland, Netherlands; [2]Department of Urology, Radboud University Nijmegen Medical Centre, Nijmegen, Gelderland, Netherlands; [3]Department of Urology, Canisius Wilhelmina Hospital, Nijmegen, Gelderland, Netherlands; [4]Department of Pathology, Radboud University Nijmegen Medical Centre, Nijmegen, Gelderland, Netherlands

Problem Undersampling of prostate cancer can lead to incorrect surveillance (AS) patient selection. Aim: to determine if T2-weighted (T2w) MRI and diffusion weighted MRI (DWI) could contribute in AS patient selection by comparing radiologist reading of stage and Gleason score(GS) to prostatectomy. Methods Twelve prostatectomy patients were retrospectively selected by biopsy criteria and a performed 3T MRI preprostatectomy. Four radiologists scored T2w-MRI and T2w-MRI in combination with DWI. Results AUC values for T2w-MRI prediction of AS patients varied from 0,812 for inexperienced reader to 0,812-1,0 for experienced readers. Conclusion T2w-MRI could be of additional value in AS patient selection.

Wednesday 13:30-15:30 Computer 105

13:30 ***4780***. **Relative Conspicuity of Prostate Cancer: Apparent Diffusion Coefficient Versus Dynamic Contrast Enhancement**

Daniel Jason Aaron Margolis[1], Timothy McClure[1], Steven Raman[1]
[1]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States

Diffusion-weighted imaging (DWI) and dynamic contrast enhancement (DCE) can localize prostate cancer in situ, but it is unclear if one is superior. DWI, Ktrans, Kep, Ve, and T2WI are compared with surgical pathology in 23 patients using a unitless variable, the conspicuity ratio, the difference of the values from the ROI of the lesion and the contralateral side, divided by the average of these values. Prostate cancer is more conspicuous on DWI ADC maps and on DCE than on T2WI, and more conspicuous on DCE than on ADC, but Ktrans and Kep are not significantly different in terms of conspicuity.

14:00 ***4781***. **Intersequence Variability in Multiparametric-Derived 3D Prostate Tumor Volumetrics at 3.0T**

Fiona M. Fennessy[1], Sota Oguro[1], Yi Tang[1], Robert V. Mulkern[1], Steven Haker[1], Ehud J. Schmidt[1], Sandeep Gupta[2], Clare M. Tempany[1]
[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States; [2]GE Global Research, Niskayuna,, NY, United States

Newer approaches for prostate cancer treatment mandate improvements in MR imaging to allow for accurate index lesion detection and display, to guide biopsy and focal therapy. In 9 pathology-proven prostate cancer patients, we manually segmented tumor according to multiparametric MR (mpMR) sequences using 3D-slicer software, and obtained volumetrics for each. Volumes based on DCE maps were significantly greater than those based on ADC maps (p=0.011) or T2WI (p=0.001), possibly reflecting different physiological properties of tumor assessed with mpMR. Volume discrepancies can be displayed in a single framework, and should be taken into consideration for tumor mapping in focal therapy planning.

14:30 ***4782***. **The Utility of Prostate MRI Using Diffusion and Dynamic Enhanced Imaging in the Evaluation of Patients Previously Biopsy Negative for Cancer**

Andrew Dean Hardie[1]
[1]Radiology, Medical University of South Carolina, Charleston, SC, United States

Patients with an initial set of prostate biopsies which were negative for cancer were assessed by phased array MRI. All patients subsequently had repeat prostate biopsy which was used as the gold standard. The diagnostic accuracy of MRI, negative predictive value, and the difference in the number of biopsy samples performed in patients with cancer suspected by MRI and those unlikely to have cancer by MRI were assessed. MRI was 100% sensitive, 91% specific, and had a 100% negative predictive value for cancer. Less biopsy passes were performed in patients with an MRI read as likely to have cancer than those unlikely to have cancer by MRI.

15:00 ***4783***. **Multiparametric Prostate MR Imaging and Spectroscopy in Patients with High-Risk Localized Prostate Cancer Before Radical Prostatectomy Assesses Risk of Extracapsular Extension And/or Positive Margins.**

Ernesto Castillo[1,2], Emilio Hernandez[3], Jose Maria Rodriguez-Barbero[4], Pilar Perez Sanz[1], Javier Gonzalez[3], Pedro Cabrera[3], Javier C. Angulo, [23]
[1]Radiology, H.U. de Getafe, Getafe, Madrid, Spain; [2]Universidad Europea de Madrid; [3]Urology, H.U. de Getafe; [4]Pathology, H.U. de Getafe

In 30 patients with high-risk localized (T1-2) prostate cancer the risk of extracapsular extension and affected margins before radical prostatectomy were evaluated blindly before surgery. The pathologists' evaluation of the biopsy cylinders predicted the risk erroneously in 35% of the evaluations. Using multiparametric MRI and MR spectroscopic imaging, diffusion-weighted imaging and dynamic CE-MRI with an endorectal coil the radiologist did so in 18.3%. Multiparametric MRI of the prostate preoperatively alerts upon the risk of extracapsular disease in high-risk localized prostate cancer better than accurate review of transrectal biopsy.

Thursday 13:30-15:30 Computer 105

13:30 ***4784***. **MR-US Fusion for Targeted Prostate Biopsy**

Clifford Weiss[1], Michael Seitz[2], Karin Herrmann[3], Arno Graser[3], Berthold Kiefer[4], Martin Requardt[4], Jens Fehre[4], Ralf Nanke[4], Mamadou Diallo[5], Parmeshwar Khurd[5], Ali Kamen[5], Wolfgang Wein[5]
[1]Center Department of Radiology, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Urology Department, Ludwig Maximilian Universität München, München, Germany; [3]Radiology Department, Ludwig Maximilian Universität München, München, Germany; [4]Siemens Healthcare, Erlangen, Germany; [5]Imaging & Visualization Department, Siemens Corporate Research, Princeton, NJ, United States

We aim to improve prostate targeted biopsy procedures, by taking pre-acquired diagnostic MRI images, and actively fusing them to the real-time trans-rectal ultrasound. In this way the diagnostic power of prostate MRI is married to the flexible, rapid and inexpensive ultrasound guided procedure. We propose a system based on a magnetically tracked freehand ultrasound probe, combined with a novel powerful deformable registration workflow that effectively compensates prostate organ deformation between the two modalities. We

present initial results in terms of registration accuracy and clinical usefulness, from a study on 19 middle aged patients with elevated PSA and suspected prostate cancer.

14:00 ***4785*. Fast T_2 Relaxometry in Prostate Cancer Patients at 3T**

Wei Liu[1], Julien Senegas[2], Baris Turkbey[3], Dagane Daar[4], Marcelino Bernardo[4], Peter Choyke[3]

[1]Clinical Sites Research Program, Philips Research North America, Briarcliff Manor, NY, United States; [2]Sector of Tomographic Imaging, Philips Research Europe, Hamburg, Germany; [3]Molecular Imaging Program, National Cancer Institute, Bethesda, MD, United States; [4]Molecular Imaging Program, National Cancer Institute, SAIC-Frederick Inc., Bethesda, MD, United States

A fast T2 mapping technique using multi-echo spin-echo sequence with four-fold undersampling has been applied to characterize prostate T2 values in 23 patients. Utilizing the temporal and spatial correlation of T2 signal decay, folding-free images were reconstructed at each echo time providing a series of diagnostic images with variable T2-weighting. Quantitative T2 maps were generated with very good reproducibility in clinical relevant scan time. T2 values of tumor tissues were significantly lower than the normal control regions. Our results demonstrate this fast T2 relaxometry can provide an effective approach for accelerated T2 quantification in prostate patients.

14:30 ***4786*. Quantitative and Radiologic Evaluation of the Patient-Specific MR-Based Molds**

Vijay Pravin Shah[1,2], Baris Turkbey[2], Thomas Pohida[3], Haresh Mani[4], Maria Merino[4], Peter A. Pinto[5], Cheng Ruida[3], Matthew McAuliffe[3], Peter Choyke[2], Marcelino Bernardo[1,6]

[1]Imaging Physics, SAIC-Frederick, Inc, Frederick, MD, United States; [2]Molecular Imaging Program, National Cancer Institute,, Bethesda, MD, United States; [3]Division of Computational Bioscience, CIT, National Institutes of Health, Bethesda, MD, United States; [4]Laboratory of Pathology, National Cancer Institute, Bethesda, MD, United States; [5]Urologic Oncology Branch, National Cancer Institute, Bethesda, MD, United States; [6]Molecular Imaging Program, National Cancer Institute, Bethesda, MD, United States

Prostatectomy specimens were processed using the Patient-specific MR-based molds (PSMRM) to improve correlation clinical MR imaging with the histopathology. In this study, we compare *in vivo* and *ex vivo* MRI of the prostate to evaluate performance of the PSMRM. The volume and surface area were measured to quantitatively evaluate fit of the specimen in the mold, while an experience radiologist performed radiology evaluation. Prostate volume shrinkage ranged from 2-25%, but we could observe good correlation between the *in vivo* and *ex vivo* MRI for most cases.

15:00 ***4787*. MRI of Prostate Patients in the Radiotherapy Treatment Planning Position**

Scott Hanvey[1], John Foster[2]

[1]Radiotherapy Physics, Beatson West of Scotland Cancer Centre, Glasgow, Lanarkshire, United Kingdom; [2]MRI Physics, Beatson West of Scotland Cancer Centre, Glasgow, United Kingdom

Accurate localisation of the planning target volume (PTV) is vitally important in radiotherapy. The excellent soft tissue contrast of magnetic resonance imaging (MRI) makes it an ideal imaging modality for radiotherapy of the prostate. Registration of MRI with CT can be problematic since the MRI table is not generally flat. The following study compared the accuracy of the registration of MRI with CT in 20 prostate patients receiving an MRI in the typical curved table and on a specially designed flat table. It also measured the PTVs of patients in the normal and radiotherapy position in MRI.

Cancer Cells & Biopsies

Hall B Monday 14:00-16:00 Computer 106

14:00 ***4788*. Activation of Choline Kinase and Phospholipase C in HDAC Inhibition**

Christopher S. Ward[1], Judy Hwang[1], Sabrina M. Ronen[1]

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

The aim of this study is to examine the modulation of choline metabolism by SAHA through a combination of magnetic resonance spectroscopy and enzymatic studies. This study confirmed previous findings of increased choline-related metabolites following HDAC inhibition, while providing new insight into the underlying mechanism. HDAC inhibition was associated with increases in choline kinase and phosphatidylcholine-specific phospholipase C activities, suggesting phosphocholine levels are elevated as a result of upregulation in both synthesis and catabolism.

14:30 ***4789*. Choline Metabolism in Basal-Like and Luminal-Like Breast Cancer Xenografts Respond Differently to Doxorubicin and Bevacizumab Treatment**

Siver Andreas Moestue[1], Else Marie Huuse[1], Evita Lindholm[2], Beathe Sitter[1], Gunhild Mari Mælandsmo[2], Olav Engebråten[2], Ingrid Susann Gribbestad[1]

[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway; [2]Department of Tumor Biology, Institute for Cancer Research, Oslo, Norway

Using HR MAS MRS, the changes in choline metabolite concentrations in xenograft models of luminal-like and basal-like breast cancer were studied following treatment with bevacizumab and/or doxorubicin. The choline metabolism in the two models responded differently to the treatments.

15:00 ***4790*. Fluorothymidine as a Therapeutic Response Marker of the Investigational Anticancer Agent RAF265: Insights from ^{19}F-NMR and Flow Cytometry**

Andy Dzik-Jurasz[1], Melissa Lin[2], Kathleen Dohoney[3], Jason McCormick[4], Mary Ising[4], Darrin Stuart[5], Diana Jespersen[4]

[1]Oncology Translational Medicine, Novartis Pharmaceuticals Corporation, Inc, Florham Park, NJ, United States; [2]Novartis Pharmaceuticals Corporation, Inc, NJ, United States; [3]Novartis Institutes for Biomedical Research, Inc, Cambridge, MA, United States; [4]Oncology Translational Medicine, Novartis Pharmaceuticals Corporation, Inc, East Hanover, NJ, United States; [5]Novartis Institutes for Biomedical Research, Inc, Emeryville, CA

Fluorothymidine is used as an index of cellular proliferation in studies of therapeutic response. We used 19F-NMR to follow signal changes in cell extracts of the melanoma cell line A375M incubated with 19F-fluorothymidine and the investigational anticancer agent RAF265. Flow cytometry was used to characterize differences in cell cycle profile, count and apoptosis. A 19F-resonance tentatively assigned to a phosphate metabolite of fluorothymidine demonstrated a lower intensity in the treatment group and flow cytometry reporting a drop in the proportion of metabolically active cells exposed to drug. This approach could be used to explore the cellular changes influencing fluorothymidine signal.

15:30 ***4791*. Dichloroacetate Treatment Resulted in a Dramatic Drop in the Conversion of Hyperpolarised 1-13C Labelled Pyruvate to Lactate in Human Colon Carcinoma Cells**

Yuen-Li Chung[1], Helen Troy[1], Ian R. Judson[2], John R. Griffiths[3], Martin O. Leach[1], Thomas R. Eykyn[1]

[1]CR-UK and ESPRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]CR-UK Centre for Cancer Therapeutics, Institute of Cancer Research, Sutton, Surrey, United Kingdom; [3]Cancer Research UK Cambridge Research Institute, Cambridge, United Kingdom

Dichloroacetate (DCA) is a pyruvate dehydrogenase kinase (PDK) inhibitor and is found to be an anti-cancer agent. The aim of this work was to study the mechanism of action of DCA and to develop a non-invasive biomarker for response following PDK inhibition. DCA treatment caused G1 arrest and a dramatic drop in the conversion of hyerpolarised 13C-labelled pyruvate to lactate. 1H-MRS of the culture media of DCA-treated cells also showed a reduction in steady state eupolarised lactate production and increased alanine uptake. These changes have potential as non-invasive biomarkers of drug action. DCA treatment also altered phospholipid metabolism, which could provide further biomarkers of response.

Tuesday 13:30-15:30 Computer 106

13:30 ***4792*. Creatine and N-Acetylaspartate Concentrations Are Associated with P53 Status in Astrocytoma**

Tracy Richmond McKnight[1], Kenneth J. Smith[1], Susan Chang[2], Mitchel S. Berger[2]

[1]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States; [2]Neurological Surgery, UCSF, San Francisco, CA

Abnormal function of p53 protein may result in compromised DNA repair and reduced apoptosis leading to increased tumor density and resistance to DNA-damaging therapies. We hypothesized that a downstream function of p53 might be an alteration in cell metabolism. We compared the HRMAS MRS profile of astrocytoma with normal (p53wt) and abnormal (p53ab) p53. Cre and NAA were lower and cell density was higher in p53ab tumors. No correlations were observed between any of the IHC and metabolic parameters. These findings suggest that p53 may influence the energy production and cell density of astrocytoma; however, the exact mechanisms remain unclear.

14:00 ***4793*. MS-275 and Letrozole Treatments Inhibit Tumor Growth and Reduce Phosphomonoesters in Triple Negative MDA-MB-231 Tumors**

Tariq Shah[1], Nguyen Nguyen[2], Sara Sukumar[2], Zaver M. Bhujwalla[1]

[1]JHU ICMIC Program, Russell H Morgan Department of Radiology and Radiological Sciences, Johns Hopkins School of Medicine , Baltimore, MD, United States; [2]Breast Cancer Program, Sidney Kimmel Comprehensive Cancer Center , Johns Hopkins School of Medicine, Baltimore, MD, United States

The absence of ER/PR/Her-2/neu receptors in triple negative breast cancers makes them difficult to treat. Histone deacetylase (HDAC) inhibitors have been found to re-express the estrogen receptor (ER). Combining an HDAC inhibitor with hormonal treatment is therefore an attractive choice for triple negative breast cancers. Here we have investigated the effect of the HDAC inhibitor MS-275, the aromatase inhibitor letrozole that suppresses estrogen, and their combination in vivo in a triple negative human breast cancer xenograft using proton and phosphorus MR spectroscopy. We observed a significant reduction of choline metabolites following HDAC inhibition and combined HDAC and aromatase inhibition.

14:30 **_4794_. Bax-Deficiency Reduces Glycolysis and Alters Metabolic Profile in Human Colorectal Carcinoma Cells**

Gigin Lin[1], Dow-Mu Koh[1], Simon P. Robinson[1], Paul Clarke[2], Martin O. Leach[1], Yuen-Li Chung[1]

[1]Cancer Research UK and EPSRC Cancer Imaging Centre, Institute of cancer research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]Cancer Research UK Centre for Cancer Therapeutics, Institute of cancer research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom

Bax, a Bcl-2 family protein, plays a central role in regulating apoptosis pathways thus being a major determinant of tumour cellsÕ fate in response to cancer therapy. 4% of human colorectal carcinoma Hct116 cells are Bax-deficient and are known to be resistant to chemotherapy and TRAIL-induced apoptosis. However, there is little information available on the metabolic effects of Bax-deficiency in colorectal carcinoma cells. We designed a 1H NMR based metabolomics study of isogenic wild type (WT) and Bax-deficient (KO) colorectal carcinoma cells, to examine the metabolic effects of Bax-deficiency in cancer cells. Many metabolic adaptations, including glycolysis, glutaminolysis, serine/purine synthesis and metabolism were found in Bax KO cells when compared with WT cells. This study indicates the functional diversity of Bax-deficiency on colorectal carcinoma Hct116 cells.

15:00 **_4795_. Identification of Signals from Glycosylation Precursors in ^{1}H MR Spectra of Intact Tumour Cells**

Sveva Grande[1], Alessandra Palma[1], Anna Maria Luciani[1], Laura Guidoni[1], Antonella Rosi[1], Vincenza Viti[1]

[1]Dipartimento di Tecnologie e Salute, Istituto Superiore di Sanità and INFN, Roma, Italy

The glycosylation process, either in the secretory pathway or in the nucleocytoplasmatic compartment, is a major post translation modification of proteins. MRS is a technique able to observe cell metabolites directly in intact cells. Carbohydrate metabolism is not fully exploited with this technique in intact systems. In a previous study we identified some relevant signals of glycosylation precursors in the low field region in intact tumor cells spectra. The present study deals with identification of signals from GalNAc in a cancer cells from adenocarcinoma of the human cervix. Treatment of cells with ammonium chloride allowed confirming signal assignment.

Wednesday 13:30-15:30 Computer 106

13:30 **_4796_. 1H HRMAS NMR Based Metabolomics of Benign and Malignant Neuro-Endocrine Tumors and Its Comparision with Oral Cancer and Benign Gall Bladder Tissues**

Shatakshi Srivastava[1], Raja Roy[1]

[1]CBMR, Centre of Biomedical Magnetic Resonance, Lucknow, Uttar Pradesh, India

A comprehensive metabolic profiling of malignant and non-malignant tumors of neuro-endocrine system alongwith tumors present in other parts of body has been performed using 1H HRMAS NMR spectroscopy. The contributions of small metabolites in each kind of tumor define the mechanisms, which are critical to cellular function of a particular tissue. This may provide a better understanding of biochemical alterations in each tissue and thus, may open novel avenues of therapeutic interventions for various cancers.

14:00 **_4797_. Metabolite-Metabolite Correlation Maps: A Novel Method to Understand Metabolic Pathways**

Basetti Madhu[1], Alexandra Jauhiainen[2], Masako Narita[3], Simon Tavaré[2], Masashi Narita[3], John R. Griffiths[1]

[1]Molecular Imaging, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom; [2]Bioinformatics, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom; [3]Cellular Senescence and Tumour Suppressor Lab, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom

Metabolomics studies the global metabolites in a cell, tissue or organism, and plays a vital role in understanding the cellular phenotype, and novel bioinformatic methods such as metabolite-metabolite correlation analysis are being developed to analyse the data. ^{1}H NMR is a useful method for obtaining metabolic profiles from cell or tissue extracts. We have recently developed a novel method of metabolite-metabolite correlation maps derived from 1H NMR based metabolomics data. These correlation maps are helpful in understanding the perturbed metabolic pathways in the cells due to the gene modifications, enzymatic modulations (inhibition/over-expression), toxic and/or drug effects and nutrient supply.

14:30 **_4798_. NMR Molecular Profiling of High Grade Human Glioma Reveals Distinct Metabolic Subgroups**

Jose Manuel Morales[1], Ana Gonzalez-Segura[2], Jose Gonzalez-Darder[3], Concha Lopez-Gines[1], Miguel Cerda-Nicolas[1], Daniel Monleon[4]

[1]Universitat de Valencia, Valencia, Spain; [2]CIBER-BBN, Valencia, Spain; [3]Hospital Clinico Universitario de Valencia, Valencia, Spain; [4]Fundacion Investigacion Hospital Clinico Valencia, Valencia, Spain

GBM and AA are neoplasic entities of the CNS, with high biological and clinical aggressiveness. Metabolic phenotyping of high grade glioma may provide new information for better management of this disease. In this communication, we show high grade glioma molecular profiles and metabolic subgroups based on HRMAS spectra of 31 high grade glioma biopsies. One of the subgroups, which includes most AA samples, reflects a less aggressive type of tumour with lower levels of phosphocholine. Metabolic discrimination between these subgroups according to the PCA, include the levels of some metabolites which can be seen by MRS 'in vivo'.

15:00 **4799. Phosphocholine/Glycero-Phosphocholine Ratio Is a Potential Marker for Cellular Senescence**

Basetti Madhu[1], Masako Narita[2], Masashi Narita[2], John R. Griffiths[1]
[1]Molecular Imaging, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom; [2]Cellular Senescence and Tumour Suppressor Lab, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom

Senescence, a permanent cell cycle arrest, is thought to be a fail-safe mechanism that prevents the malignant transformation of cells; as a tumour-suppressing mechanism it shares conceptual and therapeutic similarities with the apoptosis machinery. SA-β-gal activity, elevated p53 and p16 protein levels, coupled with morphological changes are used as senescence markers, though reliable metabolic markers for senescence are still required. We present a ^{1}H NMR based metabolomics study of senescence induced by oncogenic Ras or MEK, or by prolonged replication, compared with growing, transformed, and quiescent cells. The data shows that phosphocholine/glycerophosphocholine ratio is a potential metabolic marker for cellular senescence.

Tumor Perfusion & Permeability

Hall B Monday 14:00-16:00 Computer 107

14:00 **4800. The Influence of Cardiac Frequency on the Properties of the Arterial Input Function (AIF) and Computed DCE-MRI Parameter Values**

Rickmer Braren[1], Yvonne Kosanke[1], Jonas Svensson[2], Ernst Rummeny[1], Andreas Steingoetter[1]
[1]Institute of Radiology, Klinikum rechts der Isar der TU München, Munich, Germany; [2]Department of Medical Radiation Physics, Malmo University Hospital, Lund University, Malmo, Sweden

DCE-CT in combination with standard MR contrast agent allows the determination of rat population AIF. This study analyzed the impact of cardiac frequency on AIF properties detected in the rat abdominal aorta and the accompanied changes in DCE-MRI parameter values. Different anesthesia induced a change of ~100 bpm in cardiac frequency which resulted in different AIF bolus shape, recirculation and washout. These in turn induced systematic errors in tumor and muscle Ktrans of 15% or 36%, respectively. In longitudinal therapy response studies, where systemic changes, due to drug treatment, are very likely to occur this phenomenon must thoroughly be considered.

14:30 **4801. Histological Validation of the Cerebral Blood Volume Quantification in a C6 Brain Tumor Model Using RSST1-MRI with an Intravascular Contrast Agent: Gd-ACX**

Adriana-Teodora Perles-Barbacaru[1,2], Boudewijn Van der Sanden[3], Régine Farion[1], Christoph Segebarth[1], Hana Lahrech[1]
[1]Functional and Metabolic Neuroimaging, Grenoble Institute of Neuroscience, Grenoble, France; [2]Caltech Brain Imaging Center, Beckman Institute, Pasadena, CA, United States; [3]Rayonnement Synchrotron et Recherche Médicale, Grenoble Institute of Neuroscience, Grenoble, France

The cerebral blood volume fraction (CBVf) quantification by MRI remains complex in the tumor due to the contrast agent (CA) leakage through the blood brain barrier. Gd-ACX (α-cyclodextrin complexed to gadolinium), a novel CA was shown to remain in the vascular space in a C6 brain tumor model and was used for CBVf mapping in microvasculature permeable for Gd-DOTA. Here, the use of Gd-ACX for tumor CBVf quantification was validated using histological vascular morphometry. After selecting the tumor vessels perfused by the Hoechst dye, we found a quantitative equivalence for the CBVf obtained by MRI and by vascular morphometry.

15:00 **4802. Effects of Reference Tissue AIF Derived from Low Temporal Resolution DCE-MRI Data on Pharmacokinetic Parameter Estimation**

Marieke Heisen[1], Xiaobing Fan[2], Johannes Buurman[3], Bart M. ter Haar Romeny[1]
[1]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands; [2]Radiology, The University of Chicago, Chicago, IL, United States; [3]Healthcare Informatics, Philips Healthcare, Best, Netherlands

Quantitative pharmacokinetic analysis of dynamic contrast enhanced (DCE) MRI clinical data is important for detection and diagnosis of cancer. For breast imaging, however, data is often acquired at low temporal resolution to enable high-spatial resolution coverage of both breasts. The effect of arterial input functions derived from low temporal resolution data on estimation of Ktrans and ve was investigated by downsampling high temporal resolution pre-clinical data in k-space. The results demonstrate that using a reference tissue AIF extracted from low temporal resolution data (till T ¡Ö 60 s) is feasible and could be used to quantitatively analyze DCE-MRI data.

15:30 **4803. Dynamic Contrast-Enhanced (DCE)-MRI with Gadobutrol for Monitoring Sorafenib Effect on Experimental Prostate Carcinomas**

Clemens Christian Cyran[1], Philipp Marius Paprottka[1], Bettina Schwarz[2], Jobst von Einem[1], Steven Sourbron[1], Olaf Dietrich[1], Rabea Hinkel[3], Christiane J. Bruns[2], Hubertus Pietsch[4], Bernd J. Wintersperger[1], Maximilian F. Reiser[1], Konstantin Nikolaou[1]
[1]Institute of Clinical Radiology, Munich University Hospitals - Campus Grosshadern, Munich, Germany; [2]Department of Surgery, Munich University Hospitals - Campus Grosshadern, Munich, Germany; [3]Department

of Cardiology, Munich University Hospitals - Campus Grosshadern, Munich, Germany; [4]Contrast Media Research, Bayer Schering Pharma AG, Berlin, Germany

The purpose of this study was to investigate the effects of Sorafenib on experimental prostate carcinomas in rats by dynamic MRI enhanced with Gadobutrol. Target parameters were tumor perfusion and tumor endothelial permeability. Tumor perfusion (ml/100ml/min), assayed by DCE-MRI enhanced with the small molecular contrast medium Gadobutrol, decreased significantly ($p<0.01$) in experimental prostate carcinomas treated with a daily, one-week treatment course of Sorafenib (10mg/kg bodyweight). In the control group, tumor perfusion increased significantly ($p<0.05$) over the experimental course of 7 days. No significant change was observed regarding the endothelial permeability in tumors, neither in the therapy nor in control group.

Tuesday 13:30-15:30 Computer 107

13:30 ***4804*. Assessment of Tumor Microvasculature by a Kinetic Model Independent DCE-MRI Method Using a High Molecular Weight Contrast Agent**

Wenlian Zhu[1], Yoshinori Kato[1], Shruthi Shankar[1], Zaver Bhujwalla[1], Dmitri Artemov[1]
[1]ICMIC Program, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States

The goal of this study is to identify a DCE-MRI method that can minimize the effect of water exchange and blood flow on the assessment of tumor microvasculature. This was achieved with a 3D FLASH method using a short recovery delay, a high flip angle, and non selective saturation pulses followed by crusher gradients. Such method can help to establish a reliable method to monitor tumor vascular response to therapy. Preliminary results are reported for a preclinical breast cancer model treated with bevacizumab.

14:00 ***4805*. Is It "Safe" to Use a Population Arterial Input Function for DCE-MRI in Mice?**

Mary E. Loveless[1,2], Jane Halliday[3], Carsten Liess[4], Lei Xu[5], Richard Dortch, [2,6], Jennifer Whisenant, [2,7], John C. Waterton[4], John C. Gore, [2,6], Thomas E. Yankeelov, [2,6]
[1]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States; [2]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [3]Imaging, Translational Sciences, AstraZeneca, Macclesfield , Cheshire, United Kingdom; [4]Imaging, Translational Sciences, AstraZeneca, Macclesfield, Cheshire, United Kingdom; [5]Biostatistics, Vanderbilt University, Nashville, TN, United States; [6]Radiology and Radiological Science, Vanderbilt University, Nashville, TN, United States; [7]Chemical & Physical Biology, Vanderbilt University, Nashville, TN, United States

In the quantitative analysis of DCE-MRI data, the contrast agent concentration time course in the blood plasma (AIF) is required. In this study we compare parameters resulting from two common DCE-MRI models driven by both individual and population derived AIFs in mice for two different contrast agents, Gd-DTPA and P846. The goal is to determine how the individual and population AIF derived parameters compare and how this affects the number of animals that would be needed in a given study.

14:30 ***4806*. Structural Spectroscopic Analysis of Tumor Vasculature Before and After Contrast Agent Administration to Mice**

Gilberto S. Almeida[1,2], Ian Wilson[1,2], Lance Farr[3], Ross J. Maxwell[1,2]
[1]Northern Institute for Cancer Research, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [2]Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, Tyne and Wear, United Kingdom; [3]Osteotronix Ltd, Swansea, United Kingdom

The aim of this study was to estimate the dimensions of vascular features in animal tumour models (HT29 colon carcinomas in mice) using a combination of structural spectroscopy analysis and contrast agent uptake. Structural spectroscopy data were acquired from rectangular prisms across the tumour using a one-dimensional spin-echo pulse sequence at 7T. The signal profiles were analyzed to determine the size distribution of the anatomical elements of interest before and 10 min after injection of gadoteridol. There was a clear difference in the intensity of structural features (dimensions 10-20 mm-1) after injection of contrast agent.

15:00 ***4807*. Radial Multi Gradient Echo DCE-MRI for 3D K^{trans} Mapping with Individual AIF Measurement in Mouse Tumor Models**

Julien Vautier[1,2], Christine Walczak[1,2], Nadine El Tannir El Tayara[1,2], Andreas Volk[1,2]
[1]U759 INSERM, Orsay, France; [2]Institut Curie, Orsay, France

This study presents proof of concept for a new 3D radial DCE-MRI technique well adapted to preclinical studies of microvasculature in mouse tumor models experiencing respiratory motion. The technique measures R_2*-corrected R_1 (t). It is based on an interleaved 2D and 3D radial multi gradient echo acquisition to provide simultaneously the AIF on the heart at high temporal resolution (2s) and 3D data on the tumor at a lower time resolution (2min). 3D K^{trans} maps were obtained in colorectal tumor xenografts subcutaneously implanted at the abdominal level.

Wednesday 13:30-15:30 Computer 107

13:30 ***4808*.** **Prediction of Disease Specific Survival in Patients with Head and Neck Cancer Using Dynamic MRI**

Sanjeev Chawla[1], Sungheon Kim[2], Laurie A. Loevner[1], Harry Quon[3], Wei T. Hwang[4], G Weinstein[5], A Chalian[1], Harish Poptani[1]

[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Radiology, New York University, New York, NY, United States; [3]Radiation Oncology, University of Pennsylvania, Philadelphia, PA, United States; [4]Biostatistics, University of Pennsylvania, Philadelphia, PA, United States; [5]Otorhinolaryngology, University of Pennsylvania, Philadelphia, PA, United States

We evaluated the potential of pretreatment volume transfer constant (Ktrans) from DCE-MRI in predicting disease specific survival in patients with squamous cell carcinomas of head and neck. Sixty-six patients underwent chemo-radiation therapy and were followed up clinically (median follow up time for the surviving patients was 24.0 months). Pretreatment median Ktrans was used as threshold value to separate patients into two groups (above and below the threshold value). The survival for patients with higher pre-treatment Ktrans was significantly prolonged compared to patients with lower Ktrans value indicating that Ktrans can be used to predict survival outcome in these patients.

14:00 ***4809*.** **Quantitative Correlation of Volume Transfer Coefficient Ktrans with Histopathologic Grades of Gliomas**

Na Zhang[1,2], Zhengsheng Deng[2], Li Meng[3], XiaoYi Wang[3], Weihua Liao[3], Bob L. Hou[4]

[1]Paul C. Lauterbur Research Center for Biomedical Imaging,Paul C. Lauterbu, Chinese Academy of Science , Shenzhen, Guangdong, China; [2]1Institute of Biomedical Engineering, School of Info-physics and Geomatics Engineering,, Central South University, Changsha, Hunan, China; [3]Department of Radiology, XiangYa Hospital of School of Medicine, Central South University, Changsha, Hunan, China; [4]Radiology, West Virginia University, Morgantown, WV, United States

The breakdown of blood-brain barrier (BBB) in gliomas results in the increment of microvascular permeability: a surrogate marker to assess malignant degree of gliomas. The volume transfer coefficient of contrast agent (CA) from plasma space to extravascular extracellular space (EES), as defined Ktrans, has been used to characterize the microvascular permeability quantitively. Since knowing the grades of gliomas for administration of the tumor treatments is very important, and there were only few reports for applying T1 perfusion MRI data for evaluating grades of glioma, in current study we presented the results of correlation of Ktrans and histopathologic grades of gliomas by using the T1-weighted dynamic contrast enhancement magnetic resonance imaging (DCE-MRI) method and a modified Tofts' model, and also investigated to apply Ktrans, Kep, Kel, Ve, and Vp obtained from the T1 perfusion data analyses for evaluating grades of the gliomas.

14:30 ***4810*.** **Diffusion-Weighted MRI and Dynamic Contrast-Enhanced MRI of Bladder Cancer at 3T**

Huyen Thanh Nguyen[1,2], Guang Jia[1], Zarine Shah[1], Mitva Patel[1], Peter Wassenaar[1], Steffen Sammet[1], Amir Mortazavi[3], Karmal Pohar[4], Cathy Mojzisik[1], Michael Knopp[1]

[1]Department of Radiology, The Ohio State University, Columbus, OH, United States; [2]Biophysics Program, The Ohio State University, Columbus, OH, United States; [3]Department of Internal Medicine, The Ohio State University, Columbus, OH, United States; [4]Department of Urology, The Ohio State University, Columbus, OH, United States

This on-going study evaluates the ability of Diffusion-Weighted MRI (DWI) and Dynamic Contrast-Enhanced MRI (DCE-MRI) to diagnose bladder tumors and the consistency between the two sequences. Preliminary results from this study show that DWI and DCE-MRI are effective to detect bladder cancer. With these promising preliminary results, the combination can be continued to study the alteration of tumor characteristics after neoadjuvant therapy and the most importantly to help stage bladder tumors. In addition, DWI performed with high b-factors can be supportive to the differentiation of bladder tumors from surrounding tissues.

15:00 ***4811*.** **Quantitative Osteosarcoma DCE-MRI: How Long Is the Acquisition Time Necessary?**

Ya Wang[1], Wei Huang[2], David M. Panicek[1], Laurence H. Schwartz[1], Jason A. Koutcher[1]

[1]Memorial Sloan Kettering Cancer Center, New York, NY, United States; [2]Oregon Health & Science University, Portland, OR, United States

Based on actual Ktrans and Ve values from 18 osteosarcoma patients, simulated DCE-MRI time-courses were reconstructed with varying scan time length to estimate minimal acquisition time needed to derive accurate and stable pharmacokinetic parameters. The results suggest that for typical osteosarcoma necrosis percentage range, 5 min DCE-MRI scan time is adequate.

Thursday 13:30-15:30 Computer 107

13:30 ***4812*.** **Defining Adequate Complexity of Compartment Models in DCE-MRI**

Julia Catarina Kärcher[1], Volker Johann Schmid[1]

[1]Department of Statistics, Ludwig-Maximilians-University, Munich, Germany

Standard one compartment models used for the quantitative analysis of concentration time series in DCE-MRI fail in modeling heterogeneity. We propose a model with two tissue compartments that accounts for heterogeneity within voxels and thus more

appropriately describes the uptake behavior at tumor margins. We propose a model selection criterion that accounts for the adequacy both of model fit and of model complexity. DCE-MRI scans from breast cancer data are evaluated with the proposed model selection criterion per voxel: at tumor margins the proposed two tissue compartment model outperforms the standard one compartment model.

14:00 ***4813*. Cross-Visit Tumour Sub-Segmentation May Reveal Localised Response to Anti-Angiogenic Treatment in DCE-MRI Data**

Giovanni Alessandro Buonaccorsi[1], Caleb Roberts[1], James O' Connor[1], Chris Rose[1], Sue Cheung[1], Yvonne Watson[1], Karen Davies[1], Lynn Hope[2], Alan Jackson[1], Gordon Jayson[2], Geoff Parker[3]

[1]Imaging Science and Biomedical Engineering, University of Manchester, Manchester , United Kingdom; [2]Cancer Research UK Dept of Medical Oncology, Christie Hospital, Manchester, United Kingdom; [3]Imaging Science and Biomedical Engineering, University of Manchester, Manchester, United Kingdom

Using DCE-MRI data from four patients enrolled in a trial of a VEGF inhibitor, we performed cross-visit tumour sub-segmentations to obtain cluster volumes and localised cluster VOI statistics for Ktrans. In each tumour a subset of clusters showed statistically significant post-treatment volume changes for at least one visit. Eight of 9 clusters with decreased volume had mean Ktrans > 0.127 min-1. Reduced post-treatment volume in clusters with "high" Ktrans is consistent with reduced volume of actively-angiogenic tumour regions, as would be expected with a VEGF inhibitor. These effects would not be evident when using whole tumour VOI statistics.

14:30 ***4814*. Dynamic Contrast-Enhanced T_1 -Weighted Perfusion MRI Differentiates Tumor Recurrence from Radiation Necrosis: Relative Cerebral Blood Volume Measurements and FDG-PET Validation**

Vibeke Andrée Larsen[1], Helle Juhl Simonsen[2], Ian Law[3], Henrik Pedersen[2], Henrik BW Larsson[2], Adam Espe Hansen[2]

[1]Dept. of Radiology, Glostrup Hospital, University of Copenhagen, Glostrup, Denmark; [2]Functional Imaging Unit, University of Copenhagen, Glostrup Hospital, Glostrup, Denmark; [3]PET and Cyclotron Unit, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark

The use of perfusion MRI for tumor characterization is complicated by the blood brain barrier deficiency. This preliminary study provides evidence that dynamic contrast enhanced T_1 weighted perfusion imaging can distinguish radiation-induced necrosis from tumor recurrence. We studied 9 patients after radiation treatment for gliomas and the results were validated with the FDG-PET gold standard. For 10 contrast enhancing lesions, 2 metabolically inactive lesions had relative cerebral blood volume (rCBV) of less than 1.7, whereas 8 active lesions had rCBV greater than 2.0.

15:00 ***4815*. Relationship Between VEGF Receptor Expression and DCE-MRI Tracer Kinetic Parameters in Advanced Ovarian Cancer**

Caleb Roberts[1,2], Claire L. Mitchell[3], James P. O'Connor, [23], Yvonne Watson[1,2], Sue Cheung[1,2], Alison Backen[4], Caroline Dive[4], Alan Jackson[1,2], Gordon C. Jayson[3], Geoff J. Parker[1,2]

[1]Imaging Science and Biomedical Engineering, School of Cancer and Imaging Sciences, The University of Manchester, Manchester, United Kingdom; [2]The University of Manchester Biomedical Imaging Institute, The University of Manchester, Manchester, United Kingdom; [3]Cancer Research UK Dept Medical Oncology, Christie Hospital and University of Manchester, Manchester, United Kingdom; [4]Clinical and Experimental Pharmacology Group, Paterson Institute for Cancer Research, Manchester, United Kingdom

The integration of imaging strategies such as dynamic contrast-enhanced MRI (DCE-MRI) in early phase drug development can help elucidate the underlying tumor physiology and assess drug efficacy. This study focuses on the relationships between serological expression of soluble VEGF receptors and DCE-MRI tracer kinetic parameters in a group of ovarian tumors. We observe striking relationships between the serological markers, K^{trans} and v_p that indicate that DCE-MRI is sensitive to specific aspects of the angiogenic process in these tumors.

Cancer Preclinical Studies of Animal Models

Hall B Monday 14:00-16:00 Computer 108

14:00 ***4816*. Dynamic Oxygen-Enhanced T1-Weighted MR in Mouse Tumour Xenografts. Comparison Between Oxygen-Enhanced MRI and DCE-MRI.**

Inna V. Linnik[1,2], Neil Woodhouse[3], Marietta Scott[3], Carsten Liess[3], Jean J. Tessier[3], Hervé Barjat[3], Geoffrey J.M. Parker[1,4], John C. Waterton[3,5], Josephine H. Naish[1,4]
[1]Imaging Science and Biomedical Engineering, School of Cancer and Imaging Sciences, University of Manchester, Manchester, United Kingdom; [2]Biomedical Imaging Institute, University of Manchester, Manchester, United Kingdom; [3]Imaging, Translational Sciences, AstraZeneca, Alderley Park, Macclesfield, Cheshire, United Kingdom; [4]Biomedical Imaging Institute, University of Manchester, Manchester, United Kingdom; [5] Biomedical Imaging Institute, University of Manchester, Manchester, United Kingdom

Recent studies have suggested that oxygen-enhanced (OE) MRI can potentially be used for assessing regional changes of oxygen delivery and accumulation in tumours when switching from breathing air to 100% oxygen, based on T1-shortening due to dissolved molecular oxygen. However while many tumours do show the domains with expected R1 increase, we have previously observed regions exhibiting apparent R1 reduction.
The aim of this study was to characterise the R1-increasing and R1-decreasing parcellations in OE-MRI in terms of their DCE-MRI response. DCE-MRI data exhibit high Gd-DTPA uptake in the R1-increasing domains and low contrast uptake - in the R1-decreasing domains.

14:30 ***4817*. Investigating the Effect of Size and Site of Implantation on Tumour Vascular Morphology and Function Using Combined Carbogen USPIO (CUSPIO) Imaging**

Jake Samuel Burrell[1], Jane Halliday[2], Simon Walker-Samuel[3], John C. Waterton[2], Jessica Boult[1], Yann Jamin[1], Lauren C. Baker[1], Simon P. Robinson[1]
[1]The Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]AstraZeneca, Manchester, United Kingdom; [3]UCL, London, United Kingdom

Tumour vascular morphology and function is dependent on both tumour size and site of implantation. Perturbation of tissue R_2* by carbogen gas (95% O2, 5% CO2) breathing, or ultra small paramagnetic iron oxide (USPIO) particle injection offers biomarkers for tumour oxygenation, and blood volume respectively. Using a combined carbogen USPIO imaging protocol, tumour δR_2* during carbogen breathing, and after injection of USPIO particles was found to be significantly different in small and large subcutaneous, and orthotopic PC3 prostate tumours. This has implications when considering both drug delivery, and extent of tumour oxygenation during drug trials

15:00 ***4818*. Non-Invasive Assessment of Vascular Changes in an Animal Model of Breast Cancer Bone Metastases After Treatment with an Integrin Antagonist Using DCE-MRI**

Dorde Komljenovic[1], Maximilian Merz[1], Wolfhard Semmler[1], Tobias Bäuerle[1]
[1]Medical Physics in Radiology, DKFZ, Heidelberg, Germany

Breast cancer frequently metastasizes to the skeleton, resulting in predominantly osteolytic lesions causing pain and fracture. In bone metastases, αvβ3 integrin is significantly up-regulated on activated endothelial cells and recognized as an important factor in bone resorption. Furthermore, αvβ5 integrin is expressed on various breast cancer cells, including the human breast cancer cell line MDA-MB-231. In this study, we have investigated effects of the inhibition of αvβ3 and αvβ5 integrins in bone metastases by employing a small molecule antagonist of this integrin subclass. Further, our aim was to elucidate whether therapeutic effects, visualized and quantified using dynamic contrast enhanced (DCE) magnetic resonance imaging (MRI) and flat panel volumetric computed tomography (VCT), allow early prediction of treatment response in experimental breast cancer bone metastases.

15:30 ***4819*. Monitoring Treatment Response to an Anti-Angiogenic Therapy in Experimental Breast Cancer Bone Metastases Using DWI, DCE-MRI and VSI**

Maximilian Merz[1], Dorde Komljenovic[1], Wolfhard Semmler[1], Tobias Bäuerle[1]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany, Germany

Imaging treatment response of bone metastases is pivotal for clinical practice. The most recent version of the response evaluation criteria in solid tumors (RECIST) recommends measuring the osteolytic bone lesion by CT and the respective soft tissue tumor by MRI. However, changes in morphology and lesion size are usually observed months after the initiation of treatment. In our study we report that non-invasive imaging of tumor cellularity by DWI as well as tumor vasculature by DCE-MRI and VSI serves as an early quantifiable biomarker for the assessment of treatment response to an anti-angiogenic therapy in experimental breast cancer bone metastases.

Tuesday 13:30-15:30 Computer 108

13:30 ***4820*. Multimodality Characterization of a Bone-Metastasis Model**

Dmitri Artemov[1], Kristy L. Weber[2], Yoshinori Kato[1], Wenlian Zhu[1], Zaver M. Bhujwalla[1]
[1]JHU ICMIC Program, The Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Department of Orthopedic Surgery, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

Metastasis is the leading cause of mortality from cancer. For several cancers, the bone is a major site of bulk disease from metastasis. While multimodality imaging of subcutaneous preclinical tumor models are becoming fairly routine, the application of multi-modality imaging to bone-metastasis models is a challenge. However, multi-modality imaging of such models can provide a wealth of information on the microenvironment, vasculature, and metabolism of bone metastasis that can used to improve treatment outcome and identify new strategies for treatment. Here we present multi-modal imaging characterization of a well-established bone metastasis model.

14:00 ***4821*. Towards a Better Understanding of Bone Metastatic Pain: A Multimodal Micro-Imaging Approach**

Louis Dore-Savard[1,2], Luc Tremblay[3,4], Melanie Archambault[3,4], Jean-François Beaudoin[3,4], Nicolas Beaudet[1,2], Eric E. Turcotte[3,4], Roger Lecomte[3,4], Philippe Sarret[1,2], Martin Lepage[3,4]
[1]Physiologie et biophysique, Universite de Sherbrooke, Sherbrooke, Quebec, Canada; [2]Centre des Neurosciences de Sherbrooke, Sherbrooke, Quebec, Canada; [3]Médecine nucléaire et radiobiologie, Universite de Sherbrooke, Sherbrooke, Quebec, Canada; [4]Centre d'imagerie moléculaire de Sherbrooke, Sherbrooke, Quebec, Canada

A better understanding of the mechanisms underlying the genesis of bone cancer pain is clearly needed. We used a multimodal imaging protocol combining μCT and MRI-PET co-registration in a novel murine bone cancer pain model. Interestingly, we consistently detected bone tumor before pain behavior were observable. Moreover, MRI, Na18F and 11C-methionine PET provided us with complementary information allowing the visualization of compensative bone formation, inflammation, tumor metabolism and extensive damage in bone microenvironment. This model and our imaging approach will help the understanding of metastatic bone pain and facilitate the development of improved analgesic therapy.

14:30 ***4822*. Using MRI to Monitor Tumorigenesis in a Murine Model of Melanoma Brain Metastasis**

Amr Morsi[1,2], Evelyn Voura[1,2], Susan Pun[2], Minh Dung Hoang[2], Asad Baig[3], Erik Parker[1], John Golfinos[1], Youssef Zaim Wadghiri[2]
[1]Neurosurgery, NYU langone medical center, NYC, NY, United States; [2]RADIOLOGY, NYU langone medical center, NYC, NY, United States; [3]Radiology, NYU langone medical center, NYC, NY, United States

Our group at NYU medical center tried to establish a murine model of melanoma brain metastasis and implement an MRI protocol to longitudinally follow the metastatic tumor over time which will aid in therapeutic studies. Although the established model spread to unconventional sites (intra-ventricular and meningeal) instead of parenchymal, the MRI studies conducted showed promising results since it echoed the MRI characteristic findings observe in clinical settings.

15:00 ***4823*. Monitoring Metastases in a Mouse Model of Ewings Sarcoma Using DWIBS**

Cornelius Faber[1], Marc Hotfilder[2], Sareeta Kailayangiri[2], Hendrik Kooijman[3], Uta Dirksen[2], Claudia Rössig[2], Volker Vieth[1]
[1]Department of Clinical Radiology, University Hospital Muenster, Muenster, Germany; [2]Department od Pediatric Hematology and Oncology, University Hospital Muenster; [3]Philips Health Care

Diffusion-weighted Whole-body Imaging with Body background signal Suppression (DWIBS) was implemented in a mouse model of Ewings Sarcoma on a clinical 3 T scanner. Metastasis formation could be detected and monitored over a period of four weeks. 3D MIP reconstruction of DWIBS data allowed for fast identification of metastases and provided additional information (ADC) as compared to STIR, T1 and T2 weighted images, supporting a more reliable lesion classification. DWIBS may serve as a valuable asset to the tools for characterizing cancer models in mice.

Wednesday 13:30-15:30 Computer 108

13:30 ***4824*. A Comparative Study of Frequency and Time Domain Data Analysis of HR-MAS ^{1}H NMR Data from *Apc*$^{Min/+}$ Mouse Gut Tumours**

Basetti Madhu[1], Santiago Uribe Lewis[2], Adele Murrell[2], John R. Griffiths[1]
[1]Molecular Imaging, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom; [2]Epigenetics Imprinting, Cancer Research UK Cambridge Research Institute, Cambridge, England, United Kingdom

In this study we compared HR-MAS 1H NMR spectroscopy data of mouse gut tumour tissue biopsies obtained by time domain (ER-QUEST) and frequency domain (LCModel) analysis methods., Our results show that LCModel fitting resulted in either equal or

smaller fractional uncertainties in the estimates of metabolites in comparison to the ER-QUEST method. The LCModel method also showed greater ease and robustness in the fitting of HR-MAS ^{1}H NMR data from the experimental tumours.

14:00 ***4825*****. Correlation Between TCho Peak at H-MRS and Gene Expression of Choline Kinases and Transmembrane Choline Transporters: An Experimental Study on a Rodent Rhabdomyosarcoma Model Using a Standard 3T Clinical Imager**

Denis Rommel[1], Frank Peeters[2], Jorge Abarca-Quinones[2], Christine De Saeger[3], Isabelle Leclercq[3], Thierry Duprez[1]
[1]Radiology, Université Catholique de Louvain, Brussels, Belgium; [2]Radiology, Université Catholique de Louvain, Belgium; [3]Gastro-enterology, Université Catholique de Louvain, Brussels, Belgium

We investigated which from transmembrane choline transporters and choline kinases had the most prominent role in the elevation of the tCho peak at H-MRS using a rodent rabdomyosarcoma model. tCho peak was quantified as the area under the curve at 3.2 ppm obtained on a 3T clinical system, and gene expression was quantified by PCR after reverse transcription into cDNA using standard ΔCt calculations with reference to RPL19 gene expression. The prominence of the choline kinase α expression versus that of the transmembrane choline transporters was strongly suggested by the statistical analysis.

14:30 ***4826*****. Characterization of Two High Grade Human Oligodendroglioma Mouse Models Using ^{1}H MRSI**

Bob C. Hamans[1], An Claes[2], William P. Leenders[2], Arend Heerschap[1]
[1]Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands; [2]Pathology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Here we characterize two human oligodendroglioma xenograft models by their metabolic profile using ^{1}H MRSI and compare the findings to previously published human oligodendroglioma data. Particular metabolic differences were observed between the xenograft oligodendroglioma lines indicating the possibility to differentiate high to low grade glioma in these models using ^{1}H MRSI.

15:00 ***4827*****. 1H MRS Metabolite Profiles of Medulloblastomas in Transgenic SMO Mice**

Khan S. Hekmatyar[1], Martin Wilson[2], Neil Jerome[3], Julian L. Griffin[4], Andrew Peet[2], Risto A. Kauppinen[1]
[1]Radiology, Dartmouth Medical School, Hanover, NH, United States; [2]University of Birmingham, United Kingdom; [3]Dartmouth Medical School, United States; [4]Biochemistry, University of Cambridge, United Kingdom

Aberrant hedgehog signaling is implicated in generation of human medulloblastomas. We have used smoothened receptor (SMO) transgenic mice with high incidence of spontaneous medulloblastomas to characterize 1H MRS metabolic profiles in tumours with known molecular pathology. Medulloblastomas in the SMO mice showed very low NAA, low GABA and myo-inositol and high taurine, total cholines, scyllo-inositol and glycine. It appears that taurine, cholines and scyllo-inositol are potential common MRS biomarkers for medulloblastomas, whereas myo-inositol, GABA and glycine may be more associated with aberrant SMO signaling in medulloblastomas.

Thursday 13:30-15:30 Computer 108

13:30 ***4828*****. Investigating δR_1 and δR_2* as Biomarkers of Tumour Oxygenation**

Jake Samuel Burrell[1], Jane Halliday[2], Simon Walker-Samuel[3], John C. Waterton[2], Jessica Boult[1], Yann Jamin[1], Lauren C. Baker[1], Simon P. Robinson[1]
[1]The Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]AstraZeneca, Manchester, United Kingdom; [3]UCL, London, United Kingdom

Carbogen-induced changes in R_1, sensitive to dissolved paramagnetic molecular oxygen in the blood, and R_2*, dependent on paramagnetic deoxyhaemoglobin, were determined in the same murine GH3 prolactinomas. Carbogen significantly increased R_1 and reduced R_2* in all tumours. A weak yet statistically significant positive correlation was determined between δR_1 and δR_2*. Tumour regions exhibiting a large reduction in R_2* yet small δR_1 may indicate hypoxic tumour tissue. The combined use of δR_1 and δR_2* may prove more informative for the assessment of tumour hypoxia.

14:00 ***4829*****. Evaluation and Immunohistochemical Qualification of Carbogen-Induced δR_2* as a Non-Invasive Imaging Biomarker of Improved Tumour Oxygenation**

Lauren CJ Baker[1], Jessica K.R. Boult[1], Yann Jamin[1], Lesley D. McPhail[1], Simon Walker-Samuel[1], Jake S. Burrell[1], Margaret Ashcroft[2], Franklyn A. Howe[3], John R. Griffiths[4], James A. Raleigh[5], Albert J. van der Kogel[6], Simon P. Robinson[1]
[1]The Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]University College London, London, United Kingdom; [3]St. George's, University of London, London, United Kingdom; [4]Cambridge Cancer Institute, Cambridge, United Kingdom; [5]University of North Carolina, Chapel Hill, United States; [6]University of Nijmegen Medical Centre, Nijmegen, Netherlands

The transverse relaxation rate R_2* (s^{-1}) of GH3 prolactinomas was quantified whilst the host breathed air and subsequently carbogen (95%O_2/5%CO_2), and the data compared with quantitative immunohistochemical analysis of uptake of two hypoxia markers, CCI-103F, administered whilst the host breathed air, and pimonidazole, administered during subseqent carbogen breathing, within the same tumour. A significant reduction in R_2* with carbogen breathing was associated with a significant reduction in pimonidazole staining, providing further validation of carbogen-induced δR_2* as a non-invasive imaging biomarker of increased tumour oxygenation.

14:30 ***4830***. **Gas-Challenge Blood Oxygen Level Dependent (BOLD) MRI for Quantitative Assessment of Tumor Necrosis in Rodent Hepatoma Model**

Yang Guo[1], Ning Jin[1,2], Rachel Klein[1], Guang-Yu Yang[3], Reed Omary[1,2], Andrew Larson[1,2]
[1]Department of Radiology, Northwestern University, Chicago, IL, United States; [2]Department of Biomedical Engineering , Northwestern University, Chicago, IL, United States; [3]Department of Pathology, Northwestern University, Chicago, IL, United States

Assessment of tumor necrosis is important for evaluating tumor treatment response. Gas-challenge (GC) blood oxygen level dependent (BOLD) MRI may permit tissue characterization without the need for exogenous contrast agents. For our study, we tested the feasibility of using GC-BOLD MRI to assess tumor necrosis fraction and compare to reference standard histological measurements in a rodent N1-S1 hepatoma model and found a significant positive correlation between gold-standard histology and GC-BOLD measured necrotic fraction. GC-BOLD MRI might serve as a non-invasive surrogate for early assessment of therapy response (prior to conventional anatomic size changes).

15:00 ***4831***. **In Vivo Measurement of Tumor Oxygen Consumption by 19F-MRI Relaxometry**

Caroline Diepart[1], Julie Magat[1], Bénédicte Jordan[1], Bernard Gallez[1]
[1]UCL, Brussels, Belgium

In this study, we developed a method based on 19F-MRI relaxometry for mapping the oxygen consumption in tumors. The protocol was based on the measurement of pO2 during a carbogen challenge protocol. The hyperthyroid mice provided ideal models with tissues presenting differences in oxygen consumption rates. The histogram of the 19F MRI data showed a shift to the higher oxygen consumption rates for the hyperthyroid tumors. For each tumor, we obtained a color map created from the 19F MRI data, reflecting the heterogeneity in oxygen consumption. 19F-MRI relaxometry allows the non invasive mapping of the oxygen consumption in tumors.

Tumor Therapy Response: Preclinical & Clinical

Hall B Monday 14:00-16:00 Computer 109

14:00 ***4832***. **Two Vascular Disrupting Agents at a Clinically Equivalent Dose on Rodent Liver Tumors: Comparison of Therapeutic Outcomes with Multiple MRI Biomarkers**

Huaijun Wang[1], Junjie Li[1], Feng Chen[1], Frederik De Keyzer[1], Jie Yu[1], Yuanbo Feng[1], Yansheng Jiang[1], Guy Marchal[1], Yicheng Ni[1]
[1]Department of Radiology, Catholic University of Leuven, Leuven, Vlaams Brabant, Belgium

This study aimed to compare tumoricidal events after 2 lead vascular- targeting-agents (VDAs), Combretastatin-A-4-phosphate (CA4P) and ZD6126 at a clinically-equivalent-dose (CED) in tumors with multiple MRI biomarkers correlated with postmortem microangiography and histopathology. Rhabdomyosarcomas in rat liver were treated with either VDA. Therapeutic outcomes were evaluated morphologically and functionally with 1.5T-MRI. Diffusion-weighted-imaging and dynamic-contrast-enhanced-MRI successfully monitored vascular-shutdown at 1h after VDA treatment, prior to the advent of morphological change of tumor size at 120h, which was verified with postmortem techniques. CED of CA4P has longer vascular-shutdown effect until 48h than ZD6126, leading to significantly different tumor growth delay at 120h.

14:30 ***4833***. **Evaluation of the Effect of Anti-Angiogenic Therapy on Tumor Vasculature in Breast Cancer Mouse Xenograft**

Yoshinori Kato[1], Wenlian Zhu[1], Shruthi Shankar[1], Venu Raman[1], Susanta K. Sarkar[2], Zaver M. Bhujwalla[1], Dmitri Artemov[1]
[1]JHU ICMIC Program, The Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States; [2]Medicines Development, Oncology R&D, GlaxoSmithKline, Collegeville, PA, United States

The biological mechanisms underlying anti-angiogenic therapy when used in combination with conventional cytotoxic treatment are still not entirely understood. We have evaluated the effect of anti-angiogenic therapy on tumor vasculature with MRI and tumor hypoxia with optical imaging. Anti-angiogenic therapy transiently decreased tumor hypoxia, but induced tumor hypoxia post-treatment possibly due to the reduction of vascular volume in the tumor. Our results provide further insights as to whether anti-angiogenic therapy induces the normalization of the tumor vasculature, which improves drug delivery by reducing hypoxia, an important environmental factor in tumor resistance.

15:00 **4834. Response of a Human Melanoma Xenograft Model to the MEK Inhibitor AZD6244 (ARRY-142886) Evaluated by Diffusion-Weighted MRI**

Mounia Beloueche-Babari[1], Yann Jamin[1], Vaitha Arunan[1], Simon Walker-Samuel[1], Paul D. Smith[2], John C. Waterton[2], Jane Halliday[2], Martin O. Leach[1], Simon P. Robinson[1]
[1]Institute of Cancer Research, Sutton, Surrey, United Kingdom; [2]AstraZeneca, Macclesfield, Cheshire

Down-modulation of the BRAF-MEK-ERK1/2 signalling pathway is a novel strategy for targeted cancer treatment that causes tumour growth inhibition and induction of apoptosis. Diffusion-weighted MRI was used to detect pharmacodynamic biomarkers of treatment with the MEK inhibitor AZD6244. Treatment of a human melanoma xenograft model with AZD6244 caused inhibition of tumour growth that was associated with an increase in the apparent diffusion coefficient and tumour necrosis.

15:30 **4835. Early Detection of Treatment Response to Antiangiogenic Therapy Using IVIM-DWI in Mouse Model of Breast Cancer**

Sungheon Kim[1], Lindsey DeCarlo[2], Gene Y. Cho[1], Jens H. Jensen[1], Daniel K. Sodickson[1], Silvia Formenti[3], Robert J. Schneider[2], Eric E. Sigmund[1]
[1]Center for Biomedical Imaging, Radiology, New York University, New York, NY, United States; [2]Microbiology, New York University, New York, NY, United States; [3]Radiation Oncology, New York University, New York, NY, United States

This study was to investigate the feasibility of using Intra-Voxel-Incoherent-Motion (IVIM) diffusion weighted imaging (DWI) to detect the early onset of tumor vascular normalization induced by an antiangiogenic therapy. BALB/c mice with 4T1 tumor were scanned before and after administration of Bevacizumab. The average ADC from the monoexponential diffusion model did not change noticeably by post-treatment day 1. However, the biexponential model was found to be adequate for more voxels in the tumor and the product of perfusion fraction and pseudodiffusivity increased substantially in one day, suggesting the feasibility of using IVIM-DWI for early detection of vascular normalization.

Tuesday 13:30-15:30 Computer 109

13:30 **4836. Dynamic Contrast-Enhanced (DCE)-MRI Enhanced with Macromolecular Contrast Media for Monitoring Sorafenib Effect on Experimental Prostate Carcinomas**

Clemens Christian Cyran[1], Philipp Marius Paprottka[1], Bettina Schwarz[2], Steven Sourbron[1], Olaf Dietrich[1], Jobst von Einem[1], Rabea Hinkel[3], Christiane Bruns[2], Hubertus Pietsch[4], Maximilian F. Reiser[1], Bernd J. Wintersperger[1], Konstantin Nikolaou[1]
[1]Institute of Clinical Radiology, Munich University Hospitals - Campus Grosshadern, Munich, Germany; [2]Department of Surgery, Munich University Hospitals - Campus Grosshadern, Munich, Germany; [3]Department of Internal Medicine I, Munich University Hospitals - Campus Grosshadern, Munich, Germany; [4]Contrast Media Research, Bayer Schering Pharma AG, Berlin, Germany

The purpose of this study was to investigate the effects of sorafenib on experimental prostate carcinomas in rats by dynamic MRI and macromolecular contrast media (MMCM) albumin-(Gd-DTPA). Target parameters were tumor endothelial permeability (ml/100ml/min) and tumor vascularity (%). In the therapy group treated daily with sorafenib (10mg/kg) tumor endothelial permeability and tumor vascularity decreased significantly ($p<0.01$) over one week. Results indicate a significant effect of sorafenib on experimental prostate carcinomas in rats. Tumor endothelial permeability and tumor vascularity as assayed with DCE-MRI and MMCM have the potential to be applied as non-invasive surrogate parameters of tumor response to anti-angiogenic therapy

14:00 **4837. Vessel Size Index MRI to Monitor the Effects of Vascular Disruption by ASA404 (Vadimezan, 5,6-Dimethylxanthenone-4-Acetic Acid) in Orthotopic Gliomas**

Kirstie S. Opstad[1], Simon P. Robinson[2], Franklyn A. Howe[1]
[1]Division of Cardiac & Vascular Sciences, St. George's, University of London, London, United Kingdom; [2]Cancer Research UK Clinical Magnetic Resonance Research Group, Institute of Cancer Research, Sutton, United Kingdom

Vascular disrupting agents (VDAs) reduce tumour blood flow and non-invasive methods of monitoring are essential for brain tumours. Vessel size index (VSI) MRI was used to determine effects of the Tumour-VDA ASA404 (vadimezan, formerly AS1404, 5,6-dimethylxanthenone-4-acetic acid, DMXAA) on fractional blood volume (fBV) and blood vessel size (Rv) in orthotopic C6 gliomas. We show a post-treatment histogram shift towards reduced fBV and significant increase in fBV<0.4%, consistent with vascular collapse; and large post-ASA404 reductions in fBV and Rv indicate development of necrosis. In conclusion, VSI MRI appears effective in monitoring treatment effects of the Tumour-VDA ASA404 on brain tumour vasculature.

14:30 **_4838_. Detection and Improvement of Anti-Angiogenic Therapeutic Efficacy by Using Hemodynamic Response Imaging in Mice**

Yifat Edrei[1,2], Eitan Gross[3], Nathalie Corchia[1], Elia Dery[1], Shmuel Ben-Sasson[4], Rinat Abramovitch[1,2]

[1]The Goldyn Savad Inst. for Gene Therapy, Hadassah Hebrew University Medical Center, Jerusalem, Israel; [2]MRI/MRS lab HBRC, Hadassah Hebrew University Medical Center, Jerusalem, Israel; [3]Pediatric Surgery, Hadassah Hebrew University Medical Center; [4]Experimental Medicine & Cancer Research, The Hebrew Universioty Hadassah Medical School

Since anti-angiogenic therapies may not lead to substantial tumor shrinkage, their effect is better imaged using perfusion imaging rather than tumor size measurement. Recently, we demonstrated the feasibility of Hemodynamic Response Imaging (HRI), an fMRI method combined with hypercapnia and hyperoxia, for monitoring changes in liver perfusion and hemodynamics. Here we show that a novel anti-angiogenic drug (Hamsa) reduces colorectal liver metastases growth and thus prolong mice survival. We assessed the therapeutic efficacy by HRI and revealed two types of response. By utilizing HRI we revealed the underlying mechanisim of Hamsa potential which hopefully would improve the Hamsa therapeutic potency.

15:00 **_4839_. In Vivo MRI Follow-Up of Murine Tumors Treated by Electrochemotherapy with Bleomycin.**

Lucie Calmels[1], Bassim Al-Sakere[2,3], Lluis Mir[2,3], Jean-Pierre Ruaud[4], Anne Leroy-Willig[4]

[1]U2R2M, University Paris-Sud XI , Orsay, 91405, France; [2]CNRS UMR 8121, Institut Gustave Roussy, Villejuif, 94805, France; [3]UMR 8121, University Paris-Sud XI , Orsay, 91405; [4]U2R2M, University Paris-Sud XI, Orsay, 91405, France

Sixteen mice bearing grafted fibrosarcoma were treated with electrotransfer without (E), after a low (B) and a high (HB) dose of bleomycin.Volume, ADC and T2 of tumors were measured before and after treatment. Bleomycin induced a volume decrease depending on the dose. ADC reached a maximum at 24 and 10 hrs for B and HB group respectively. T2 was increased during a few hours after application of electric field in the three groups.

Wednesday 13:30-15:30 Computer 109

13:30 **_4840_. Diffusion-Weighted Imaging for Rectal Cancer Response Monitoring After Neo-Adjuvant Radiochemotherapy: A Good Correlation with Pathological Response.**

Martijn Intven[1], Onne Reerink[1], Taro Takahara[2], Marielle E. P. Philippens[1]

[1]Radiation Oncology, University Medical Centre Utrecht, Utrecht, Netherlands; [2]Radiology, University Medical Centre Utrecht, Utrecht, Netherlands

Rectal cancer response analysis after neo-adjuvant radiochemotherepy (RCT) is important because good pathological response prediction enables safe omission of surgery in the group of clinical complete responders. Diffusion-weighted MR imaging (DWI) reflects the microanatomy in tissues and is frequently used in oncology for tissue characterisation and response assessment. In this study, we analysed rectal cancer response after neo-adjuvant RCT with DWI. Apparent diffusion coefficient (ADC) values were compared with the pathological rectal cancer regression grade. Unexpectedly, low post-RCT ADC values and low ADC differences correlated with a good pathological response after neo-adjuvant RCT.

14:00 **_4841_. Correlation of the Phospholipid-Related Signatures in ^{31}P and ^{1}H Spectra: An Approach to Increase the Sensitivity of the Prediction of Therapeutic Outcome in Non-Hodgkin's Lymphoma by *In Vivo* MRS**

Fernando Arias-Mendoza[1], Franklyn Howe[2], Marion Stubbs[3], Seung-Cheol Lee[4], Geoffrey S. Payne[5], Kristen Zakian[6], Hamed Mojahed[1], Harish Poptani[4], Mary McLean[3], Amita Shukla-Dave[6], Nicholas R. Maisey[5], Owen A. O'Connor[7,8], Ruth Pettengell[9], Steven J. Schuster[4], David Cunningham[10], John R. Griffiths[3], Jerry D. Glickson[4], Martin O. Leach[5], Jason A. Koutcher[6], Arend Heerschap[11], Truman R. Brown[1]

[1]Radiology, Columbia University, New York, NY, United States; [2]Radiology, St. George's Hospital, London, United Kingdom; [3]Radiology, Cambridge University, Cambridge, United Kingdom; [4]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [5]Radiology, Institute of Cancer Research, London, United Kingdom; [6]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States; [7]Medical Oncology, Columbia University, New York, NY, United States; [8]Medical Oncology, New York University, New York, NY, United States; [9]Medical Oncology, St. George's Hospital, London, United Kingdom; [10]Medical Oncology, Institute of Cancer Research, London, United Kingdom; [11]Radiology, Radboud University Nijmegen Medical Center, Nijmegen, Netherlands

In vivo localized, ^{31}P and ^{1}H MRS was acquired in tumors of non-Hodgkin's lymphoma patients before treatment, and the phosphoethanolamine plus phosphocholine-to-nucleoside triphosphate and total choline-to-water ratios determined in the ^{31}P and ^{1}H tumor spectra respectively. In these preliminary data, the pretreatment ratios showed a linear correlation (y=0.16x 0.77, r2=0.7, $p<0.005$). This correlation and the increased sensitivity of ^{1}H observations in comparison to those of ^{31}P suggests that the prediction of therapeutic outcome by MR technology can be improved by the addition of ^{1}H spectroscopy to the *in vivo* MR observations of NHL patients.

14:30 **4842. Dynamic Contrast-Enhanced MRI Parameters Monitor and Predict Outcome of Targeted Radionuclide Therapy in Patients with Neuroendocrine Tumour Liver Metastases**

Keiko Miyazaki[1], Matthew R. Orton[1], James A. d'Arcy[1], Val Lewington[2], Martin O. Leach[1], David J. Collins[1], Dow-Mu Koh[3]

[1]CR-UK and EPSRC Cancer Imaging Centre, The Institute of Cancer Research and Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]Department of Nuclear Medicine, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom; [3]Department of Radiology, Royal Marsden NHS Foundation Trust, Sutton, Surrey, United Kingdom

Dynamic contrast-enhanced (DCE-) MRI is a technique that enables non-invasive interrogation of tissue microvascular environment. The role of quantitative DCE-MRI parameters in the assessment and prediction of response in patients with liver metastases to a targeted radionuclide therapy was investigated using both model-free and model-dependent data analyses. Distribution volume and IAUGC60 were found to be potential predictors of response. The number of fitted voxels and the enhancing fraction were found to be most sensitive in assessing treatment response. This study demonstrates the role of DCE-MRI as a potential biomarker for predicting and assessing treatment response.

15:00 **4843. Diffusion Weighted MRI for Assessing Treatment Response in Myeloma Bone Disease**

Christina Messiou[1], David Collins[1], Veronica Morgan[1], Sharon Giles[1], Catherine Parry-Jones[1], Faith Davies[2], Gareth Morgan[3], Nandita deSouza[1]

[1]CRUK and EPSRC Cancer Imaging Centre, Department of Magnetic Resonace Imaging, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [2]Molecular Target Treatment Team, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom; [3]Leukaemia and Molecular Genetics Team, Institute of Cancer Research/The Royal Marsden Hospital, Sutton, Surrey, United Kingdom

There is growing interest in diffusion weighted (DW) MRI as a biomarker of treatment response in metastatic and myeloma bone disease. We performed an ROC analysis of normal vs myeloma involved marrow. Using an ADC threshold of 724 mm2s-1 x 10-6 the sensitivity and specificity for detecting myeloma marrow involvement are 90 and 70% respectively. This threshold was applied to a test case to produce segmented ADC maps which were used to predict treatment response.

Thursday 13:30-15:30 Computer 109

13:30 **4844. Monitoring Treatment Response of Prostate Cancer Bone Metastases with the Functional Diffusion Map**

Carolin Reischauer[1], Johannes M. Froehlich[2], Christoph A. Binkert[2], Peter Boesiger[1], Andreas Gutzeit[2]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Department of Radiology, Cantonal Hospital Winterthur, Winterthur, Switzerland

Most patients with advanced prostate cancer feature bone metastases that are incurable. Thus, novel therapies are constantly developed for which treatment success has to be assessed. The present work demonstrates, in a prospective clinical study of patients with known skeletal metastases, that the functional diffusion map (fDM) allows monitoring treatment response. Thereby, the fDM segments the tumor into three regions with significantly increased, significantly decreased, and unchanged apparent diffusion coefficients (ADCs). In the present study large regions with significantly increased ADCs were observed under therapy indicating treatment success. Furthermore, the spatial distribution of tumor response could be successfully derived.

14:00 **4845. DCE-MRI Demonstrates Antivascular Properties of Sorafenib in Metastatic Hormone-Resistant Prostate Cancer**

Mark Alan Rosen[1], Ganesh Adluru[1], Ravi Amaravadi[2], Yiqun Xue[1], Yu Jiangsheng[1], Hee-Kwon Song[1], Naomi Haas[2], Peter O'Dwyer[2]

[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States; [2]Medicine, University of Pennsylvania, Philadelphia, PA, United States

DCE-MRI using large-volume radial imaging was used to gauge response of metastatic prostate cancer to combination therapy including the anti-angiogenic agent, sorafenib. We observed strong anti-vascular response of tumors to a seven-day course of sorafenib. This effect was reversed on follow-up DCE-MRI at day 21, after a mandated three-day sorafenib free-interval, suggesting that the sorafenib effects on tumor were rapidly reversible. We also noted that alterations in tumor vascularity, as reflected in changes in tumor AUC60, were negatively correlated with early changes in serum PSA levels, in concert with clinical results revealing sorafenib's potential to increase PSA levels.

15:00 ***4846***. **The Assessment of Early Vascular Effects of the Angiogenesis Inhibitor Sunitinib in Renal Cell Carcinoma (RCC) by DCE-MRI and Diffusion Weight MRI (DWI) at 3 Tesla.**

Ingrid Desar[1], H. W.M. van Laarhoven[1], T. Hambrock[2], E. G.W. ter Voert[2], J. J.A. van Asten[2], D.J. van Spronsen[3], J. O. Barentsz[2], P. F.A. Mulders[4], A. Heerschap[2], Carla M.L. van Herpen[1]

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Sunitinib is an oral angiogenesis inhibitor, used as first line treatment in patients with metastatic renal cell cancer (RCC). A successful antiangiogenic treatment is expected to result in stabilization of the vasculature, a reduction in permeability and in interstitial fluid pressure, and the development of necrosis. This study aims to assess the early vascular effects of sunitinib in RCC patients with a DCE-MRI and DWI at 3T. Treatment with sunitinib provokes significant increases in ADC after 3 days, with recurrence to baseline values at day 10. This is possibly due to the development of edema and necrosis. In this limited number of patients, no significant changes in both mean kep and Ktrans values, as well as in the histogram results were found, although in individual patients some trends indicative for early vascular effects of sunitinib were observed.

Compressed Sensing I

Hall B Monday 14:00-16:00 Computer 110

14:00 ***4847***. **Compressive Sensing and Low Contrast Detectability**

Joshua D. Trzasko[1], Armando Manduca[1], Matt A. Bernstein[1]

[1]Mayo Clinic, Rochester, MN, United States

To date, the most successful applications of Compressive Sensing (CS) to MRI have focused on situations like contrast-enhanced MR angiography where the information of interest is represented by high-contrast features. However, many diagnostic tasks in clinical MRI are more closely related to low-contrast object detectability (LCOD) than high-contrast detectablility. In this work, we investigate the potential of the CS paradigm for LCOD and compare its performance against more widely-used approaches based on of zero-filling.

14:30 ***4848***. **High-Frequency Subband Compressed Sensing MRI**

Kyunghyun Sung[1], Brian A. Hargreaves[1]

[1]Radiology, Stanford University, Stanford, CA, United States

Compressed sensing (CS) is a technique that allows accurate reconstruction of images from a reduced set of acquired data. Here, we present a new method, which applies CS to only high-frequency subbands to maximally utilize the wavelet characteristics while minimizing reconstruction artifacts, and allowing easy incorporation of other rapid imaging techniques.

15:00 ***4849***. **The Influence of Various Adaptive Radial Undersampling Schemes on Compressed-Sensing L1-Regularized Reconstruction**

Rachel Wai-chung Chan[1], Elizabeth Anne Ramsay[2], Donald Bruce Plewes[2]

[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada; [2]Imaging Research, University of Toronto, Toronto, ON, Canada

Adaptive radial imaging allows multiple images to be retrospectively reconstructed from the same dataset, each with a different spatial-temporal balance. It has been shown that compressed sensing reconstruction can be used reduce streak artifacts in high-temporal-resolution images created by radial undersampling. Here, we compare the effect of 3 adaptive sampling schemes (golden angle, bit-reversed, and random sampling scheme) on the ability of CS reconstruction to reduce streak artifacts, at various spatiotemporal resolutions. Results show that CS reconstruction lowers the degree of error and mostly preserves the differences among sampling schemes compared to Fourier reconstruction.

15:30 ***4850***. **Efficient Non-Contrast-Enhanced MRA with Inflow Inversion Recovery by Skipped Phase Encoding and Edge Deghosting (SPEED)**

Zheng Chang[1], Qing-San Xiang[2,3], Hao Shen[4], Fang-Fang Yin[1]

[1]Department of Radiation Oncology, Duke University, Durham, NC, United States; [2]Department of Physics and Astronomy, University of British Columbia, Vancouver, bc, Canada; [3]Department of Radiology, University of British Columbia, Vancouver, BC, Canada; [4]Applied Science Laboratory, GE Healthcare, Beijing, China

Skipped Phase Encoding and Edge Deghosting (SPEED) has been demonstrated effective in accelerating typical MRI. In this work, SPEED is further developed to achieve higher efficiency in accelerating non-contrast-enhanced MRA with inflow inversion recovery (IFIR). IFIR employs an inversion recovery pulse to suppress signals from static tissue, while leaving inflow arterial blood unaffected, resulting in visible vasculature on modest tissue background. By taking advantages of sparsity of vasculature, SPEED with a single-layer-model can achieve higher efficiency than that achievable with a double-layer-model. The technique is demonstrated with a 3D renal IFIR study achieving undersmapling factors up to 5.

Tuesday 13:30-15:30 Computer 110

13:30 ***4851*.** **Partial Fourier Compressed Sensing**

Mariya Doneva[1], Peter Börnert[2], Holger Eggers[2], Alfred Mertins[1]
[1]University of Lübeck, Lübeck, Germany; [2]Philips Research Europe, Hamburg, Germany

This work considers an extension of the frequently used partial Fourier imaging to a combination with compressed sensing and parallel imaging. The sampling pattern and the reconstruction have been adjusted to allow a combined multi-coil partial Fourier compressed sensing reconstruction, which could benefit from the different fast imaging methods, potentially achieving even higher acceleration factors. The basic feasibility of the proposed method has been demostrated on in vivo brain data.

14:00 ***4852*.** **Non-Convex Greedy Compressed Sensing for Phase Contrast MRI**

Daehyun Yoon[1], Jeffrey Fessler[1], Jon-Fredrik Nielsen[2], Anna Gilbert[3], Douglas Noll[2]
[1]Electrical Engineering, University of Michigan, Ann Arbor, MI, United States; [2]Biomedical Engineering, University of Michigan; [3]Mathematics, University of Michigan

We propose a novel, non-convex greedy compressed sensing algorithm for phase-contrast MRI. Because the blood vessel distributions are sparse in the image domain, we model that the velocity encoded image has only sparse phase changes compared to the reference image without velocity encoding. Exploiting this sparsity in the velocity encoding phase, we developed a non-convex greedy compressed sensing algorithm to highly undersample the acquisition of the velocity encoded object. We also compared our proposed method to a convex optimization method and found out from the simulations that our method can achieve higher undersampling rates.

14:30 ***4853*.** **Fast Time-Resolved 3D Single Point Imaging with Compressed Sensing**

James A. Rioux[1,2], Steven D. Beyea[2,3], Chris V. Bowen[2,3]
[1]Department of Physics, Dalhousie University, Halifax, Nova Scotia, Canada; [2]National Research Council - Institute for Biodiagnostics (Atlantic), Halifax, Nova Scotia, Canada; [3]Departments of Physics, Radiology and Biomedical Engineering, Dalhousie University, Halifax, Nova Scotia, Canada

Single Point Imaging sequences are well suited to acceleration with Compressed Sensing (CS), allowing the lengthy acquisition times associated with these sequences to be shortened considerably. We demonstrate such acceleration with 128x128x16 3D TurboSPI images, which also contain time course information for quantification of relaxation parameters. Acceleration factors of 6-10 are readily achievable, with further improvements possible at larger matrix sizes. CS reconstruction retains overall image quality and preserves time course information to within a few percent, allowing SPI to be more readily used for *in vivo* imaging, or studying dynamic systems.

15:00 ***4854*.** **Clinically Feasible Reconstruction Time for L1-SPIRiT Parallel Imaging and Compressed Sensing MRI**

Mark Murphy[1], Kurt Keutzer[1], Shreyas Vasanawala[2], Michael Lustig[1]
[1]EECS, UC Berkeley, Berkeley, CA, United States; [2]Radiology, Stanford University, Stanford, CA, United States

We have optimized for GPUs the L1-minimization for reconstruction of Parallel Imaging and Compressed Sensing MRI, reducing the runtime to 97 seconds. This is the first clinically-feasible runtime reported for Compressed Sensing MRI reconstruction.

Wednesday 13:30-15:30 Computer 110

13:30 ***4855*.** **Total Generalized Variation (TGV) for MRI**

Florian Knoll[1], Kristian Bredies[2], Thomas Pock[3], Rudolf Stollberger[1]
[1]Institute of Medical Engineering, Graz University of Technology, Graz, Austria; [2]Institute for Mathematics and Scientific Computing, University of Graz, Graz, Austria; [3]Institute for Computer Graphics and Vision, Graz University of Technology, Austria

Total Variation was recently introduced in many different MRI applications. The assumption of TV is that images consist of areas which are piecewise constant. However, in many practical MRI situations, this assumption is not valid due to the existence of smooth signal inhomogeneities originating from the exiting b1 field or the receive coils. This work introduces the new concept of Total Generalized Variation for MRI, a new mathematical framework which is a generalization of the TV theory and which eliminates these restrictions. Two important applications are considered in this paper, image denoising and iterative image reconstruction from undersampled radial data sets with multiple coils. Apart from simulations, experimental results from in vivo measurements are presented where TGV yielded improved image quality over conventional TV in all cases.

14:00 ***4856*.** **Wavelet-Based Compressed Sensing Using Gaussian Scale Mixtures**

Yookyung Kim[1], Mariappan S. Nadar[2], Ali Bilgin, [1,3]
[1]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States; [2]Siemens Corporation, Corporate Research, Princeton, NJ, United States; [3]Biomedical Engineering, University of Arizona, Tucson, AZ, United States

While initial Compressed Sensing (CS) techniques assumed that sparsity transform coefficients are independently distributed, recent results indicate that dependencies between transform coefficients can be exploited for improved performance. In this paper, we propose the use of a Gaussian Scale Mixture (GSM) model for exploiting the dependencies between wavelet coefficients in CS MRI.

Our results indicate that the proposed model can significantly reduce the reconstruction artifacts and reconstruction time in wavelet-based CS MRI.

14:30 ***4857*. Accelerated Compressed Sensing of Diffusion-Inferred Intra-Voxel Structure Through Adaptive Refinement**

Bennett Allan Landman[1,2], Hanlin Wan[2,3], John A. Bogovic[3], Peter C. M. van Zijl[4,5], Pierre-Louis Bazin[6], Jerry L. Prince, [23]

[1]Electrical Engineering, Vanderbilt University, Nashville, TN, United States; [2]Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States; [3]Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, United States; [4]F.M. Kirby Center, Kennedy Krieger Institute, Baltimore, MD, United States; [5]Biomedical Engineering, Johns Hopkins University, Nashville, TN, United States; [6]Radiology, Johns Hopkins University, Baltimore, MD, United States

Compressed sensing is a promising technique to estimate intra-voxel structure with traditional DTI data and avoid many of the practical constraints (e.g., long scan times, low signal-to-noise ratio) that plague more detailed, high b-value studies. However, computational complexity is a major limitation of compressed sensing techniques as currently proposed. We demonstrate a novel technique for accelerated compressed sensing of diffusion-inferred intra-voxel structure utilizing adaptive refinement of a multi-resolution basis set. Our approach achieves a tenfold reduction in computational complexity and enables more practical consideration of intra-voxel orientations in time-sensitive settings, routine data analysis, or in large studies.

15:00 ***4858*. Optimal Single-Shot K-Space Trajectory Design for Non-Cartesian Sparse MRI**

Yong Pang[1], Bing Wu[2], Xiaoliang Zhang[2,3]

[1]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA , United States; [2]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA, United States; [3] UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco & Berkeley, CA, United States

Sparse MRI can reduce the acquisition time and raw data size using significantly undersampled k-space. However, conventional k-trajectories waste much time in traveling useless k-space samples. In this work the optimal k-space trajectory design for sparse MRI is addressed. After sampling the k-space using Monto-Carlo sampling schemes, the graphic theory is applied to design an optimal shingle-shot k-trajectory traveling through all these samples, which can further decrease the acquisition time. To demonstrate the feasibility and efficiency, conventional Cartesian EPI and spiral trajectories, as well as their gradients are designed to be compared with those of the optimal k-trajectory.

Thursday 13:30-15:30 Computer 110

13:30 ***4859*. A Novel Compressed Sensing (CS) Method for B1+ Mapping in 7T**

Joonsung Lee[1], Elfar Adalsteinsson[1,2]

[1]Electrical engineering and computer science, Massachusetts Institute of Technology, Cambridge, MA, United States; [2]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

We have developed a novel CS algorithm for B1+ mapping. By imposing smoothness constraint on the B1+ map, we are able to determine B1+ with highly under-sampled data. The method is applied to any kind of B1+ mapping methods.

14:00 ***4860*. Direct Reconstruction of B1 Maps from Undersampled Acquisitions**

Francesco Padormo[1], Shaihan J. Malik[1], Jo V. Hajnal[1]

[1]Robert Steiner MRI Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom

We present a method utilizing the smoothness of the B1+ field to accelerate flip angle mapping. By randomly undersampling k-space and using a Compressed Sensing type reconstruction, we show that accurate flip angle distributions can be found with only 40% of the original data.

14:30 ***4861*. Compressed Sensing Reconstruction in the Presence of a Reference Image**

Fan Lam[1], Diego Hernando[1], Kevin F. King[2], Zhi-Pei Liang[1]

[1]Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States; [2]Global Applied Science Lab, GE Healthcare, Waukesha, WI, United States

In this work, we are addressing the problem on improving compressed sensing reconstruction in the presence of a reference image. A novel algorithm is developped to generate a motion compensated reference image to further improve signal sparsity for a difference image between the reference and the target image to be reconstructed. A compressed sensing reconstruction scheme is proposed to reconstruct the difference image and then the overal reconstruction is constructed by adding the difference image with the reference. The final reconstruction outperforms conventional CS-based reconstruction. The comparison is shown for an interventional imaging experiment.

15:00 **4862. Autocalibrated Approach for the Combination of Compressed Sensing and SENSE**

Claudia Prieto[1], Benjamin R. Knowles[1], Muhammad Usman[1], Philip G. Batchelor[1], Freddy Odille[2], David Atkinson[2], Tobias Schaeffter[1]
[1]Division of Imaging Sciences, King's College London, London, United Kingdom; [2]Centre for Medical Image Computing, University College London, London, United Kingdom

An autocalibrated approach for the combination of Compressed Sensing (CS) and SENSE is proposed. This method is based on the sequential estimation of the coil sensitivity maps using distributed CS followed by image reconstruction using SparseSENSE (or its equivalents), from the same data set. The proposed approach was tested in 2D black-blood atrial wall images with undersampling factors up to 5, showing good image quality. This method does not require extra reference scans and avoids the acquisition of the fully sampled k-space center, which could limit the maximum achievable undersampling factor.

Compressed Sensing II

Hall B Monday 14:00-16:00 Computer 111

14:00 **4863. Compressed Sensing FMRI Using Optimized Temporal Basis**

Hong Jung[1], Jong Chul Ye[1]
[1]KAIST, Yuseong-Gu, Daejon, Korea, Republic of

Functional MRI (fMRI) has become popular with the developments of echo planar imaging (EPI) sequences. However, EPI needs more image quality improvements for some applications. For example, EPI images suffer from field inhomogeneity artifacts resulting from signal losses in some areas especially around air-tissue interfaces. These artifacts can be minimized with, for example, thin slice thickness. This strategy, however, requires more acquisition time so that temporal resolution or field of view should be sacrificed. In this paper, to address this problem, we applied a compressed sensing dynamic MR imaging algorithm called k-t FOCUSS to fMRI. To resolve degradation of SNR at accelerated acquisition, more number of repetitions of tasks were conducted. Then, from down-sampled k-space data, we obtained accurate brain activation maps for right finger tapping experiments. We verified the reliability of our results by plotting receiver operating characteristic (ROC) curve.

14:30 **4864. Improving the Achievable Temporal Resolution of Compressed Sensing in CE MRA**

Bing Wu[1,2], Philip Bones[1], Anthony Butler[1], Richard Watts[3], Rick Millane[1]
[1]Electrical and computer engineering, University of Canterbury, Christchurch, Canterbury, New Zealand; [2]Brain Imaging and Analysis Center, School of Medicine, Duke University, Durham, NC, United States; [3]Physics and Astronomy, University of Canterbury, New Zealand

A new data acquisition and image reconstruction method for contrast enhanced (CE) MRA is presented. It is based on Cartesian compressed sensing and incorporates image prior knowledge embedded in the composite data set obtained from time resolved data acquisition. An acceleration factor that is comparable to that offered by HYPR has been achieved with this new method, on a Cartesian grid.

15:00 **4865. Design of Temporally Constrained Compressed Sensing Methods for Accelerated Dynamic MRI**

Julia V. Velikina[1], Kevin M. Johnson[1], Walter F. Block[1], Alexey A. Samsonov[1]
[1]University of Wisconsin - Madison, Madison, WI, United States

We present a novel temporally constrained method for reconstruction of dynamic MRI images from undersampled data using second temporal difference. The proposed method is compared to the previously described temporal compressed sensing approaches, including k-t FOCUSS. Performance comparison is done in a series of experiments in digital phantoms and in vivo human volunteer data for phase contrast and contrast-enhanced imaging. The proposed method provided higher accuracy of flow waveform estimations for acceleration factors 8-13.

15:30 **4866. Compressed Sensing Reconstruction with Retrospectively Gated Sampling Patterns for Velocity Measurement of Carotid Blood Flow**

Yuehui Tao[1], Gabriel Rilling[2], Mike Davies[2], Ian Marshall[1]
[1]Medical Physics, University of Edinburgh, Edinburgh, United Kingdom; [2]School of Engineering and Electronics, University of Edinburgh, Edinburgh, United Kingdom

Due to unpredictable heart rate variability, sampling patterns recorded in retrospectively gated dynamic scans appears to be incoherent, which suits the Compressed Sensing framework. Three such sampling patterns recorded in real scans are tested in Compressed Sensing reconstruction with in vivo data from 2D cine phase contrast velocity measurement of carotid blood flow. Both intensity and phase (velocity) errors are examined.

Tuesday 13:30-15:30 Computer 111

13:30 ***4867*. Adaptive Compressed Sensing MRI**

Ricardo Otazo[1], Daniel K. Sodickson[1]
[1]Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States

A method to adapt the sparsifying transform in order to increase image sparsity for compressed sensing (CS) is presented. The method updates the sparsifying transform and computes the corresponding sparse coefficient simultaneously using image examples from the undersampled data. We demonstrate improved performance of adaptive CS over standard CS with a pre-defined wavelet transform on a brain imaging example

14:00 ***4868*. Phase-Sensitive Reconstruction Based on the Orthogonality (PRO) of Under-Sampled MRI**

Nan-kuei Chen[1]
[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States

To improve the scan efficiency of dynamic MRI, the k-space data may be undersampled and then reconstructed using one or more of the conventional strategies: e.g., parallel imaging, partial Fourier method, and 3) UNFOLD technique. Here we report a new algorithm to reconstruct under-sampled data, based on the orthogonality of signals from voxels separated by half of the FOV. The new technique, termed Phase-sensitive Reconstruction based on the Orthogonality (PRO), performs well for data acquired from single-channel or multi-channel coils, and is complementary to existing fast MRI techniques, enabling further reduction of aliasing artifacts in under-sampled MRI data.

14:30 ***4869*. A Hybrid L0-L1 Minimization Algorithm for Compressed Sensing MRI**

Dong Liang[1], Leslie Ying[2]
[1]Department of Electrical Engineering and Computer Science , University of Wisconsin-Milwaukee, Milwaukee, WI, United States; [2]Department of Electrical Engineering and Computer Science, University of Wisconsin-Milwaukee, Milwaukee, WI, United States

Both L1 and homotopic L0 minimizations have been used in compressed-sensing MRI reconstruction. In this abstract, we propose a homotopic L0-L1 hybrid minimization algorithm such that it has the benefit of both L1 and homotopic L0 minimizations. The proposed algorithm minimizes the L0 quasi-norm of large transform coefficients but the L1 norm of small transform coefficients for the image to be reconstructed. The simulation results show the proposed algorithm outperforms both L1 and homotopic L0 minimization algorithms when the same reduction factor is used.

15:00 ***4870*. Impact of Coil Sensitivity Estimation on MRI Reconstruction Methods Combining Compressed Sensing and Parallel MRI**

Seunghoon Nam[1,2], Mehmet Akçakaya[1,2], Peng Hu[2], Warren Manning[2], Vahid Tarokh[1], Reza Nezafat[2]
[1]Harvard University, Cambridge, MA, United States; [2]Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States

MRI reconstruction methods combining parallel MRI and compressed sensing (CS) have been recently proposed to accelerate image acquisition and showed great promise. Inherited from parallel MRI, these techniques utilize the coil sensitivity information in their reconstruction procedure. The quality of reconstructed image is affected by the quality of coil sensitivity estimation and different reconstruction methods have different susceptibilities to the coil sensitivity estimation depending on how the coil sensitivity is used in their reconstruction. In this study, we investigate the impact of coil sensitivity estimation on two reconstruction methods: SparseSENSE and distributed CS-SENSE.

Wednesday 13:30-15:30 Computer 111

13:30 ***4871*. Improved K-T FOCUSS Using a Sparse Bayesian Learning**

Hong Jung[1], Jong Chul Ye[1]
[1]KAIST, Yuseong-Gu, Daejon, Korea, Republic of

In dynamic MRI, spatio-temporal resolution is a very important issue. Recently, compressed sensing approach has become a highly attracted imaging technique since it enables accelerated acquisition without aliasing artifacts. Our group has proposed an l1-norm based compressed sensing dynamic MRI called k-t FOCUSS which outperforms the existing methods. However, it is known that the restrictive conditions for l1 exact reconstruction usually cost more measurements than l0 minimization. In this paper, we adopt a sparse Bayesian learning approach to improve k-t FOCUSS and achieve l0 solution. We demonstrated the improved image quality using cardiac cine imaging.

14:00 ***4872*. Breath-Held Highly-Accelerated 2D Fourier-Velocity Encoded MRI Using Compressed Sensing**

Luca Marinelli[1], Kedar Khare[1], Kevin F. King[2], Christopher J. Hardy[1]
[1]GE Global Research Center, Niskayuna, NY, United States; [2]GE Healthcare, Waukesha, WI, United States

We optimized a pulse sequence for accelerated 2D Fourier-velocity-encoded (FVE) MRI to measure blood-velocity in disturbed flows using compressed sensing and developed a fast and accurate reconstruction algorithm. 2D Fourier-velocity-encoded M-mode

MRI provides a non-invasive probe of 2D velocity distributions that cannot be measured by other modalities such as Doppler ultrasound but can be exceedingly time consuming. Unlike conventional imaging, parallel imaging cannot be utilized to reduce number of velocity encoding steps. Scan time was reduced enough to fit the acquisition in a single breath-hold, achieving a 20x overall scan-time reduction relative to the fully sampled acquisition.

14:30 ***4873*. Parameter-Free Reconstruction of Highly Undersampled MR Angiography Images Using Gradient Descent with Sparsification**

Nicole Seiberlich[1], Hyun J. Jeong[2], Timothy J. Carroll[2], Mark A. Griswold[1,3]
[1]Radiology, Case Western Reserve University, Cleveland, OH, United States; [2]Radiology, Northwestern University, Chicago, IL, United States; [3]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

Gradient Descent with Sparsification, a novel image reconstruction technique, has been applied to the generation of images from highly undersampled MR Angiography data. Unlike other techniques, this method can be implemented using no external para-meters, allowing completely unsupervised reconstructions. The extremely high acceleration factors shown here are made possible by initializing a given time frame with the previous frame, such that only differences must be reconstructed. Temporal resolutions of 180ms/frame have been achieved by undersampling the collected data by a factor of R~75 (using 4 projections per partition per frame) with no venous contamination and little residual streaking or blurring.

15:00 ***4874*. Clinical Image Quality Assessment of CS-Reconstructed Brain Images**

Samir D. Sharma[1], Caroline Fong[2], Brian Tzung[2], Krishna S. Nayak[1], Meng Law[2]
[1]Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States;
[2]Department of Radiology, University of Southern California, Los Angeles, CA, United States

Compressed Sensing (CS) is a relatively new method for MR image reconstruction from undersampled k-space data. While other acceleration techniques, like parallel imaging, are common in clinical protocols, the role of CS in clinical imaging remains an open question. In this work we perform a double-blind assessment of CS-MRI image quality by neuroradiologists. Preliminary results suggest the potential for at least 3x acceleration without significant loss in image quality.

Thursday 13:30-15:30 Computer 111

13:30 ***4875*. Novel Algorithm for L1 Wavelet-Based MR Image Reconstruction**

Matthieu Guerquin-Kern[1], Maximilian Häberlin[2], Michael Unser[1], Klaas P. Pruessmann[2]
[1]Biomedical Imaging Group, Ecole polytechnique fédérale de Lausanne, Lausanne, Vaud, Switzerland;
[2]Institute for Biomedical Engineering, University and ETH Zurich, Zürich, Switzerland

The wavelet-based reconstruction that is proposed yields encouraging results compared to more popular reconstructions and is optimized to reduce reconstruction duration.

14:00 ***4876*. Accelerated Serial MR Imaging in Multiple Sclerosis Using Baseline Scan Information**

Alexey A. Samsonov[1], Julia V. Velikina[2], John O. Fleming[3], Mark L. Schiebler[1], Aaron S. Field[1]
[1]Department of Radiology, University of Wisconsin, Madison, WI, United States; [2]Department of Medical Physics, University of Wisconsin, Madison, WI, United States; [3]Department of Neurology, University of Wisconsin, Madison, WI, United States

In this work, we present a method to accelerate MS imaging in longitudinal studies through acquisition of fully sampled images at the baseline scan and accelerated undersampled data at follow-ups. W investigated feasibility to accelerate serial scanning of MS patients with 3D pulse sequences (T2 FLAIR and T1 weighted after Gd administration). Our results indicate that the proposed technique has a potential to produce high-quality images from significantly accelerated reduced follow-up acquisition (up to 8 times) and correctly depict T2 and Gd+ lesion load and anatomical content.

14:30 ***4877*. A New Approach to Incorporate Image Prior Estimate in Compressed Sensing**

Bing Wu[1,2], Philip Bones[1], Richard Watts[3], Rick Millane[1]
[1]Electrical and computer engineering, University of Canterbury, Christchurch, Canterbury, New Zealand; [2]Brain Imaging and Analysis Center, School of Medicine, Duke University, Durham, NC, United States; [3]Physics and Astronomy, University of Canterbury, New Zealand

The success level of compressed sensing (CS) reconstruction is fundamentally limited by the sparsity of the underlying image. A data sorting process can be incorporated in the CS recovery to improve the sparsity of the underlying image based on the knowledge of an image prior estimate. We here show that performing a data sorting effectively incorporates the image prior estimate in the CS reconstruction.

15:00 ***4878*. Improved Coil Sensitivity Estimation for SENSE Using Compressed Sensing**

Bing Wu[1], Chunlei Liu[1]
[1]Brain Imaging and Analysis Center, School of Medicine, Duke University, Durham, NC, United States

The conventional approach of deriving coil sensitivity profile for SENSE reconstruction using a small number of auto-calibration scan lines limits the fidelity of the coil sensitivity estimate, and hence the quality of SENSE reconstructions. However estimating coil sensitivity from under-sampled k-space data set is an under-determined problem, and previous attempts resort to additional regularizing terms that may affect the accuracy of the outcome. We present a new compress sensing based approach that allows the coil sensitivity profile to be estimated using all the acquired data measurements to achieve improved coil sensitivity estimate, which in turn leads to an improved SENSE reconstruction.

Parallel Imaging & Compressed Sensing

Hall B Monday 14:00-16:00 Computer 112

14:00 ***4879***. **Toward Clinically Applicable Highly-Accelerated SENSE**

Feng Huang[1], Yunmei Chen[2], Xiaojing Ye[2], Wei Lin[1], Yu Li[1], Arne Reykowski[1]
[1]Invivo Corporation, Gainesville, FL, United States; [2]Department of Mathematics, University of Florida, Gainesville, FL, United States

Recently, many advanced technologies have been proposed to improve the quality of images reconstructed by SENSE with high acceleration factors. However, success of these methods needs one or more following conditions: long reconstruction time, special acquisition trajectory, or expertise on parameter choice. These requirements have hindered their clinical applicability. In this work, a novel technique based on variable splitting is proposed to tackle these problems. Mathematical proof and experimental results demonstrate that the proposed method significantly improves the clinical applicability of highly-accelerated SENSE because of low reconstruction error, fast reconstruction, insensitivity to the choice of parameters, and regular Cartesian trajectory

14:30 ***4880***. **Combining Nonconvex Compressed Sensing and GRAPPA Using the Nullspace Method**

Daniel Stuart Weller[1], Jonathan R. Polimeni[2,3], Leo J. Grady[4], Lawrence L. Wald[2,3], Elfar Adalsteinsson[1], Vivek K. Goyal[1]
[1]Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, United States; [2]A.A. Martinos Center, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States; [3]Harvard Medical School, Boston, MA, United States; [4]Imaging and Visualization, Siemens Corporate Research, Princeton, NJ, United States

This work combines GRAPPA, a parallel image reconstruction method, with compressed sensing in a joint optimization framework. To enforce consistency with the acquired data, the optimization problem operates in the nullspace of the sampling pattern, which more accurately preserves the acquired data than a data feasibility penalty in the objective. The L0 penalty was approximated using a continuation procedure with a differentiable nonconvex regularizer. The proposed method was implemented using an iterative reweighted least squares routine. The combined method was applied to highly under-sampled MPRAGE data. This approach reconstructed images at higher quality than GRAPPA and CS alone.

15:00 ***4881***. **A New Combination of Compressed Sensing and Data Driven Parallel Imaging**

Kevin King[1], Dan Xu[1], Anja CS Brau[2], Peng Lai[2], Philip J. Beatty[2], Luca Marinelli[3]
[1]Global Applied Science Lab, GE Healthcare, Waukesha, WI, United States; [2]Global Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [3]Global Research Center, General Electric, Niskayuna, NY, United States

Compressed sensing and data driven parallel imaging can be combined in a serial approach in which randomly undersampled data are reconstructed onto a uniformly undersampled k-space grid using compressed sensing. Parallel imaging uses this uniformly undersampled data plus the auto-calibration data to create a fully sampled k-space grid. The serial approach allows the acceleration to be split between compressed sensing and parallel imaging. Each method solves a problem with better conditioning than if the full acceleration were used. Any data driven parallel imaging method, such as GRAPPA, ARC or SPIRIT can be used without modification using this approach.

15:30 ***4882***. **Improved Compressed Sensing Reconstruction for Equidistant K-Space by Sampling Decomposition and Its Application in Parallel MR Imaging**

Jun Miao[1,2], Weihong Guo[3], David L. Wilson[1,4]
[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Siemens Corporate Research, Princeton, NJ, United States; [3]Mathematics, Case Western Reserve University, Cleveland, OH, United States; [4]Radiology, University Hospitals of Cleveland

Incoherent sampling requirement is a bottleneck for application of compressed sensing (CS) in parallel MR imaging. Thus, a direct plug-in of CS to parallel imaging, especially in the case of equidistant k-space sampling, is not feasible. We propose a simple method to eliminate this problem by sampling decomposition and illustrate the idea using GRAPPA reconstruction. Significant improvement in image quality can be achieved with even less k-space acquisition.

Tuesday 13:30-15:30 Computer 112

13:30 ***4883*. l_1-Denoised Autocalibrating Parallel Imaging**

Tao Zhang[1], Michael Lustig[1,2], Shreyas Vasanawala[3], John Mark Pauly[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Electrical Engineering and Computer Science, UC Berkeley, Berkeley, CA, United States; [3]Radiology, Stanford University, Stanford, CA, United States

In this study, sequential parallel imaging and compressed sensing (CS) are applied to suppress noise and improve image quality. A noise covariance matrix constructed from the GRAPPA interpolation kernels are used to "intelligently inform" the CS optimization about the confidence level of each GRAPPA reconstructed entry. The experiment results show that the proposed method can efficiently suppress noise.

14:00 ***4884*. Acceleration of IDEAL Water-Fat Imaging Using Compressed Sensing**

Samir D. Sharma[1], Harry H. Hu[1], Krishna S. Nayak[1]
[1]Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States

IDEAL is a robust iterative technique for estimating water and fat signals on a voxel-basis, based on multi-echo data. In each iteration, two least-squares problems are solved. In this work, we reformulate each of the least-squares problems and solve them via Compressed Sensing (CS). We exploit the compressibility of both the water and fat images as well as smoothness of the field map to regularize our underdetermined systems of equations. The result is an up to 3x acceleration from the conventional IDEAL method.

14:30 ***4885*. Image Quality Parameters in MR Images, Reconstructed by Using Compressed Sensing**

Tobias Wech[1], Marcel Gutberlet[1], Daniel Stäb[1], Dietbert Hahn[1], Herbert Köstler[1]
[1]Institute of Radiology, University of Wuerzburg, Wuerzburg, Bavaria, Germany

Compressed sensing allows reconstructing undersampled data in the presence of sparse or compressible signals. However, up to now there are no studies that examine basic imaging parameters like image noise and spatial resolution for compressed sensing. In this work, methods were introduced to determine image quality parameters suitable for compressed sensing reconstructions and applied to to the compressed sensing of cardiac CINE imaging.

15:00 ***4886*. Spike Artifact Reduction in Nonconvex Compressed Sensing**

Thomas Christian Basse-Luesebrink[1,2], Thomas Kampf[1], Andre Fischer[1,3], Gesa Ladewig[2], Guido Stoll[2], Peter Michael Jakob[1,3]
[1]Experimental Physics 5, University of Wuerzburg, Wuerzburg, Germany; [2]Neurology, University of Wuerzburg, Wuerzburg, Germany; [3]Research Center for Magnetic Resonance Bavaria (MRB), Wuerzburg, Germany

Compressed sensing (CS), a reconstruction method for undersampled MR data, allows a significant reduction in experiment time. ^{19}F MR is a suitable target for CS since the ^{19}F signal distribution in vivo is sparse. However, spike artifacts appear highly pronounced in nonconvex CS reconstructions of noisy ^{19}F MR data. The present study focuses on the reduction of spike artifacts in these CS reconstructions. Therefore, a post-processing "de-spike algorithm" is proposed, using the fact that the spatial position of spike artifacts depends on the chosen sampling pattern. Numerical phantom simulations as well as *ex-* and *in-vivo* ^{19}F CSI experiments were performed.

Wednesday 13:30-15:30 Computer 112

13:30 ***4887*. Dictionary Design for Compressed Sensing MRI**

Ali Bilgin[1,2], Yookyung Kim[2], Feng Liu[2], Mariappan S. Nadar[3]
[1]Biomedical Engineering, University of Arizona, Tucson, AZ, United States; [2]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States; [3]Siemens Corporation, Corporate Research, Princeton, NJ, United States

The recently introduced Compressed Sensing (CS) theory promises to accelerate data acquisition in MRI. In this work, we propose a framework for designing and utilizing sparse dictionaries in CS MRI applications. Reconstruction results demonstrate that the proposed technique can yield significantly improved image quality compared to commonly used sparsity transforms in CS MRI.

14:00 ***4888*. 19F-Compressed-Sensing-CISS: Elimination of Banding Artifacts in 19F Bssfp MRI/CSI Without Sacrificing Time**

Thomas Christian Basse-Luesebrink[1,2], Andre Fischer[1,3], Thomas Kampf[1], Volker Sturm[1], Gesa Ladewig[2], Guido Stoll[2], Peter Michael Jakob[1,3]
[1]Experimental Physics 5, University of Wuerzburg, Wuerzburg, Germany; [2]Neurology, University of Wuerzburg, Wuerzburg, Germany; [3]Research Center for Magnetic Resonance Bavaria (MRB), Wuerzburg, Germany

Balanced ssfp (bssfp) MRI and CSI sequences show banding artifacts in either the image domain or the spectral domain. Those artifacts can be eliminated using a constructive interference in the steady state (CISS) technique. This, however, prolongs experiment

times due to the need of additional experiments with different phase cycles. Compressed sensing (CS), a reconstruction method for undersampled MR data allows reduction in measurement time. The present study focuses on the application of CS in bssfp ^{19}F-MRI/CSI in order to gain enough time for the acquisition of additional experiments with different phase cycles for CISS reconstruction.

14:30 ***4889*. Compressed Sensing with *a Priori* Information for Reconstruction of Remotely Detected Microfluidic Devices**

Thomas Z. Teisseyre[1,2], Jeffrey Paulsen[2], Vik Bajaj[2], Nicholas Halpern-Manners[2,3], Alexander Pines[2,3]

[1]Bioengineering, UC Berkeley/UCSF, Berkeley, CA, United States; [2]Materials Sciences Division, Lawrence Berkeley National Lab, Berkeley, CA, United States; [3]Chemistry, UC Berkeley, Berkeley, CA, United States

We developed a novel reconstruction technique for remotely detected microfluidic NMR using prior knowledge about the chip geometry. This technique allows significant amounts of subsampling for shorter acquisition times.

15:00 ***4890*. MR Rician Noise Reduction in Diffusion Tensor Imaging Using Compressed Sensing by Sampling Decomposition**

Jun Miao[1], Wen Li[1], Sreenath Narayan[1], Xin Yu[1], David L. Wilson[1,2]

[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States; [2]Radiology, University Hospitals of Cleveland

Reduction of Rician noise in MRI is very much desired, particularly in low signal-to-noise ratio (SNR) images such as diffusion tensor imaging. We used compressed sensing to reduce noise by decomposing full k-space data into multiple sets of incoherent subsamples, reconstructing full k-space individually, and aggregate them to be the final k-space data. Noise can be significantly suppressed in image and fractional anisotropy (FA) estimation can be significantly improved.

Thursday 13:30-15:30 Computer 112

13:30 ***4891*. Feasibility Study of Combining CS with SENSE for Catheter Visualization in MR Endovascular Intervention**

Jérôme Yerly[1,2], Michel Louis Lauzon, [23], Richard Frayne, [23]

[1]Department of Electrical and Computer Engineering, University of Calgary, Calgary, Alberta, Canada; [2]Seaman Family MR Research Centre, Foothills Medical Centre, Calgary, Alberta, Canada; [3]Departments of Radiology, and Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada

MR imaging is a promising alternative to x-ray fluoroscopy for guiding/monitoring catheters in endovascular intervention by offering many advantages. Conventional MR imaging has insufficient temporal resolution, but accelerated approaches such as sensitivity encoding (SENSE) and compressed sensing (CS) prove favorable via accurate reconstruction of undersampled k-space datasets. Since SENSE relies on coil sensitivity whereas CS depends on sparsity to recover the missing information, it may be advantageous to combine these two different methodologies. Previously, we demonstrated that CS alone accurately reconstructs catheter images. Here, we extend our catheter image reconstructions and investigate the potential of sequentially combining CS with SENSE.

14:00 ***4892*. Coarse-To-Fine Iterative Reweighted L_1-Norm Compressed Sensing for Dynamic Imaging**

Michael Lustig[1,2], Julia Velikina[3], Alexey Samsonov[3], Chuck Mistretta[3,4], John Mark Pauly[2], Michael Elad[5]

[1]Electrical Engineering and Computer Science, University of California Berkeley, Berkeley, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States; [4]Radiology, University of Wisconsin-Madison, Madison, WI, United States; [5]Computer Science, Technion IIT, Haifa, Israel

A coarse-to-fine compressed sensing (CS) reconstruction for dynamic imaging is presented. It is inspired by the composite image constraint in HYPR-like processing. At each temporal scale, a “composite” image is reconstructed using a CS reconstruction. The result is used as an initial image for the next finer scale. In addition it is used to generate weighting of the l1-norm in the CS reconstruction, promoting sparsity at locations that appear in the composite. Reconstruction from highly undersampled DCE-MRA is demonstrated.

14:30 ***4893*. Efficient Randomly Encoded Data Acquisition for Compressed Sensing**

Eric C. Wong[1]

[1]Radiology and Psychiatry, UC San Diego, La Jolla, CA, United States

Compressed sensing (CS) allows for efficient extraction of information from MR data, and benefits from incoherent sampling. We propose here an imaging strategy that simultaneously produces high steady state signal, high A/D duty cycle, and pseudo-random sampling functions, and is therefore both SNR efficient and amenable to CS reconstruction. The method uses rapid low flip angle pulses of random phase, along with a rosette gradient trajectory to produce an array of coherence pathways. Simulated data and reconstruction demonstrate simultaneous estimation of proton density, T2, and field maps from under-sampled data.

15:00 **4894. Faster Acquisition of MR Images with Double Quantum Filtering by Regularization**

Genevieve Guillot[1], Yongchao Xu[1], Slawomir Kusmia[1], Hadia Hanachi[1], Jean-François Giovannelli[2], Alain Herment[3]

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MRI with Double Quantum Filter (DQF) gives a direct access to water linked to macromolecules, but requires 16 up to 64 repetitions of the acquisition scheme with different phases of the RF pulses in the DQ filter to select the DQ signal. We reduced the number of phase encoding lines kept in the data for each DQF step, employing a regularization method to compute each image. The acquisition time could be reduced by 2/3 without any significant loss of contrast and minor loss of contrast on contours. Even faster acquisition should be possible with radial or spiral k-space trajectories.

Topics in Parallel Imaging

Hall B Monday 14:00-16:00 Computer 113

14:00 **4895. Noise-Facilitated GRAPPA Reconstruction for FMRI**

Hu Cheng[1], Wei Lin[2], Feng Huang[2]

[1]Indiana University, Bloomington, IN, United States; [2]Invivo Diagnostic Imaging, Gainesville, FL, United States

In fMRI, temporal SNR is the main concern in the optimization of parallel imaging algorithms such as GRAPPA. It is shown in this work that adding noise to the auto-calibration signal (ACS) region of GRAPPA data can increase the temporal SNR of fMRI series, with a minimal impact on image quality. Simulation on the EPI images of a phantom and human subject demonstrated that image quality can be improved by adding a certain amount of noise to the raw data of reference scans, while the temporal SNR can be further improved with a higher level of additive ACS noise.

14:30 **4896. Undersampled Multi Coil Image Reconstruction for Fast FMRI Using Adaptive Linear Neurons**

Thimo Grotz[1], Benjamin Zahneisen[1], Marco Reisert[1], Maxim Zaitsev[1], Jürgen Hennig[1]

[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany

Standard fMRI experiments have a rather limited temporal resolution of 1-3s. The temporal resolution of fMRI experiments can be increased by an order of magnitude by acquiring less k-space and using a high number of receive channels. Image reconstruction is thus an ill-posed inverse problem. Here we would like to introduce a new approach, based on neural networks, to reconstruct the undersampled fMRI data that offers a significantly improved point spread function with reduced spatial spread and hence improved spatial localization of activation.

15:00 **4897. Time Dependent Regularization for Functional Magnetic Resonance Inverse Imaging**

Aapo Nummenmaa[1,2], Matti S. Hamalainen[1], Fa-Hsuan Lin[1,3]

[1]MGH-MIT-HMS Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States; [2]Department of Biomedical Engineering and Computational Science, Helsinki University of Technology, Espoo, Finland; [3]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan

We propose a novel method for time dependent regularization of functional magnetic resonance Inverse Imaging (InI). A Variational Bayesian approximation with a dynamic model for the regularization is constructed to obtain an automatic, temporally adaptive estimation algorithm. The proposed method is compared with the standard Minimum-Norm Estimate (MNE) by using simulated InI data. The dynamic dMNE shows significant improvements in determining the activation onset from the baseline period.

15:30 **4898. Magnetic Resonance Multi-View Inverse Imaging (MV InI) for Human Brain**

Kevin Wen-Kai Tsai[1], Thomas Witzel[2], Fa-Hsuan Lin[1,3]

[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan; [2]A. A. Martinos Center; [3]A. A. Martinos Center, Massachusetts General Hospital, Charlestown, MA, United States

To solve the anisotropic spatial resolution of MR inverse imaging (InI) reconstruction method, we propose the multi-view InI (MV InI) to using a few projections and a highly parallel detection to achieve high spatiotemporal MR dynamic imaging. Specifically, we used three orthogonal projections and a 32-channel head coil array to achieve the effective TR of 300 ms and 4 mm3 isotropic spatial resolution. We demonstrated the acquisitions and reconstruction of MV InI using in vivo data. This method achieved a 8 times faster temporal resolution than conventional multi-slice EPI acquisitions.

Tuesday 13:30-15:30 Computer 113

13:30 **4899. Homotopic l_0 Minimization Technique Applied to Dynamic Cardiac MR Imaging**

Muhammad Usman[1], Philip G. Batchelor[1]

[1]King's College London, London, United Kingdom

The L1 minimization technique has been empirically demonstrated to exactly recover an S-sparse signal with about 3S-5S measurements. In order to get exact reconstruction with smaller number of measurements, recently, for static images, Trzasko has

proposed homotopic L0 minimization technique. Instead of minimizing the L0 norm which achieves best possible theoretical bound (approximately 2S measurements) but is a NP hard problem or L1 norm which is a convex optimization problem but requires more measurements, the homotopic technique minimizes iteratively the continuous approximations of the L0 norm. In this work, we have extended the use of homotopic L0 method to dynamic MR imaging. For dynamic 2D CINE data, using five different non-convex functional approximations to L0 norm, we have compared the performance of homotopic L0 minimization technique with the standard L1 method.

14:00 ***4900*****. Fast Time-Resolved Cine Sequence Using Temporal Regularization for Small Animal Cardiac Imaging on a Clinical 3T Scanner**

Bénédicte Delattre[1], Vincent Braunersreuther[2], Jean-Noël Hyacinthe[1], Jean-Paul Vallée[1], Dimitri Van De Ville[3,4]
[1]University of Geneva - Faculty of medicine, Geneva, Switzerland; [2]Division of Cardiology - Department of Medicine, Geneva University Hospital - Foundation for medical researchers, Geneva, Switzerland; [3]Department of Radiology and Medical Informatics - University of Geneva, Geneva, Switzerland; [4]Institute of Bioengineering - Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

Small animal cardiac imaging on clinical scanners allows contributing effectively to translational medicine. However, hardware limitations prevent obtaining the same space and time resolution than with dedicated instrumentation. Here, we propose a novel method to improve time resolution for cardiac mouse imaging. By combining two fast repetitions with temporal regularization based on l1-minimization in the Fourier domain, we achieve a TR=6.5 ms with an in-plane resolution of 257 μm^2 and reduce efficiently artifacts resulting from the combination of the two repetitions.

14:30 ***4901*****. Four-Dimensional Analytical Cardiac Magnetic Resonance Imaging Phantom in the Fourier Domain**

David Moratal[1], Lei Hou Hamilton[2], Senthil Ramamurthy[3], Marijn Eduard Brummer[3]
[1]Universitat Politècnica de València, Valencia, Spain; [2]Georgia Institute of Technology, Atlanta, GA, United States; [3]Emory University, Atlanta, GA, United States

The value of a standardized simulation phantom to test and compare reconstruction methods for cardiac imaging has become evident during last years. In this work, a 4D analytical phantom in the Fourier domain is proposed, aimed to serve as a flexible, objective, standardized benchmark for evaluation and comparison of different image reconstruction techniques in dynamic 3D MRI. It can be used to compare different non-Cartesian encoding schemes and reconstruction methods, as well as different cardiac MRI acceleration strategies. The k-space signal for the 4D phantom can be evaluated analytically and sampled accordingly to any chosen k-space trajectory or encoding scheme.

15:00 ***4902*****. RF Excitation Encoding: A Fast Imaging Technique for Dynamic Studies**

Yanle Hu[1], Gary H. Glover[2]
[1]Imaging Research Center, University of Texas at Austin, Austin, TX, United States; [2]Department of Radiology, Stanford University, Stanford, CA, United States

Fast imaging techniques based on under-sampling are all approaching the problem from the acquisition side. Less effort has been involved in exploring the possibility of speeding up image acquisition from the excitation side. Although parallel excitation is focused on the excitation side, it is typically used to reduce the RF pulse duration rather than accelerate image acquisition. In this work, a new technique is introduced to speed up image acquisition from the excitation side. This technique is independent of other techniques focused on the acquisition side and thus may be combined with them to achieve a higher acceleration factor.

Wednesday 13:30-15:30 Computer 113

13:30 ***4903*****. Analytic Image SENSE Reconstruction for Dynamic PMRI**

Josiane Yankam Njiwa[1], Christof Baltes[1], Markus Rudin[1,2]
[1]ETH-University Zurich, Institute for Biomedical Engineering, Zurich, Switzerland; [2]University Zurich, Institute of Pharmacology & Toxicology, Zurich, Switzerland

Dynamic susceptibility (DSC) MRI is increasingly being used to evaluate cerebral microcirculation. In this study is proposed an acquisition scheme, combining partial k-space sampling and pMRI, allowing higher gains for DSC perfusion measurements in small animals. Three male Lewis rats were imaged and a T2*- weighted FLASH sequence was performed for data acquisition. The results show that the used method satisfactory reconstruct DSC-MRI while preserving a good reconstruction quality and image characteristics compared to the non-accelerated and SENSE reconstructed image series. The combination of an Analytic Image based reconstruction with SENSE to reconstruct the images series increase the temporal resolution.

14:00 ***4904*****. Application of Hybrid Through-Time/k-Space Radial GRAPPA Calibration to Real-Time Cardiac Imaging**

Nicole Seiberlich[1], Philipp Ehses[2], Jeffrey L. Duerk, [1,3], Robert Gilkeson[1], Mark A. Griswold[1,3]
[1]Radiology, Case Western Reserve University, Cleveland, OH, United States; [2]Experimentelle Physik V, Universitaet Wuerzburg, Wuerzburg, Germany; [3]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

While standard radial GRAPPA can be used to reconstruct images with low undersampling factors, its primary assumption (that segments of the radial lines can be approximated as Cartesian) breaks down at high acceleration factors. A new through-time

calibration method has recently been proposed; this method yields high image quality, but requires large numbers of calibration frames. The method proposed here uses through-k-space segments as well as repetitions through time to reduce the number of calibration frames needed while maintaining image quality. This hybrid radial GRAPPA calibration method is demonstrated for real-time, ungated cardiac acquisitions with frame rates of 43 ms.

14:30 ***4905*.** **On the Optimal Acceleration of Time-Resolved 3D Imaging Using GRAPPA**

Bernd André Jung[1], Simon Bauer[1], Michael Markl[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital, Freiburg, Germany

The aim of this work was to explore how to optimally undersample and reconstruct time-resolved 3D data using GRAPPA. Two different data sets were acquired in a moving phantom with isotropic and anisotropic data matrices. Reconstruction was performed with 3D- (kx,ky,t) and 4D-kernel (kx,ky,kz,t) configurations. For the symmetric data matrix, it was demonstrated that the 4D-kernel configuration leads to better results in terms of error behaviour. However, in a more realistic anisotropic data matrix typically used in clinical applications the different kernel configurations show an opposite behaviour. Furthermore, noise enhancement for 4D-kernel configuration was more pronounced compared to 3D-configurations.

15:00 ***4906*.** **A Nonlinear GRAPPA Method for Improving SNR**

Yuchou Chang[1], Dong Liang[1], Leslie Ying[1]
[1]Electrical Engineering and Computer Science, University of Wisconsin-Milwaukee, Milwaukee, WI, United States

This abstract presents a nonlinear GRAPPA method to address the poor SNR of GRAPPA at high reduction factors. The method is motivated by the fact that nonlinear filtering usually outperforms linear ones in denoising. The proposed method uses a nonlinear combination of the acquired k-space data to estimate the missing data. The experimental results demonstrate that the proposed method is able to improve the SNR of GRAPPA at high reduction factors.

Thursday 13:30-15:30 Computer 113

13:30 ***4907*.** **Generalized PRUNO Kernel Selection by Using Singular Value Decomposition (SVD)**

Jian Zhang[1], Chunlei Liu[2], Michael Moseley[3]
[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, United States; [3]Department of Radiology, Stanford University, Stanford, CA, United States

Parallel Reconstruction Using Null Operations (PRUNO) is an iterative k-space based reconstruction method for Cartesian parallel imaging. One particular challenge in PRUNO is to select a set of proper nulling kernels. In this work, we demonstrate an improved kernel selection strategy to create generalized PRUNO kernels from the Singular Value Decomposition (SVD) of calibration data. Furthermore, by introducing composite kernels prior to the conjugate-gradient (CG) reconstruction, the reconstruction time wouldn't increase much when a large number of kernels are used. These new strategies boost the robustness of PRUNO with faster algorithm convergence and lower noise sensitivity.

14:00 ***4908*.** **Image Reconstruction from Phased-Array Mri Data Based on Multichannel Blind Deconvolution**

Huajun She[1], RongRong Chen[1], Dong Liang[2], Yuchou Chang[2], Leslie Ying[2]
[1]Department of Electrical and Computer Engineering, University of Utah, Salt Lake City, UT, United States; [2]Department of Electrical Engineering and Computer Science, University of Wisconsin-Milwaukee, Milwaukee, WI, United States

In this abstract we consider image reconstruction from multichannel phased array MRI data without prior knowledge of the coil sensitivity functions. A new framework based on multichannel blind deconvolution (MBD) is developed for joint estimation of the image function and the sensitivity functions in k-space. By exploiting the smoothness of the image and sensitivity functions in the spatial domain, we develop a regularized MBD method to obtain both the image function and sensitivity functions. Simulation and in vivo experimental results demonstrate that the proposed method reconstructs images with more uniform intensity than the SoS method does.

14:30 ***4909*.** **KLT-GRAPPA: A New Method to Estimate Auto-Calibration Signal in Dynamic Parallel Imaging**

Yu Ding[1], Mihaela Jekic[1], Yiu-Cho Chung[2], Orlando P. Simonetti[1]
[1]The Ohio State University, Columbus, OH, United States; [2]Siemens Medical Solutions, Columbus, OH, United States

TSENSE and TGRAPPA are widely used parallel acquisition methods that can dynamically update the sensitivity map to accommodate variations caused by physiological motion. These methods use temporal low-pass filtering or sliding window averaging to estimate a dynamically changing sensitivity map. We propose to use the Karhunen-Loeve Transform filter to generate a frame-by-frame estimate of the time-varying channel sensitivity. In-vivo experiments showed that the new method significantly reduces the artifact level in TGRAPPA reconstruction compared to traditional approaches.

15:00 ***4910*.** **Auto-Calibrated Parallel Imaging Using a Distortion-Optimal Filter-Bank**

Behzad Sharif[1], Yoram Bresler[1]
[1]Electrical and Computer Engineering, Coordinated Science Laboratory, University of Illinois at Urbana-Champaign, Urbana, IL, United States

We presented a k-space-based self-calibrating parallel MRI reconstruction technique, dubbed ACSIOM, which estimates a GRAPPA-type interpolation kernel by jointly minimizing data inconsistency and aliasing distortion. In imaging scenarios where high effective acceleration is desired, the capability to reconstruct artifact-free images with minimal amount of reference (auto-calibration scan) data is needed. In such cases, we have shown that ACSIOM outperforms two different implementations of GRAPPA. The results indicate that improved image quality, and thus greater scan time reductions compared to GRAPPA can be achieved.

RF Shimming & Parallel RF

Hall B Monday 14:00-16:00 Computer 114

14:00 ***4911*.** **Combination of Basic and Tailored RF Shimming Using Curved Spoke Trajectories**

Ulrich Katscher[1], Peter Börnert[1]
[1]Philips Research Europe, Hamburg, Germany

Generally, two RF shimming approaches are reported. The first approach, "basic" RF shimming via adjusting the channels' drive weights, is stable and fast, however, has limited shimming potential. The second approach, "tailored" RF shimming via multidimensional RF pulses, is more complex and requires significant sequence modifications, however, has superior shimming potential. This study investigates a compromise combining the advantages of both approaches. It applies a slight curvature of the "straight" k-space trajectory of standard slice selective excitation, maintaining short pulse durations, and sharp slice profiles. Simultaneously, it allows higher freedom for in-plane B1 variation, yielding an enhanced shimming potential.

14:30 ***4912*.** **A New Class of Encoding Techniques Using a Transmit Array: Illustration with Cylindrical Encoding**

Emre Kopanoglu[1,2], Adil Firat Yilmaz[1,2], Taner Demir[2], Vakur B. Erturk[1], Ergin Atalar[1,2]
[1]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey; [2]UMRAM - National Research Center for Magnetic Resonance , Ankara, Turkey

In nearly all magnetic resonance imaging applications, data encoding is made by gradient coils, which limit the slice to a plane and the field-of-view (FOV) to a rectangle although the region-of-interest (ROI) can have an arbitrary shape. In this paper we propose a novel encoding scheme for arbitrarily shaped slices, so that the need to get unnecessary data from outside the ROI is eliminated. The proposed method uses multi-dimensional pulses for slice selection and RF pulses to encode the data instead of gradient coils, hence a slice with an arbitrary shape and FOV can be selected.

15:00 ***4913*.** **Comparison of Whole Body Transmit Coil Configurations for RF Shimming at 3T**

Kay Nehrke[1], Ulrich Katscher[1], Peter Börnert[1], Ingmar Graesslin[1]
[1]Philips Research Europe, Hamburg, Germany

Whole body MRI at 3T may be impeded by B1 transmit field inhomogeneities caused by the dielectric shortening of the RF wavelength. RF shimming techniques based on parallel transmission can strongly improve the image quality in clinical whole body applications. In this context, it is an important question, how the RF shimming performance depends on the chosen coil topology and, in particular, on the number of transmit channels. In the present work, an 8-channel transmit system is used for B1 mapping and shimming, providing the flexibility of emulating different coil configurations and comparing their RF shimming performance.

15:30 ***4914*.** **T1 Weighted Whole Brain Imaging with Uniform Contrast at 3T Using Parallel Transmission**

Shaihan J. Malik[1], Shiva Keihaninejad[2], Alexander Hammers[2,3], Joseph V. Hajnal[4]
[1]Robert Steiner MRI Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom; [2]Division of Neuroscience and Mental Health, Imperial College London, London, United Kingdom; [3]Neurodis Foundation, CERMEP - Imagerie du Vivant, Lyon, France; [4]Robert Steiner MRI Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, United Kingdom

T1 weighted brain imaging at 3T suffers from contrast variation caused by B1 field inhomogeneity. This can lead to reduced conspicuity of key anatomical structures; particularly the deep grey matter nuclei. We present a 3D tailored RF pulse using parallel transmission which produces uniform excitation over the whole brain incorporated into a standard MPRAGE sequence. The resulting images demonstrate more uniform contrast than those acquired with standard RF pulses and result in more accurate depiction and automated segmentation of deep grey matter structures.

Tuesday 13:30-15:30 Computer 114

13:30 ***4915***. **Image Quality Improvements for Balanced TFE at 3.0T Using a Clinical Parallel RF Transmission MR System**

Trevor Andrews[1,2], Melanie Kotys[1], Marc Kouwenhoven[3], Jay Gonyea[2], Takamaru Ashikaga[2], George Gentchos, [2,4]
[1]Philips Healthcare, Cleveland, OH, United States; [2]College of Medicine, University of Vermont, Burlington, VT, United States; [3]Philips Healthcare, Best, Netherlands; [4]Radiology, Fletcher Allen Health Care, Burlington, VT, United States

Cardiac MR imaging with steady state free precession sequences suffer from at least two image quality problems at 3T: excessive banding artifacts and suboptimal contrast due to inadequate flip angle. In this study RF shimming was utilized to address these issues. Results from 8 subjects demonstrated improved blood-to-septum contrast and radiologist-assessed image quality. For one choice of parameters banding artifacts were effectively eliminated in all subjects while maintaining good overall image quality.

14:00 ***4916***. **Multi-Slice Parallel Excitation Reduced FOV Imaging for Rodent EPI Applications**

Denis Kokorin[1,2], Martin Haas[1], Maxim Zaitsev[1]
[1]Dept. of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany; [2]International Tomography Center, Novosibirsk, Russian Federation

The technique of parallel transmission in combination with spatially selective excitation allows for reduction of the field of view in the phase encoding direction. In this study the novel principle of multi-slice inner volume imaging is presented and the advantages are illustrated when combined with single shot EPI. The method was implemented successfully in DWI applications on the Bruker BioSpec animal system.

14:30 ***4917***. **Parallel Excitation of a 3D ROI Inside a Post Mortem Brain**

Kaveh Vahedipour[1], Tony Stöcker[1], Daniel Brenner[1], N Jon Shah[1,2]
[1]Institute of Neuroscience and Medicine, Forschungszentrum Jülich, Jülich, Germany; [2]Department of Neurology, RWTH Aachen University, Aachen, Germany

This work demonstrates the excitation of a 3D ROI within a post mortem brain by parallel RF transmission at 4T.

15:00 ***4918***. **A Simple and Analytical Way to Correct for δB0 Inhomogeneity in the Evaluation of B1 Maps Relying on Flip Angle Measurements and Non-Selective Square Pulses**

Nicolas Boulant[1], Martijn Cloos[1], Alexis Amadon[1]
[1]NeuroSpin, CEA, Gif sur Yvette, France

Efficient mitigation of the radiofrequency inhomogeneity at high field using coil arrays relies on the accurate knowledge of the individual B1 maps. To date, no simple recipe has been formulated to correct for B0 inhomogeneity in the evaluation of the B1 maps themselves. Here we derive a simple analytical approximation to increase the accuracy of the B1 mapping techniques which rely on the measurement of the flip angle using non-selective square pulses, in the presence of B0 variations. In some possibly encountered cases, applying the correction reduces the error of the estimated B1 amplitude from 13 % to 0.2 %.

Wednesday 13:30-15:30 Computer 114

13:30 ***4919***. **Improving RF Shimming Via Non-Linear Sub-Image Combination**

Ulrich Katscher[1], Peter Vernickel[1], Kay Nehrke[1], Ingmar Graesslin[1]
[1]Philips Research Europe, Hamburg, Germany

RF shimming is able to overcome B1 inhomogeneities at high main fields via optimizing the drive weights of multiple transmit channels. However, due to the limited degrees of freedom in this approach, residual B1 inhomogeneities might occur for particular anatomies. This study tries to mitigate residual B1 inhomogeneities by a suitable, non-linear combination of images obtained from different sub-images. The sub-images have been acquired using different drive weights of the transmit channels, leading to complementary inhomogeneities in the different sub-images. The subsequent combination of the sub-images can be optimized with respect to constant total B1 and constant image contrast.

14:00 ***4920***. **Enhanced Slab Selective Brain Imaging at 3T Using Wide Band Tailored RF Pulses**

Shaihan J. Malik[1], Joseph V. Hajnal[1]
[1]Robert Steiner MRI Unit, Imaging Sciences Department, MRC Clinical Sciences Centre, Hammersmith Hospital, Imperial College London, London, United Kingdom

Short (~2ms) 2DRF B1 inhomogeneity mitigation pulses designed to give broadband uniformity with a controlled excitation in fat were integrated into a T1 weighted MPRAGE sequence. No SAR increase was experienced compared with a standard sequence, but improved grey/white matter contrast was observed.

14:30 **_4921_. Sparse Parallel Transmission Using Optimized Sparse K-Space Trajectory by Simulated Annealing**

Yong Pang[1], Xiaoliang Zhang[2,3]
[1]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA , United States; [2]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA, United States; [3]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco & Berkeley, CA, United States

The combination of parallel transmission and sparse pulse is able to shorten the excitation duration by using both the coil sensitivity and sparse k-space. In this work, a novel sparse parallel transmission design based on optimal k-space trajectory is proposed. After undersampling the k-space, the simulated annealing (SA) algorithm is applied to design a short k-trajectory traveling through all the sparse samples. Almost without sampling useless k-space data, this k-trajectory is shorter than conventional trajectories and thus shortening the pulse width. Bloch simulation of 90^{O} excitation has been performed to demonstrate the feasibility of this method.

15:00 **_4922_. Improved SNR/g Using Small FOV Spatially Selective Pulses with Parallel Excitation**

Mike J. Smith[1], Scott B. King[1], Matthew Sodomsky[1], Peter Latta[1], Jarod Matwiy[1], Ulrich Fontius[2], Franz Schmitt[2], Boguslaw Tomanek[1]
[1]National Research Council, Winnipeg, Manitoba, Canada; [2]Siemens Medical Solutions, Erlangen, Germany

Transmit array systems generate improved spatially selective excitation profiles while mitigating RF power disposition. We used our 3T Siemens 8-channel transmit system for small FOV excitation to improve parallel imaging SNR when the sample exceeds the ROI. We ensure that excitation artifact signals are below the image noise level, making the g-factor maps ideal (unity) and effective reduction factors greater than what would typically be used for a particular array become possible.

Thursday 13:30-15:30 Computer 114

13:30 **_4923_. Eddy-Current-Compensated RF Pulse Design for Parallel Excitation**

Hai Zheng[1], Tiejun Zhao[2], Tamer Ibrahim[1], Fernando Emilio Boada[1]
[1]MR Research Center, University of Pittsburgh, Pittsburgh, PA, United States; [2]Siemens Medical Systems, Malvern, PA, United States

High-performance RF coils for high or ultra high field MRI often require the use of RF shields that are in close proximity to the imaged volume. These shields can sometimes generate Eddy-currents that are not adequately compensated for using the pre-emphasis algorithm of the scanner and lead to severe distortions in the desired excitation pattern. In this work, we introduce a simple yet effective method for designing eddy-current-compensated parallel transmit RF pulses and demonstrate its effectiveness using simulations as well as experimental data at 7T.

14:00 **_4924_. VERSE-Guided Numerical RF Pulse Design**

Daeho Lee[1], William Allyn Grissom[1], Michael Lustig[1], John Mark Pauly[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States

Numerical optimization-based RF pulse design methods are widely used to incorporate system non-idealities and non-linearities such as field inhomogeneities, coil sensitivities, and signal decay. These approaches often lead to RF pulses with high peak RF magnitude exceeding the hardware or safety limits and the variable-rate selective excitation (VERSE) principle can be utilized to directly constrain the peak RF power on-the-fly. However, discrete-time implementations of VERSE may not preserve spins' rotational behavior due to the imperfect system modeling and sampling. Also, the excitation profile of reshaped pulses is affected by time-dependencies that are not accounted for in VERSE. To effectively correct these errors while achieving a fast peak RF power control, VERSE-guided numerical RF pulse design framework is introduced for parallel transmit applications.

14:30 **_4925_. GrIP: Gradient Iterative Predistortion for Multidimensional and Parallel Excitation**

William A. Grissom[1], Adam B. Kerr[1], Pascal P. Stang[1], Michael Lustig[2], Greig C. Scott[1], John M. Pauly[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Electrical Engineering, University of California, Berkeley, Berkeley, CA, United States

Multidimensional and parallel excitation pulses are highly sensitive to trajectory imperfections resulting from eddy currents and gradient amplifier nonlinearity. It has been recently proposed to solve this by redesigning RF pulses on measured trajectories; however, this approach is not compatible with RF pulse design methods in which the RF and gradients are designed jointly. We introduce an iterative technique for gradient preemphasis for multidimensional and parallel excitation. The method is capable of overcoming gradient amplifier non-linearities, and obviates the need to redesign pulses on a measured trajectory.

15:00 **_4926_. Using Dedicated Fieldprobes for Trajectory Measurements in Parallel Excitation Experiments**

Johannes Thomas Schneider[1], Christoph Barmet[2], Wolfgang Ruhm[1], Klaas Paul Pruessmann[2], Peter Ullmann[1]
[1]Bruker BioSpin MRI GmbH, Ettlingen, Germany; [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Several studies have demonstrated the benefit of measuring actually traversed k-space trajectories and incorporating this information into the design process of parallel spatially-selective excitation (PEX) pulses. However, most of the applied measurement techniques

are based on phase evolutions in situ within the object. This leads to a strong dependency of data-quality and -reliability on the imaged objects. To overcome these limitations, a newly developed D2O-fieldprobe was used in this study in order to acquire object-independent trajectory data. This allows robust measurements of calibration data for the calculation of PEX pulses and results in high excitation accuracy under various experimental conditions.

Large-tip-angle & SAR in Parallel RF Contrast Agents & their Detection

Hall B Monday 14:00-16:00 Computer 115

14:00 ***4927.*** **Bloch Simulation Acceleration for Fast Pulse Design in Parallel Transmit**

Seung-Kyun Lee[1], Dan Xu[2], Silke M. Lechner[3,4], Mika W. Vogel[3]
[1]GE Global Research, Niskayuna, NY, United States; [2]Applied Science Laboratory, GE Healthcare, Waukesha, WI; [3]Advanced Medical Applications Laboratory, GE Global Research, Munich, Bavaria, Germany; [4]Department of Scientific Computing in Computer Science, Technical University Munich, Munich, Bavaria, Germany

Analytical and computational methods are presented to accelerate Bloch simulation for optimal control-based RF pulse design in parallel transmit. In the first method, the cost and steepest descent calculation in optimal control theory is performed in a frame of reference in which local longitudinal magnetic fields are transformed away analytically. In the second method we demonstrate an order-of-magnitude enhancement in iterative calculation speed as we shift the calculation load from the conventional Central Processing Unit to a Graphics Processing Unit. Both methods were tested in simulated 8-channel pTx pulse design.

14:30 ***4928.*** **Optimized Chemical Shift Selective Suppression for PTx Systems at 7T**

Rene Gumbrecht[1,2], Borjan Gagoski[1], Elfar Adalsteinsson[1,3]
[1]Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States; [2]Department of Physics, Friedrich-Alexander-University, Erlangen, Germany; [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Parallel RF transmission offers flexible control of magnetization generation and has been successfully applied at 7T for spatially tailored excitations and mitigation of in-plane B1+ inhomogeneity for slice-selection. CHESS pulses are known to provide good frequency selective suppression in proton spectroscopy as long as B1+ inhomogeneity is small. We propose an optimized CHESS pulse design for pTx systems with high variation in peak-to-trough excitation field magnitude.

15:00 ***4929.*** **Large Tip Angle Parallel Excitation Using Nonlinear Non-Bijective PatLoc Encoding Fields**

Martin Haas[1], Peter Ullmann[2], Johannes T. Schneider, [1,2], Wolfgang Ruhm[2], Jürgen Hennig[1], Maxim Zaitsev[1]
[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Bruker BioSpin MRI GmbH, Ettlingen, Germany

The nonlinear non-bijective "PatLoc" fields recently proposed for anatomically tailored readout encoding are examined in combination with RF transmission for 2D spatially selective excitation. It is shown that parallel transmission is necessary to resolve encoding ambiguities but that PatLoc encoding allows for higher resolution magnetization patterns to be generated locally as compared to conventional linear encoding fields. The RF pulse design is based on the optimal control algorithm introduced by D. Xu et al. MRM 59, 547 (2008), which has been generalized to the regime of nonlinear non-bijective encoding fields.

15:30 ***4930.*** **SAR Benefits of Including E-Field Interactions in Parallel RF Pulse Design**

Cem Murat Deniz[1,2], Leeor Alon[1,2], Riccardo Lattanzi[1,2], Daniel K. Sodickson[1], Yudong Zhu[1]
[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States; [2]Sackler Institute of Graduate Biomedical Sciences, NYU School of Medicine, New York, NY, United States

SAR management and excitation homogeneity are critical aspects of RF pulse design at ultra-high magnetic field strength. We investigated the effects on SAR behavior of incorporating measurable E-field interactions into parallel transmission RF pulse design. We simulated three different transmit coil array configurations using two different coil loadings, a human mesh and a homogeneous water phantom. Small-tip-angle and linear class large-tip-angle pulses were employed. We found that global SAR during parallel excitation decreases when E-field interactions are included in RF pulse design optimization. Larger global SAR benefits were achieved for lower accelerations and for human mesh data.

Tuesday 13:30-15:30 Computer 115

13:30 ***4931*. A Fast Algorithm for Local-1gram-SAR Optimized Parallel-Transmit RF-Pulse Design**

Alessandro Sbrizzi[1], Hans Hoogduin[2], Jan J. Lagendijk[2], Peter Luijten[2], Gerard Sleijpen[3], Cornelis A. van den Berg[2]
[1]Imaging Division, UMC utrecht, Utrecht, Netherlands; [2]UMC Utrecht; [3]Mathematics, Utrecht University

In this paper we present a novel approach to the fast design of local SAR optimized multidimensional spatially selective RF pulses. It is based on the application of a multi-shift Conjugate Gradients (mCGLS) algorithm for computing RF pulses whose resulting local 1 gram SAR is more uniformly distributed, lowering the maximal value over the whole 3D spatial domain. The method was validated by simulations showing a reduction of 23% of the maximal SAR.

14:00 ***4932*. Local SAR Constrained Hotspot Reduction by Temporal Averaging**

Ingmar Graesslin[1], Christian Steiding[1], Bjoern Annighoefer[2], Julia Weller[1], Sven Biederer[3], David Brunner[4], Hanno Homann[1], Ferdinand Schweser[5], Ulrich Katscher[1], Klaas Pruessmann[4], Peter Boernert[1]
[1]Philips Research Europe, Hamburg, Germany; [2]TU Hamburg-Harburg, Hamburg, Germany; [3]Institute of Medical Engineering, University of Lübeck, Lübeck, Germany; [4]University and ETH Zurich, Zurich, Switzerland; [5]IDIR / University Clinics, Jena, Germany

With increasing field strength the local specific absorption rate (SAR) becomes a limiting factor for many MR imaging applications. Minimal SAR RF pulses can be selected from the large solution space due to the extra degrees of freedom in the RF pulse design. This paper extends the recently proposed temporal averaging approach for local SAR reduction with multiple local SAR constraints. It successively applies multiple RF pulses with similar target excitation patterns, but different spatial SAR distributions, for averaging out local hotspots. The concept was validated by simulations and initial experiments on an 8-channel TX MRI system.

14:30 ***4933*. Characterization of Adiabatic Pulse Prepared Cell Imaging of Iron Oxide Nanoparticles**

Steven Harris[1], Chase Kessinger[2], Jinming Gao[2], Hongwei Chen[3], Hui Mao[3], Xiaoping Hu[1]
[1]Biomedical Engineering, Georgia Institute of Technology / Emory University, Atlanta, GA, United States; [2]Simmons Comprehensive Cancer Center, University of Texas Southwestern Medical Center, Dallas, TX, United States; [3]Department of Radiology, Emory University School of Medicine, Atlanta, GA, United States

An adiabatic preparation pulse is used to produce an increasing contrast with increasing iron oxide nanoparticle concentration in cell and tumor models. The adiabatic condition has been shown to fail leading to a contrast for spins diffusing near the nanoparticles. We show that the adiabatic contrast is linearly correlated with R2 over the range of iron loading tested. Also, increasing contrast is observed in a tumor region confirmed by histology to contain nanoparticles in a model of tumor angiogenesis. This technique has the potential for cellular imaging and quantification as it is less sensitive magnetization transfer and B0 homogeneity.

15:00 ***4934*. Local SAR Reduction Based on Channel-Dependent Tikhonov Parameters**

Martijn Anton Cloos[1], Michel Luong[2], Guillaume Ferrand[2], Alexis Amadon[1], Dennis Le Bihan[1], Nicolas Boulant[1]
[1]CEA, DSV, I2BM, NeuroSpin, LRMN, Gif-sur-Yvette, France; [2]CEA, DSM, IRFU, SACM, Gif-sur-Yvette, France

The possibility of high local SAR values can be a limiting factor to in-vivo transmit-SENSE applications at high field. In this work we introduce a novel method to reduce the local SAR and demonstrate its application based on simulations. When considering the human head at 7T, the proposed method demonstrates local SAR reductions up to a factor of 6.

Wednesday 13:30-15:30 Computer 115

13:30 ***4935*. Selective Positive Contrast of Subvoxel Field-Disturbers Using Off-Resonance Excitation**

Gerrit Hendrik van de Maat[1], Hendrik de Leeuw[1], Peter R. Seevinck[1], Chris J.G Bakker[2]
[1]Image Sciences Institute, Utrecht, Netherlands; [2]Department of Radiology, University Medical Center, Utrecht, Netherlands

It is feasible to excite protons that reside in the vicinity of Holmium loaded microspheres inside a voxel by shifting the center frequency f_0 of the rf-excitation pulse. Due to this frequency shift, on-resonance protons are not excited and signal is only generated by protons strongly influenced by the dipole fields invoked by the microspheres. The total signal intensity of a voxel is related to the concentration HoMS in that voxel. The resulting positive contrast can be manipulated by the user since it will depend on the excitation bandwidth and profile and on the f0 frequency shift.

14:00 ***4936*.** **Combined Off-Resonance Imaging and Relaxation in the Rotating Frame for Positive Contrast Imaging of Infection in a Murine Burn Model**

Valeria Righi[1,2], Dionyssios Mintzopoulos[1,2], Ovidiu C. Andronesi[1,2], Jianxin He[3], George Dai[2], Laurence G. Rahme[3], A Aria Tzika[1,2]

[1]NMR Surgical Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States; [2]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Athinoula A. Martinos Center for Biomedical Imaging, Boston, MA, United States; [3]Molecular Surgery Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States

We employed positive-contrast MRI in a murine model of burn and infection. We used off-resonance imaging (ORI) and a novel method of combining off-resonance imaging and relaxation in the rotating frame (ORI-T2ρ). We imaged accumulation of ultra-small super-paramagnetic iron oxide (USPIO) nanoparticle-labeled macrophages at the infection site in mice, which were burned and infected with Pseudomona aeruginosa. We concluded that ORI-T2ρ is more sensitive than ORI in detecting USPIOs and that we can successfully detect infection with positive contrast imaging, which opens up perspectives for monitoring infection and testing anti-infectives.

14:30 ***4937*.** **Quantification of Bound Contrast Agent Concentration Using Delta Relaxation Enhanced MR**

Jamu K. Alford[1], Blaine A. Chronik[1]

[1]Physics and Astronomy, The University of Western Ontario, London, ON, Canada

Delta relaxation enhanced magnetic resonance (dreMR) is an emerging method for performing molecular imaging, which utilizes a removable electromagnetic coil to modify the strength of the main magnetic field during an MRI pulse sequence. The purpose of this field-cycling method is to acquire information about the binding state of targeted contrast agents that is not obtainable with static-field MRI methods. This work describes a method for advancing dreMR from qualitative imaging to quantitative measurement of contrast agent binding. By measuring the concentration of bound agent, the corresponding concentration of the target molecule can determined.

15:00 ***4938*.** **Rigidity of the Microscopic Environment Surrounding the Binding Site of Magnetic Nanoparticles**

John B. Weaver[1], Adam M. Rauwerdink[2]

[1]Radiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH, United States; [2]Thayer School of Engineering, Dartmouth College, Hanover, NH, United States

The microscopic stiffness of cellular cytoskeleton and the extracellular matrix have been very important in understanding metastasis and angiogenesis but no methods capable of in vivo measurement exist. We show that a new method related to magnetic particle imaging (MPI) called magnetic spectroscopy of nanoparticle Brownian motion (MSB) is sensitive to the stiffness of the microscopic environment surrounding the binding sites of the streptavidin functionalized nanoparticles. The matrix consisted of gels made with mixtures of gelatin and biotinated BSA. Gel stiffness was changed by varying the concentration of gelatin. MSB showed significant differences between each of the gels.

Thursday 13:30-15:30 Computer 115

13:30 ***4939*.** **Unambiguous Localization of Contrast Agents Via B_0-Field-Cycling**

Uvo Christoph Hoelscher[1], Steffen Lother[1], Florian Fidler[1], Matin Blaimer[1], Peter Jakob[1,2]

[1]Research Center Magnetic Resonance Bavaria (MRB), Wuerzburg, Germany; [2]Department for Experimental Physics 5, University of Wuerzburg, Wuerzburg, Germany

This work presents a setup and analysis algorithm for unambiguous localization of contrast agents via a cycled magnetic field inside a clinical scanner. The algorithm detects contrasts agents with high relaxivity dispersion and suppresses signal from pure tissue. Data for the contrast agent Vasovist is shown and compared to theoretical results.

14:00 ***4940*.** **Contrast Agents: the Effect of Relaxation on Magnetic Particle Imaging**

Yong Wu[1], Zhen Yao[1], Gareth Kafka[1], David Farrell[1], Mark Griswold[2], Robert Brown[1]

[1]Department of Physics, Case Western Reserve University, Cleveland, OH, United States; [2]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States

Magnetic particle imaging (MPI) is a new tomographic technique that allows fast, inexpensive imaging of MRI contrast ferrofluid agents with submillimeter resolution. Selection fields combined with oscillating driving fields can move unsaturated field-free-points so as to cover the field of view. In previous studies, the average magnetization is assumed to respond instantaneously to changes in the applied field. Realistically, however, a finite relaxation time slows the magnetic response. The present simulation demonstrates that, for contrast agents of interest, the choice of an optimal particle size is strongly dependent on this effect. A trade-off thus exists between sensitivity and resolution.

14:30 ***4941*** **A Fast Optimization Algorithm for Multi-Dimensional RF-Pulse Design under Multiple Constraints**

A. Sbrizzi[1], H. Hoogduin[2], P. Luijten[2], J. J. Lagendijk[2], G. Sleijpen[3], and C. A. van den Berg[4]

[1]Imaging Division, UMC utrecht, Utrecht, Utrecht, Netherlands, [2]UMC Utrecht, [3]Mathematics, Utrecht University, [4]Radiotherapy, UMC Utrecht

Multi dimensional spatially selective excitation (mDSSE) RF pulse design aims to homogenize the magnetization over a given region of interest. After discretizing the solution of the Bloch Equation under the small flip angle approximation, the problem is to find an optimal numerical solution to the least squares problem argmin{||**Ax-b**||2 } (**1**) where the matrix **A** is the discretization of the integral operator as in [1], **x** and **b** the vectors corresponding to the requested RF pulses and desired magnetization respectively. In this paper we present an algorithm to solve (**1**) in a fast and stable way. From recent works it appears that a smooth RF pulse profile improves accuracy in the magnetization obtained from a transmit system. The speed achieved by the algorithm is exploited to add regularization terms to (**1**) in order to optimize the smoothness of the solution.

15:00 ***4942*. Detection of Human Mononuclear Cells Labelled with Micron-Sized Iron Oxide Particles Using the Sub-Pixel Enhancement of Nonuniform Tissue (SPENT) Sequence**

Bernard Siow[1], David W. Carmichael[2,3], Johannes Riegler[4], Daniel Alexander[1], Mark Lythgoe[4], Roger Ordidge[3]
[1]Centre for Medical Image Computing, University College London, London, United Kingdom; [2]Institute of Neurology, University College London, United Kingdom; [3]Department of Medical Physics and Bioengineering, University College London, United Kingdom; [4]Centre for Advanced Biomedical Imaging, University College London, United Kingdom

The Sub-pixel Enhancement of Nonuniform Tissue (SPENT) sequence applies a 2pi phase dispersion across each voxel: the net phase of spins in magnetically homogeneous voxels would be equal to zero and thus no signal would be generated. If there are sub-pixel inhomogeneities, then the net phase of spins in a voxel is not zero and thus signal is seen. In this study, human mononuclear cells labelled with micron-sized iron oxide particles, which creates sub-voxel perturbations in the field, are scanned with a spin-echo SPENT sequence producing positive contrast images. SPENT provides directional information, as well as the potential for quantification.

Topics in RF Design

Hall B Monday 14:00-16:00 Computer 116

14:00 ***4943*. ΦFA CUP: PHase Based Flip Angle Calibration Using the P0 Pulse for Proton MRI at 7T**

Davide Santoro[1], Tomasz Lindel, [1,2], Matthias Dieringer, [1,3], Wolfgang Renz, [1,4], Thoralf Niendorf, [1,5]
[1]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, Berlin, Germany; [2] (PTB), Physikalisch Technische Bundesanstalt, Berlin, Germany; [3]Franz-Volhard Klinik, Clinic for Cardiology, Charité Berlin, University Medicine, Berlin, Germany; [4]Siemens Healthcare, Erlangen, Germany; [5]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany

We demonstrate the applicability of a rapid 3D-B1+ mapping method for proton MRI at 7T. The method is based on the acquisition of two phase images where the effective flip angle is encoded in the phase of the non-slice selective rectangular composite pulse used as excitation in a gradient recall echo. On phantoms our method compares well with the double angle method, and is approximately 40 times faster. 3D FA map of human brain acquired in 102s are presented.

14:30 ***4944*. Spatial RF Pulse Design in Local Rotating Frame**

Seung-Kyun Lee[1]
[1]GE Global Research, Niskayuna, NY, United States

In magnetic resonance, a gradient- and voxel-dependent rotating frame, which we call a “local rotating frame” can eliminate all longitudinal magnetic fields in magnetization dynamics and therefore significantly simplifies the theory and practice of spatial RF pulse design. When the gradient waveform is pre-determined, as is the case in most existing numerical RF design methods, the frame transformation is completely straightforward, and removes need for repeated calculation of the same gradient effects as RF pulse is iteratively updated. After introducing basic theoretical elements of the new frame approach, we demonstrate its usefulness in two examples. First, we demonstrate calculation of the residual dephasing in slice selective excitation caused by nonlinearity of the Bloch equations by analytical integration of the equations in the local rotating frame. Second, we show that numerical integration of the Bloch equations is made significantly faster in the new frame due to the lack of strong longitudinal field. We discuss the relevance of the new approach in the context of iterative RF design in parallel transmit.

15:00 **_4945_. RF Concatenation with Spiral In-And-Out Trajectory for Two-Dimensional Large-Tip-Angle Excitation**

Seung-Kyun Lee[1], Dan Xu[2], W A. Grissom[3], Ileana Hancu[1], Mika W. Vogel[4]
[1]GE Global Research, Niskayuna, NY, United States; [2]Applied Science Laboratory, GE Healthcare, Waukesha, WI; [3]Department of Electrical Engineering and Radiology, Stanford University, Stanford, CA; [4]GE Global Research, Munich, Bavaria, Germany

We demonstrate that the time-reversed RF concatenation principle, which was previously considered in one-dimensional non-adiabatic inversion pulse design, can be extended to multi-dimensional and multi-coil excitation pulses. We present general analytical formulation of the concatenation principle, and demonstrate its use in (i) simulated inversion in 8-channel parallel transmit, and (ii) in-vivo inversion experiment on a single channel system with a human subject. The off-resonance field sensitivity, which is a drawback of the concatenation method in one dimension, is significantly reduced for two-dimensional excitation when a spiral in- and out-trajectory is employed.

15:30 **_4946_. Design of Velocity Selective Inversion Pulse for VSASL Using the Shinnar-Le Roux Algorithm**

Kangrong Zhu[1], Kui Ying[1], Xinlu Xu[1], William Grissom[2], Michael Lustig[2], John Pauly[2]
[1]Tsinghua University, Beijing, China; [2]Stanford University, Stanford, CA, United States

A new method which employs the SLR algorithm to generate velocity selective inversion pulse is presented and a design example is shown. Simulation results demonstrate that the slice profile of the designed inversion pulse is very smooth and that the pulse has good resistance to B1 inhomogeneity. Phantom studies verified the frequency selectivity and the velocity selectivity of the pulse. All results imply that the pulse is potentially suitable for use as a tagging pulse in VSASL. The design method enables the pulse designer to explicitly trade off among important parameters such as slice thickness, pulse duration and pass-band ripple.

Tuesday 13:30-15:30 Computer 116

13:30 **_4947_. Combined Excitation and Partial Saturation to Reduce Inflow Enhancement**

Misung Han[1,2], Brian A. Hargreaves[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States

Partially saturating outer slab upstream can reduce inflow enhancement and pulsatile ghost artifacts by preparing flowing spins to a steady state before entering the imaging slab. However, adding another RF pulse and spoilers increases scan time. Here, we present a short RF pulse that simultaneously excites the imaging slab and partially saturates the outer slab. This pulse was designed and demonstrated by phantom and in vivo experiments for the RF-spoiled gradient echo sequence.

14:00 **_4948_. Partial Fourier Accelerated Selective Excitation Improves Pattern Fidelity at 9.4 Tesla**

Kaveh Vahedipour[1], Tony Stöcker[1], N Jon Shah[1,2]
[1]Institute of Neuroscience and Medicine, Forschungszentrum Jülich, Jülich, Germany; [2]Department of Neurology, RWTH Aachen University, Aachen, Germany

Partial Fourier Spatially has so far been only investigated in 1 dimension in form of asymmetric echoes. Recently, we have prposed to use partial Fourier excitations for higher dimension. This work encloses recent results and considerations.

14:30 **_4949_. T2-Weighted Spin Echo Pulse Sequence That Is Sensitive to Restricted Diffusion**

Ziqi Sun[1], Robert Bartha[2]
[1]The Ohio State University, Columbus, OH, United States; [2]Robarts Research Institute, London, Ontario, Canada

A spin-echo (SE) pulse sequence incorporated with two selective adiabatic full passage (AFP) pulse trains separated by a time delay tau (varying with TE) and located symmetrically on both sides of an amplitude modulated 180 degree refocusing pulse. Apparent T2 and diffusion measurements on a phantom of multi-medium and multi-compartment demonstrated that the customized SE sequence generated T2-weighted contrast that is specifically sensitive to restricted diffusion in the phantom media in comparison to those of the conventional SE and CPMG pulse sequences.

15:00 **_4950_. On the Generation of Half-Sinc Pulses for Optimal Excitation Profile**

Keith Wachowicz[1], B. Gino Fallone[2,3]
[1]Medical Physics, Cross Cancer Institute, Edmonton, Alberta, Canada; [2]Medical Physics, Cross Cancer Institute, Canada; [3]University of Alberta

In this work, we perform simulations to explore the effects of fast T2 relaxation on excitation with half-sinc pulses. The generation of pulses for optimal excitation profiles is explored in terms of optimal flip angle, for which standard reasoning used for longer T2 species will no longer hold. Also, the number of side lobes to generate an optimal excitation profile was investigated, since, unlike the case of longer T2, using more side-lobes does not necessarily result in a better profile.

Wednesday 13:30-15:30 Computer 116

13:30 ***4951*. Arbitrary Shape Excitation Using a 2D SPOKE Pulse at 7T**

Christopher Joseph Wargo[1], Marcin Jankiewicz[1], Huairen Zeng[1], John C. Gore[1]
[1]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States

Arbitrarily shaped volume excitation has a variety of potential MRI applications. By restricting the FOX, the information obtained is isolated to particular anatomical or functional regions. Faster acquisitions can also be enabled for high resolutions due to fewer collected points. To accomplish this, multi-pulse composites can be applied at various excitation k-space points, with simulations used to define RF and gradient waveforms for a specific desired excitation pattern. B1 inhomogeneity effects, prevalent at ultra-high field strengths such as 7T, can also be accounted for. Here we demonstrate the performance of a SPOKE based arbitrary shape excitation at 7T in phantoms.

14:00 ***4952*. Multi-Voxel Excitation Using Sparse Pulse on Significantly Undersampled K-Space**

Yong Pang[1], Xiaoliang Zhang[2,3]
[1]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA , United States; [2]Radiology and Biomedical imaging, University of California San Francisco, San Francisco, CA, United States; [3]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco & Berkeley, CA, United States

Multi-dimensional spatial selective excitation and parallel transmission have been applied to single- and multi-voxel MR spectroscopy to excite arbitrarily shaped region and shorten the pulse width. Recently the sparse pulse has been developed to shorten the excitation duration by using significantly undersampled k-space. Taking the advantage of this new technique, an example of multi-voxel excitation using sparse pulse is presented. Bloch simulation results demonstrate that each voxel can be well localized within the Field of View and the in-slice error can be controlled within 5%.

14:30 ***4953*. Refine Phase Modulation Function Sampling Step Size in Off-Center Variable-Rate Selective Excitation with Rf Pulse Magnitude Replication**

Leping Zha[1], Mitsue Miyazaki[1]
[1]Toshiba Medical Research Institute USA, Vernon Hills, IL, United States

Optimized rf waveforms are often designed under the "hard pulse approximation", and come with a small number of wave points and singular features. When the original designs are converted to variable-rate pulses, the small number of points often causes the often required variable-rate phase modulation function to be inadequately sampled, resulting in selection profile degeneration in off-center slices. The piece-wise-constant amplitude function should be preserved, with the proposed simple pulse magnitude replication method which enables much finer phase sampling step size to better mimic the continuous phase function, and to help maintain the selection quality of the original pulse design.

15:00 ***4954*. Optimization of RF Excitation to Maximize Signal and T2 Contrast of Tissues with Rapid Transverse Relaxation**

Michael Carl[1], Mark Bydder[2], Jiang Du[2], Atsushi Takahashi[1], Eric Han[1], Graeme Bydder[2]
[1]GE Healthcare, Waukesha, WI, United States; [2]University of California, San Diego

We present experimental data to verify theoretical findings on how to select the RF parameters of a non-selective SPGR pulse train to maximize signal amplitude and T2 contrast in tissues with fast transverse relaxation. The experimental data very closely matched the theory so that our results may directly be implemented to maximize the scan efficiency of UTE acquisitions.

Thursday 13:30-15:30 Computer 116

13:30 ***4955*. Reduction of Slice Select Artifacts in Half Pulse Excitations Used in Ultrashort TE (UTE) Imaging**

Atsushi M. Takahashi[1]
[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States

In ultra short TE (UTE) imaging, so-called "half pulses" are used because they do not require a refocusing gradient, thus reducing the echo time. Two half pulses are required and cancellation of signal outside the desired slice desired. Poor cancellation results in artifacts generated by signals from out of slice. Here we present a method for improving the cancellation of out-of-slice signal to improve slice selection.

14:00 ***4956*. "M_Y Way" – a New Construction Technique for Broadband Slice-Selective Refocusing Pulses**

James B. Murdoch[1]
[1]Toshiba Medical Research Institute USA, Mayfield Village, OH, United States

High-bandwidth slice-selective refocusing pulses are important for proton spectroscopy at 3T and above, but they are not easy to construct. Previously it has been proposed to combine a self-refocused 90° excitation pulse with a time-reversed version of itself to create a suitably spin-flipping 180° waveform. However, the 90° pulse need not be wholly slice-selective: M_X and M_Z can vary outside the desired slice width so long as $M_Y \approx 0$. Both AM and PM excitation pulses have therefore been optimized for the proper M_Y response and then combined to spawn new refocusing pulses (with a PM second-component phase flip for overall antisymmetry).

14:30 **_4957_. A Study of Wideband MR Imaging: SNR and CNR**

Edzer Lienson Wu[1,2], Jyh-Horng Chen, [23], Tzi-Dar Chiueh[3]
[1]Biomedical Engineering, National Taiwan University, Taipei, Taiwan; [2]Interdisciplinary MRI/MRS Lab, Taipei, Taiwan; [3]Electrical Engineering, National Taiwan University, Taipei, Taiwan

Most of the MR image accelerating methods suffer from degradation of acquired images, which is often correlated with the degree of acceleration. However, Wideband MRI is a novel technique that transcends such flaws. In this study we demonstrate that Wideband MRI is capable of obtaining images with identical quality as conventional MR images in terms of SNR, CNR (contrast-to-noise ratio) and image sharpness, while using only half the total scan time (Wideband factor W=2) of normal MRI sequence.

15:00 **_4958_. High Fidelity Imaging Using Frequency Sweep Encoding**

Jun Shen[1]
[1]NIMH, Bethesda, MD, United States

Recently Frydman et al proposed a mechanism for directly forming images in k space using frequency sweep encoding. It relies on the quadratic dependence of magnetization phase on position. In combination with EPI-type readout, this method has found applications in single-shot spin-echo imaging. Its sequential excitation of magnetization may also be used for novel image contrast generation. Fidelity of images directly formed in k space, however, is significantly degraded. Here we show that fidelity of this type of images can be restored and we also extend this method to susceptibility-weighted imaging.

Non-Cartesian Imaging Methods

Hall B Monday 14:00-16:00 Computer 117

14:00 **_4959_. Fast Regridding Using LSQR on Graphics Hardware**

Gerald Buchgraber[1], Florian Knoll[2], Manuel Freiberger[2], Christian Clason[3], Markus Grabner[1], Rudolf Stollberger[2]
[1]Institute for Computer Graphics and Vision, Graz University of Technology, Graz, Austria; [2]Institute of Medical Engineering, Graz University of Technology, Graz, Austria; [3]Institute of Mathematics and Scientific Computing, University of Graz, Graz, Austria

Iterative image reconstruction methods have become increasingly popular for parallel imaging or constrained reconstruction methods, but the main drawback of these methods is the long reconstruction time. In the case of non-Cartesian imaging, resampling of k-space data between Cartesian and non-Cartesian grids has to be performed in each iteration step. Therefore the gridding procedure tends to be the time limiting step in these reconstruction strategies. With the upcoming parallel computing toolkits (such as CUDA) for graphics processing units image reconstruction can be accelerated in a tremendous way. In this work, we present a fast GPU based gridding method and a corresponding inverse-gridding procedure by reformulating the gridding procedure as a linear problem with a sparse system matrix.

14:30 **_4960_. A General Trajectory Tester**

Lawrence Frank[1,2], Greg Balls[1], Souheil Inati[3], Leslie Greengard[4]
[1]Radiology, UCSD, La Jolla, CA, United States; [2]Radiology, VASDHS, San Diego, CA, United States; [3]Dept of Psychology, NYU, New York; [4]Courant Institute, NYU, New York, United States

We present a software platform called the General Trajectory Tester (GTT) that allows users to input arbitrary 3D k-space trajectories, in an arbitrary number of interleaves, which are then used to sample and reconstruct a known 3D analytical phantom. The GTT can also simulate diffusion weighting, including arbitrary diffusion angular encoding schemes for DTI, multiple b-values, eddy current and motion induced artifacts and self-navigation, and so is a natural platform to test efficient DTI acquisition and self-navigation schemes.

15:00 **_4961_. Nonlinear Inverse Reconstruction for Real-Time MRI of the Human Heart Using Undersampled Radial FLASH**

Martin Uecker[1], Shuo Zhang[1], Jens Frahm[1]
[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany

A previously proposed algorithm for autocalibrated parallel imaging simultaneously estimates image content and coil sensitivities by inverting a nonlinear equation. Here, this algorithm is extended to non-Cartesian encodings and applied to real-time MRI. The method takes advantage of a convolution-based technique to simplify the implementation on a graphical processing unit (GPU) for reduced reconstruction times. The method is validated for real-time MRI of the human heart at 3 T using RF-spoiled radial FLASH. The results demonstrate artifact-free reconstructions for acquisitions with only 65 – 85 spokes corresponding to imaging times of 130 – 170 ms.

15:30 **_4962_. Improved BPE Reconstruction Using FOCUSS**

Hisamoto Moriguchi[1], Yutaka Imai[1]
[1]Radiology, Tokai University, Isehara, Kanagawa, Japan

Bunched Phase Encoding (BPE) is a new type of fast data acquisition method in MRI that takes advantage of zigzag k-space trajectories. A primary disadvantage of BPE is that images reconstructed using matrix inversion methods are sometimes affected by high levels of noise. In this study, a novel framework to reduce SNR loss in BPE reconstruction is presented. In this technique, high frequency k-space data are processed using regularization and the focal underdetermined system solver (FOCUSS). The newly proposed method is referred to as eBPE-FOCUSS f. Noise levels in the images of BPE-FOCUSS are substantially reduced from those of BPE.

Tuesday 13:30-15:30 Computer 117

13:30 ***4963*.** **Accurate Iterative Reconstruction Algorithm from Undersampled Radial Trajectory**

Sung-Min Gho[1], Dong-Hyun Kim[1,2]
[1]Electrical and Electronic Engineering, Yonsei University, Shinchon-Dong, Seoul, Korea, Republic of; [2]Radiology, Yonsei University, Shinchon-Dong, Seoul, Korea, Republic of

Radial k-space sampled data can be reconstructed using a variety of schemes such as gridding, filtered back-projection (FBP), etc. Recently, the iterative next-neighbor regridding (INNG) algorithm was proposed as a means for accurate reconstruction. However, these algorithms have drawbacks in their ability to reconstruct image from undersampled radial trajectory. Therefore, we propose a new algorithm to reconstruct accurate images from undersampled radial trajectory.

14:00 ***4964*.** **Sampling Density-Adaption for Directly Filtered Projection Reconstruction**

Armin Michael Nagel[1], Frederik Bernd Laun[1], Christian Matthies[1], Armin Biller[2,3], Michael Bock[1]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany; [2]Radiology, German Cancer Research Center, Germany; [3]Department of Diagnostic and Interventional Radiology, University Hospital Heidelberg, Germany

To minimize ringing artifacts apodization functions are often used. In this work a sampling density weighted apodization (SW) with a Hamming-window was implemented for 3D projection reconstruction trajectories (3DPR). This pulse sequence was compared with two post-acquisition filtered 3DPR-sequences, a conventional 3DPR-sequence and a sampling density adapted sequence (3DPR-UPF). Both, the 3DPR-UPF- and the 3DPR-SW-sampling scheme show a much better performance when compared to a conventional post-acquisition filtered 3DPR-sequence. Comparing the 3DPR-SW- and the post-acquisition filtered 3DPR-UPF-sequence, the SNR-benefits of the SW approach competes against the better artifact-behavior of the post-filtered technique.

14:30 ***4965*.** **2D Radial Acquisition Technique with Density Adaption in Sodium MRI**

Simon Konstandin[1], Armin Michael Nagel[2], Patrick Michael Heiler[1], Lothar Rudi Schad[1]
[1]Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany; [2]Department of Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

A 2D projection reconstruction method with variable gradient amplitudes is proposed to cover the k-space uniformly. Simulations and sodium measurements were performed to compare a non-adapted with a density adapted radial sequence scheme in regard to SNR and blurring. A total SNR benefit of 1.37 for the adapted sequence can be reached. The new density adapted 2D radial sampling scheme provides higher SNR and less artifacts in the presence of magnetic field inhomogeneities than conventional projection reconstruction methods.

15:00 ***4966*.** **Anisotropic Twisted Projection Sodium MRI of Articular Cartilage in the Human Knee**

Alexander Watts[1], Robert Stobbe[1], Christian Beaulieu[1]
[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada

3D projection imaging has potential benefits in sodium MRI due to ultra-low echo times, but the spherical sampling of k-space leads to isotropic voxels which may not be ideal for imaging thin structures such as cartilage in the knee. Oblate-spheroidal twisted projection imaging, which yields anisotropic voxels, was compared to isotropic acquisition; both projection acquisitions had equal voxel volume (2.56 mm3), twist, readout length, and scan time. The anisotropic projection acquisition had better effective in-plane resolution in a saline resolution phantom and yielded sharper, higher quality sagittal sodium images of human knee cartilage (n=3) in 9 min at 4.7T.

Wednesday 13:30-15:30 Computer 117

13:30 ***4967*.** **Flexible Retrospective Selection of Temporal Resolution in Real-Time Speech MRI Using a Golden-Ratio Spiral View Order**

Yoon-Chul Kim[1], Shrikanth S. Narayanan[1], Krishna S. Nayak[1]
[1]Ming Hsieh Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States

In speech research using real-time MRI, the analysis of vocal tract dynamics is performed retrospectively after acquiring data in real-time. A flexible selection of temporal resolution is desirable because of natural variations in speaking rate and variations in the speed of different articulators. In this work, a golden ratio temporal view order was applied. Compared to a traditional spiral acquisition, the proposed method can provide an improved aliasing artifact reduction for static postures (e.g. pause, vowel sound) and an improved temporal resolution for capturing the dynamics of rapid articulator movement (e.g. consonant to vowel transition).

14:00 ***4968***. **Efficient T2*- Contrast Manipulations in 3D Abdominal Imaging Using Autocorrected Forward/Reverse Spiral MRI**

Peter Börnert[1], Peter Koken[1], Holger Eggers[1]
[1]Philips Research Europe, Hamburg, Germany

Large volume coverage, short total scan time, robust fat suppression and dedicated measures to varyimage contrast are important issues in abdominal MRI. To manipulate T2* weighting from very weak to very strong, 3D single breath-hold forward and reverse spiral imaging is performed in combination with three-point chemical-shift imaging (IDEAL) for high quality fat suppression and off-resonance artifact correction. Parallel imaging was employed to improve SNR, sampling efficiency and to achieve an up-front data compression during image reconstruction and correction. The combination of forward/reverse spiral signal sampling, IDEAL and SENSE could pave the way for interesting future water / fat resolved clinical applications.

14:30 ***4969***. **Spiral MRI Trajectory Design with Frequency Constraint**

Thomas Oberhammer[1,2], Markus Weiger, [1,2], Franciszek Hennel[3]
[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland; [2]Bruker BioSpin AG, Faellanden, Switzerland; [3]Bruker BioSpin MRI GmbH, Ettlingen, Germany

An improved, 3-domain design for Archimedean spiral trajectories is proposed, utilising the instantaneous frequency for taking into account frequency limitations of the gradient system. It is demonstrated by simulations and experiments that the new layout enables creating trajectories with high fidelity and efficiency, leading to improved spiral image quality.

15:00 ***4970***. **A Comparison of Spiral-Out, Spiral-In/out and Radial Balanced SSFP Sequences for Dynamic Cardiac Imaging**

Xue Feng[1], Michael Salerno[2], Christopher M. Kramer, [23], Craig H. Meyer[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

Cartesian and radial balanced SSFP (bSSFP) sequences are widely used clinically for dynamic cardiac imaging. Dynamic spiral sequences have been used in many research studies, but clinical adoption has been slow. One goal of this study is to compare radial and spiral dynamic balanced SSFP scanning. The other goal is to develop a new spiral-in/spiral-out bSSFP pulse sequence to achieve flow compensation through symmetry and to exploit the bSSFP refocusing mechanism at TE = TR/2. We compared this new sequence to radial bSSFP and spiral-out bSSFP with flow-compensated rewinders.

Thursday 13:30-15:30 Computer 117

13:30 ***4971***. **3D Cardiac Cine Imaging Using a 3D Cones Trajectory**

Holden H. Wu[1,2], Bob S. Hu[3], Dwight G. Nishimura[2], Michael V. McConnell[1]
[1]Cardiovascular Medicine, Stanford University, Stanford, CA, United States; [2]Electrical Engineering, Stanford University, Stanford, CA, United States; [3]Palo Alto Medical Foundation, Palo Alto, CA, United States

In this work, we present a 3D cardiac cine sequence based on the 3D cones non-Cartesian trajectory which can resolve multiple cardiac phases for a 3D volume within a single breath-held scan. The 3D cones trajectory is a fast sampling method that enables a high degree of scan time reduction. Furthermore, its robust motion and flow properties are beneficial for cardiac imaging. We implement the 3D cones cine sequence using a prospectively cardiac-triggered segmented SSFP sequence. Experimental results demonstrate that 12 cardiac phases can be resolved for 10 contiguous slices within a single 30-second breath-held scan.

14:00 ***4972***. **Spiral Phyllotaxis: A Better Way to Construct a 3D Radial Trajectory in MRI**

Davide Piccini[1], Arne Littmann[2], Peter Schmitt[2], Michael O. Zenge[2]
[1]Pattern Recognition Lab,, University Erlangen-Nuernberg, Erlangen, Germany; [2]MR Applications and Workflow Development, Healthcare Sector, Siemens AG, Erlangen, Germany

In order to exploit the self-navigating properties of 3D radial MRI, the trajectory has to be arranged so that the first readout of each interleave is oriented in superior-inferior direction. If this is done sub-optimally, image quality is degraded. Hence, an innovative trajectory based on spiral phyllotaxis featuring optimized interleaving properties is presented. The trajectory was compared to an Archimedean spiral in phantom experiments and in-vivo. The smooth gradient waveforms of the novel trajectory avoided eddy currents effects and, thus, allowed for whole-heart coronary imaging with highly undersampled data. Moreover, the presented method is intrinsically prepared for self-gated cardiac MRI.

14:30 ***4973***. **Fast 3D SSFP Imaging Using a Concentric Cylinders Trajectory**

Kie Tae Kwon[1], Holden H. Wu, [1,2], Dwight G. Nishimura[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Cardiovascular Medicine, Stanford University, Stanford, CA, United States

A 2D concentric rings trajectory is inherently centric-ordered, provides a smooth weighting in k-space, and enables shorter scan times. Extensions of this trajectory for 3D imaging include: stack-of-rings and concentric cylinders. 3D stack-of-rings trajectory directly inherits flexible trade-offs property from 2D concentric rings. 3D concentric cylinders trajectory is similar to stack-of-rings, but it also has a unique property that leads to fewer excitations and benign off-resonance effects. In this work, we revisited the 3D concentric

cylinders trajectory and have implemented an SSFP version of this sequence. Among the potential applications of this sequence is non-contrast MR angiography based on SSFP.

15:00 ***4974*. A Fast 3D Trajectory with Orthogonal Oversampling**

James Grant Pipe[1], Ryan K. Robison[1], Ajit Devaraj[1], Nicholas Zwart[1], Kenneth Otho Johnson[1]
[1]Neuroimaging Research, Barrow Neurological Institute, Phoenix, AZ, United States

This work presents a new, center-out, rapid 3D trajectory based on spirals. It has very uniform sampling density, and good suppression of aliasing and motion artifacts. A unique feature is that, with little penalty in time, it samples most of k-space twice, in orthogonal directions, making it a good method undersampling for parallel imaging or compressed sensing.

Quantitative Imaging

Hall B Monday 14:00-16:00 Computer 118

14:00 ***4975*. A Technique for Rapid Single-Echo Spin Echo T2 Mapping**

Marshall S. Sussman[1], Logi Vidarsson[2], John M. Pauly[3], Hai-Ling Margaret Cheng[4,5]
[1]Medical Imaging, University Health Network, Toronto, Ontario, Canada; [2]Diagnostic Imaging, The Hospital for Sick Children, Toronto, Ontario, Canada; [3]Electrical Engineering, Stanford University, Stanford, CA, United States; [4]Research Institute & Diagnostic Imaging, The Hospital for Sick Children, Toronto, Ontario, Canada; [5]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada

Rapid T2 mapping is conventionally performed using multi-echo spin-echo imaging. However, due to errors arising from stimulated echoes and limited availability, the traditional but much slower single-echo spin-echo approach is often preferred. In this work, a rapid and accurate T2 mapping method based on single-echo spin-echo imaging is presented. Acquisition times are significantly reduced by employing a short repetition time (TR) together with a constant TR-TE difference to maintain monoexponential decay. Accuracy of the proposed method is demonstrated in phantom results and in-vivo imaging of the healthy human knee cartilage and brain.

14:30 ***4976*. Transverse Relaxation of Tissue Water in Human Brain: Relative Contributions of Iron and Macromolecules**

Fumiyuki Mitsumori[1], Hidehiro Watanabe[1], Nobuhiro Takaya[1], Michael Garwood[2], Edward Auerbach[2]
[1]National Inst. Environmental Studies, Tsukuba, Ibaraki, Japan; [2]University of Minnesota, United States

Apparent transverse relaxation rate ($R_2^\dagger$) of the tissue water was measured in various regions of healthy human brain at four different fields of 1.9, 3, 4.7, and 7T using a multi-echo adiabatic spin echo (MASE) sequence. The $R_2^\dagger$ increased with field strength (B_0). Distribution of $R_2^\dagger$ in various regions is well explained by contributions from regional non-hemin iron concentration ([Fe]) and macromolecular mass fraction defined by 1 – water fraction. Assuming an equation of $R_2^\dagger = \alpha[Fe] + \beta f_M + \gamma$, the coefficient α increased linearly with B_0, as previously observed in ferritin solution.

15:00 ***4977*. Iron Accumulation and Transverse Relaxation Rates: A Quantitative Postmortem Study**

Christian Langkammer[1,2], Nikolaus Krebs[2], Walter Goessler[3], Eva Scheurer[2], Kathrin Yen[2], Franz Fazekas[1], Stefan Ropele[1]
[1]Department of Neurology, Medical University of Graz, Graz, Austria; [2]Ludwig Boltzmann Institute for Clinical-Forensic Imaging, Graz, Austria; [3]Institute of Chemistry - Analytical Chemistry, University of Graz, Graz, Austria

Iron deposition in human brain tissue is commonly assessed by mapping R2 or R2* relaxation rates. The goal of our study was to validate if transverse relaxation rates can be used as sensitive and linear measures for iron concentration. R2 and R2* mapping was done in human post-mortem brains in situ. After brain extraction and fixation iron concentrations were determined in selected grey and white matter regions using inductively coupled plasma mass spectrometry. We found that both, R2 and R2* are strongly correlated with iron concentration and therefore can be used as a surrogate marker for iron deposition.

15:30 ***4978*. In Vivo Comparison of Three Quantitative MRI Techniques to Measure Brain Iron**

Catherine Anusha Mallik[1], Gareth J. Barker[1], David J. Lythgoe[1]
[1]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, United Kingdom

Correlation of quantitative MRI with brain iron may prove a useful tool in the diagnosis and prognosis of associated neuropathology. Sequences required for three of the most promising measures were implemented: transverse relaxation rate, magnetic susceptibility and magnetic field correlation (MFC) mapping. Protocols for each technique were standardised for brain coverage under the constraint of approximately equal, patient tolerable, scan times. Data collected on three control subjects at 3T in six brain regions indicated that magnetic susceptibly is the most closely correlated with reference brain iron of the three techniques.

Tuesday 13:30-15:30 Computer 118

13:30 ***4979*. Automated Calculation of T2* Mapping for MR Images with Application of Certainty Criterion for Enhanced Display**

Oyinlolu Adeyanju[1], Einar Heirberg[2], Jane Sjögren[3]
[1]Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]Clinical Physiology, Lund University, Lund, Sweden; [3]Engineering, Medviso AB, Lund, Sweden

T2* mapping is a broadly-applied MRI measurement technique with various applications in many areas of MRI, including fMRI, molecular cell tracking, and the in vivo quantification of superparamagnetic contrast agents. This study assessed the validity of a T2* mapping module implemented in Segment (Medviso, AB). The T2* mapping module employs a linear least squares fitting algorithm with a goodness of fit certainty criterion for enhancing the accuracy of T2* maps. When compared with standard methods of T2* mapping, Segment showed an improved correlation with concentration over standard methods in phantom measurements, with a much shorter time of T2* map creation.

14:00 ***4980*. Influence of Stimulated Echoes on Iron Quantification with Multi-Echo Spin-Echo Pulse Sequences**

Christina Louise Tosti[1], Haiying Tang[2], Srirama V. Swaminathan[3], Sujit S. Sheth[2], Jens H. Jensen[4], Alvaro Nunez[4], Kristi Hultman[5], Daniel Kim[4], Ed X. Wu[6], Gary M. Brittenham[2], Truman R. Brown[2]
[1]The Ohio State University, Columbus, OH, United States; [2]Columbia University, New York, NY, United States; [3]Philips Healthcare, Andover, MA, United States; [4]New York University, New York, NY, United States; [5]Mayo Clinic, Rochester, MN, United States; [6]The University of Hong Kong, Hong Kong, Hong Kong

Phantoms that simulate the iron in tissue have been measured using a theoretical model that can separately quantify dispersed (ferritin-like) and aggregated (hemosiderin-like) iron using multiple spin echo (MSE) based R2 images. Here, we examine a large range of these heterogeneous phantoms and a preliminary patient population to determine the effects of stimulated echo (STE) contamination in MSE sequences on the iron quantification.

14:30 ***4981*. Cramer-Rao Lower Bounds for Assessment of Precision in T2* Value Evaluation by GRE Multiecho Sequence: Application to Iron Overload Measurements in Thalassemia Patients**

Vincenzo Positano[1], Luca Menichetti[1], Alessia Pepe[1], Antonella Meloni[1], Daniele De Marchi[1], Matteo Milanesi[1], Maria Filomena Santarelli[1], Giovanni Palazzi[2], Massimo Lombardi[1], Luigi Landini[1,3]
[1]MRI Lab, "G. Monasterio" Foundation and Institute of Clinical Physiology, Pisa, Italy; [2]Oncoematologia Pediatrica, Policlinico di Modena, Modena, Italy; [3]Department of Information Engineering, University of Pisa, Pisa, Italy

T2* multiecho magnetic resonance is an established methodology for assessment of iron overload in heart, liver, and other organs by evaluation of the T2* value. However, the dependence of the expected error from T2* value and acquisition parameters is unknown. This study demonstrate that evaluation of Cramer-Rao lower bounds allows to quantify the precision limits of T2* assessment for various schema of TEs. CRLB approach was applied to evaluate the T2* measurement quality in thalassemia patients.

15:00 ***4982*. MR Iron Quantification of Soluble (Ferritin-Like) and Insoluble (Hemosiderin-Like) Iron: A Biochemical Validation in Human Liver Explants**

Christina Louise Tosti[1], Boguslaw S. Wojczyk[2], Sujit S. Sheth[2], Daniel Kim[3], Haiying Tang[2], Jens H. Jensen[3], Gary M. Brittenham[2], Truman R. Brown[2]
[1]The Ohio State University, Columbus, OH, United States; [2]Columbia University, New York, NY, United States; [3]New York University, New York, NY, United States

A theoretical MR model has been proposed that separately quantifies dispersed (soluble, ferritin-like) and aggregated (insoluble, hemosiderin-like) iron by distinguishing their effects on R2 relaxation curves. In this study, we examine human liver explants with this non-invasive MR iron measurement technique. We compare the results of iron quantification using this model to the tissue concentrations of ferritin and hemosiderin iron determined by biochemical analysis.

Wednesday 13:30-15:30 Computer 118

13:30 ***4983*. Real-Time EPI T1, T2 and T2* Mapping at 3T**

Cyril Poupon[1], Jessica Dubois[1], Linda Marrakchi[1], Veronique Brion[1], Jean-Francois Mangin[1], Fabrice Poupon[1]
[1]CEA I2BM NeuroSpin, Gif-sur-Yvette, F91191, France

Besides their usual methodological use to characterize the NMR characteristics of specific chemical drugs, T1, T2 or T2* mapping is now progressively used in neuro-scientific studies, for instance to better understand the structural modifications occurring during brain development. Despite major improvements using DESPOT1 and DESPOT2 pulse sequences, mapping the whole brain relaxometry

still requires scan durations not always compatible with clinical use. In this abstract, we present a novel solution dedicated to perforrm rho, T1, T2, and T2* mapping of the human brain in real-time with a low scan duration and a 1.5mm isotropic resolution.

14:00 ***4984***. **Rapid and Simultaneous Measurements of T1, T2 and Relative Proton Density (M0) for Dynamic Musculoskeletal Studies**

Paulo Loureiro de Sousa[1,2], Alexandre Vignaud[3], Servanne Fleury[1,2], Pierre G. Carlier[1,2]
[1]Institut de Myologie, Laboratoire de RMN, Paris, France; [2]CEA, I2BM, Paris, France; [3]Siemens Healthcare, Saint Denis, France

Skeletal muscle functional imaging can provide valuable information on the physiological changes accompanying muscle activation Because skeletal muscle physiological adaptations can simultaneously impact several NMR physical parameters (T1, T2, T2*, relative spin density (M0)), mono-parametric NMR imaging may not be able to describe adequately the complex behavior of stressed or exercised muscle. We investigated the feasibility of fast simultaneous measurements of T1, T2 and M0 using an Inversion Recovery TrueFISP (IR-TrueFISP) sequence. The main advantage of this method is the possibility of performing dynamic T1, T2 and M0 measurements in a single multi-parametric acquisition protocol, with relatively high temporal resolution.

14:30 ***4985***. **Correction for T1 Determined Using Rapid Look-Locker B-SSFP and a Simple Two Parameter Model Fit**

Neville D. Gai[1], John A. Butman[1]
[1]Radiology & Imaging Sciences, National Institutes of Health, Bethesda, MD, United States

A correction scheme for modulated longitudinal magnetization and incomplete inversion recovery Look-Locker sequence with balanced SSFP acquisition is described. Correction for such a scheme typically uses a three parameter model which requires acquisition of several (6 to 10) phases. It is shown that the two parameter inversion recovery model provides excellent fit over a wide range of TR/T1 and flip angle parameter space. The T1* obtained is easily corrected using a linear model. The correction was tested in phantoms and in head scans of several volunteers and shown to be accurate. Use of the two parameter model requires fewer acquisition phases (3 to 5) leading to improved temporal and spatial resolution.

15:00 ***4986***. **T1 Error Analysis for Double Angle Technique and Comparison to Inversion Recovery B-SSFP Look-Locker Acquisition**

Neville D. Gai[1], John A. Butman
[1]Radiology & Imaging Sciences, National Institutes of Health, Bethesda, MD, United States

The dual flip angle technique (DAT) with short TRs is widely used to derive T1 maps rapidly. DAT offers a relatively faster alternative to typical Look-Locker based schemes. The optimal flip angles required, the effect of field inhomogeneity and, more recently, the effect of spoiling for DAT have been described in literature. In this work, we systematically study various sources of errors through simulations and error propagation analysis. DAT accuracy and repeatability of T1 calculations is shown to be substantially affected as a result of these sources of errors especially when compared with inversion recovery based schemes. Experimental results in phantoms and head scans in several volunteers confirm relatively poorer repeatability and accuracy in calculated T1 values especially when compared with recently described rapid Look-Locker technique with similar temporal and spatial resolution.

Thursday 13:30-15:30 Computer 118

13:30 ***4987***. **General Formulas for Optimizing Two-Point Saturation-Recovery Measurements**

Jung-Jiin Hsu[1], Gary H. Glover[2], Greg Zaharchuk[2]
[1]Department of Radiology, University of Miami School of Medicine, Miami, FL, United States; [2]Lucas Center for Imaging, Stanford University, Stanford, CA, United States

Saturation-recovery (SR) method is a popular technique for the longitudinal relaxation rate measurement, in which the relaxation rate is derived from separate measurements of at least two different recovery times. An interesting and long-standing question in clinical applications is, given a limited amount of time, how the recovery times should be allocated to minimize the uncertainty of the measurement. In this work, a systematic Monte Carlo computation for the SR method is carried out and general formulas are derived to answer this question.

14:00 ***4988***. **Fast Two-Dimensional Relaxometric Characterisation of Brain Tissue in Vivo: Is T1 Relaxation Multi-Component?**

Ana-Maria Oros-Peusquens[1], Fabian Keil[1], N Jon Shah[1,2]
[1]Institute of Neuroscience and Medicine 4, Medical Imaging Physics, Forschungszentrum Juelich GmbH, Juelich, Germany; [2]Faculty of Medicine, RWTH Aachen University, Aachen, Germany

T1 mapping is performed with a spoiled 3D multiple-echo gradient echo sequence, from two acquisitions with same TR and different flip angles. At each different echo time, an independent T1 map is produced. Apart from small variations due to decreasing SNR with echo time, no dependence of T1 on TE is expected from the theoretical description of the method. However, a systematic increase of T1 with echo time is observed in the white matter, and interpreted as an indication for multi-component T1 decay due to the presence of multiple and distinct water environments.

14:30 ***4989***. **Rapid T_1 Determination with Optimized Inversion Recovery Sequence**

Ke Li[1,2], Junzhong Xu[1,2], Zhongliang Zu[1,2], John C. Gore[1,2], Mark D. Does[1,2], Daniel F. Gochberg[1,2]

[1]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States; [2]Department of Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States

In this work, the inversion recovery sequence was optimized for T_1 measurements, by varying both the inversion recovery time (t_i) and pre-delay (t_d). Comparing to conventional acquisition scheme, which uses logarithmic spacing t_i and long t_d (> $5T_1$), the optimized sequence has precision efficiency of ~ 2.5 times greater than the conventional scheme.

15:00 ***4990***. **A Field Comparison of R1 and R2* Relaxivities of Gd-DTPA in Aqueous Solution and Whole Blood: 3T Versus 7T**

Chaitanya Kalavagunta[1], Gregory John Metzger[1]

[1]Center of Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

The goal of this study was to measure r1 and r2* relaxivity of Gd-DTPA in bovine blood and aqueous solution at 3T and 7T. To our knowledge this is the first time that the r2* characteristic for blood has been measured at 7T.

Susceptibility Mapping

Hall B Monday 14:00-16:00 Computer 119

14:00 ***4991***. **Advantages of a Local Polynomial Filter with Moving Window for Phase Reconstruction in Susceptibility Weighted Imaging**

Sandra M. Meyers[1], Amir Eissa[2], Alan H. Wilman[3]

[1]Physics, University of Alberta, Edmonton, AB, Canada; [2]Physics, Univeristy of Alberta, Edmonton, AB, Canada; [3]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada

Phase images produced from susceptibility-weighted images require extensive reconstruction. In this work we compare a moving window, local polynomial approach to a standard method, demonstrating significant differences in phase unwrapping and contrast.

14:30 ***4992***. **Improving SWI Contrast**

Kai Zhong[1], Oliver Speck[1]

[1]Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Saxon-Anhalt, Germany

Susceptibility Weighted Imaging (SWI) has been proposed to enhance the image contrast, especially between small veins and surrounding tissues and has received wide acceptance in clinical MR studies. On the other hand, it was not discussed in detail whether the original SWI filter indeed optimally exploits magnitude and phase information. A generalized filter based on the sigmoidal function was applied for SWI contrast and showed higher contrast compared to the original SWI filter. The new filter can be parameterized and thus can be dynamically adapted to the data input to improve the overall SWI contrast and therefore should improve the outcome of future studies utilizing SWI contrast.

15:00 ***4993***. **A Comparison of T2* Magnitude, SWI, K-Division Susceptibility Map, Maxwell Equation Regularized Quantitative Susceptibility Map for Brain Iron Mapping**

James R. Ledoux[1], Tian Liu[1], Jing Liu[1], Ildar Khalidov[1], Martin Prince[1], Yi Wang[1]

[1]Weill Cornell Medical Center, New York, NY, United States

The reconstruction methods of Quantitative Susceptability Mapping (QSM), Susceptability Weighted Imaging (SWI), and truncated k-space division all desire to reveal an image of susceptability sources. It is difficult to directly find susceptability sources from the magnetic field map (obtained by phase information) as the dipole convolution kernel has zeros in k-space. However, the inversion problem can be regularized to provide a solution as shown in the QSM method. We compare this to direct inversion of the convolution by truncating the convolution kernel near ill-conditioned values, and with SWI which is a phase-masked T2* image.

15:30 ***4994***. **Eliminating Streaking Artifacts in Quantitative Susceptibility Mapping Using L1 Norm Minimization**

Ildar Khalidov[1], Tian Liu[1], Xiaoyue Chen[2], Moonsoo Jin[2], Martin Prince[1], Yi Wang[1]

[1]Radiology, Weill Cornell Medical College, NYC, NY, United States; [2]Biomedical Engineering, Cornell University, Ithaca, NY, United States

Quantitative susceptibility mapping (QSM) has been developed as a technique that uses the phase information from the MRI measurements to estimate susceptibility changes in the imaged object. Moreover, it is possible to estimate the magnetic moment of the region of interest, which gives way to quantitative imaging of tracer particles in MRI. However, the inverse problem that needs to be solved to recover the susceptibility map from the phase image is ill-posed: 1), the dipole kernel that links the two maps has a cone of zeros in Fourier domain, and 2), regions of strong susceptibility change have low intensity (and hence, unreliable phase data) due to T2* dephasing. In this work, we use total variation-based regularization to tackle the inverse problem. Compared to original weighted quadratic regularization in [1], the proposed TV regularization significantly reduces the streaking artifacts from the areas of susceptibility change. This is particularly important in animal imaging where eventual air bubbles and/or voxel misclassifications at the segmentation stage could lead to strong under-estimation of the quantities of particles of interest.

Tuesday 13:30-15:30 Computer 119

13:30 ***4995*. Quantitative Susceptibility Mapping: A Comparison Between COSMOS and Weighted L1 Regularization from Single Orientation**

Tian Liu[1], Jing Liu[2], James Ledoux[2], Martin R. Prince[2], Yi Wang[1]
[1]Biomedical Engineering, Cornell University, New York, NY, United States; [2]Radiology, Weill Cornell Medical College, New York, NY, United States

Quantitative Susceptibility Mapping (QSM) provides both visualization and quantification of endogenous and exogenous susceptibility contrasts. In this study, we compared two validated reconstruction techniques, COSMOS and weighted L1, on a phantom experiment and on healthy volunteer brain scans.

14:00 ***4996*. Quantitative Susceptibility Mapping by Regulating the Field to Source Inverse Problem with a Sparse Prior Derived from the Maxwell Equation: Validation and Application to Brain**

Jing Liu[1], Tian Liu[2], Ludovic de Rochefort[3], Ildar Khalidov[1], Martin Prince[1], Yi Wang[1,2]
[1]Radiology, Weill Cornell Medical College, New York, NY, United States; [2]Biomedical Engineering, Cornell University, Ithaca, NY, United States; [3]MIRCen, I2BM, DSV, CEA, Fontenay-aux-roses, France

Quantitative susceptibility mapping (QSM) is a promising technique for quantifying endogenous and exogenous susceptibility contrasts. The problem of deriving QSM from the measured field is under-determined and can be solved by optimization minimization programming. The prior information of the MR image magnitude can be used for promoting the sparsity of the minimization problem. The proposed method was validated by phantom experiments with high accuracy and good image quality. Brain susceptibility mapping provides good visualization as well as valuable quantification of iron accumulation in the brain.

14:30 ***4997*. Quantitative Susceptibility Mapping in Vivo in the Rat Brain**

Ludovic de Rochefort[1], Aurélie Delzor[1], Martine Guillermier[1], Diane Houitte[1], Marion Chaigneau[1], Nicole Déglon[1], Philippe Hantraye[1], Vincent Lebon[1]
[1]MIRCen, I2BM, DSV, CEA, Fontenay-aux-Roses, France

Molecular and cellular imaging is seeing a growing interest, but applicability to MRI relies on the ability to be specific, sensitive and quantifiable. Superparamagnetic iron oxides are good candidates as they produce a strong magnetic field creating signal voids in gradient echo images. Quantitative susceptibility mapping (QSM) additively uses the magnetic field to quantify the magnetic sources. In this study we apply QSM in the preclinical context of the rat brain using a reconstruction algorithm that includes unwrapping, removing background effects and inverting the field map. The technique demonstrates its ability to quantify SPIO amounts injected in the brain.

15:00 ***4998*. Susceptibility Phase Imaging of the Basal Ganglia: Effects of Phase Filtering, Slice Orientation and ROI Selection with Comparison to T2* Mapping**

Andrew Walsh[1], Marguerite Wieler[2], Wayne Martin[2], Alan Wilman[1]
[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada; [2]Division of Adult Neurology, University of Alberta, Edmonton, Alberta, Canada

We examined the effectiveness of current methods in susceptibility phase imaging of basal ganglia structures using computer simulations and invivo data. The effects of phase filtering reconstruction, slice orientation and ROI selection with comparison to T2* mapping are examined in this study. These investigations showed that measured phase can be substantially influenced by filtering, slice orientation and ROI selection which can confound phase data acquired in cross sectional or longitudinal studies. We have proposed techniques to optimize phase value acquisition for the consistent evaluation of phase in future studies.

Wednesday 13:30-15:30 Computer 119

13:30 ***4999*. Accurate Susceptibility Quantification from MR Phase Data Through the Least Squares Fit Method: Phantom Validation**

Jaladhar Neelavalli[1,2], Yu-Chung Norman Cheng[3], Mudassar Kamran[2], James V. Byrne[2], Ewart Mark Haacke[3]
[1]The MRI Institute for Biomedical Research, Detroit, MI, United States; [2]Nuffield Department of Surgery, University of Oxford, Oxford, Oxfordshire, United Kingdom; [3]Academic Radiology, Wayne State University, Detroit, MI, United States

We utilize a Fourier based method of quantifying the magnetic susceptibilities of arbitrarily shaped objects with medium sizes in a phantom. The method uses the phase images and an iterative 3D least-squares fitting algorithm. The quantified susceptibility has an 11% uncertainty, which is due to the pixelization (or systematic) error.

14:00 ***5000*. Multi Echo Susceptibility Weighted Imaging: Improving Image Contrast by Applying the Susceptibility Weighted Phase Mask to Maps of the R2* Decay**

Christian Denk[1], Alexander Rauscher[1]
[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada

Maps of R2* relaxation computed from multi echo susceptibility weighted images (SWI) were multiplied with phase mask obtained from the same data. This procedure leads to an improved contrast between grey matter and white matter compared to standard SWI data processing.

14:30 ***5001*. Susceptibility Weighted Imaging (SWI) of the Kidney at 3T – Initial Results**

Moritz Mie[1], Johanna C. Nissen[2], Frank G. Zöllner[1], Melanie Heilmann[1], Henrik J. Michaely[2], Stefan O. Schönberg[2], Lothar R. Schad[1]
[1]Department of Computer Assisted Clinical Medicine, Heidelberg University, Mannheim, Germany; [2]Institute of Clinical Radiology and Nuclear Medicine, Heidelberg University, Mannheim, Germany

SWI has been investigated for its applicability to renal imaging. To handle the problems of organ motion and a higher oxygenation level of the kidneys compared to the brain, the acquisition time has been cut down to allow for breath-hold examinations and different post-processing methods were investigated. Results showed that our new post-processing strategy could produce a susceptibility weighted contrast enhancement by a factor of 1.5 compared to the standard approach. The results represent initial experiences with the SWI for abdominal imaging which proof the principal feasibility.

15:00 ***5002*. Field-Corrected 3D Multiecho Gradient Echo: Simultaneous Extraction of Quantitative R2*, T2* Weighting, SWI, and Venography**

Robert Marc Lebel[1], Alan W. Wilman[1]
[1]Biomedical Engineering, University of Alberta, Edmonton, Alberta, Canada

Susceptibility weighted imaging incorporates phase information to enhance image contrast. We employ multiecho 3D gradient-echo, with a rapid pre-scan to minimize diverging phase ramps in the readout direction, with advanced post-processing techniques to correct for macroscopic field gradients to generate multiple high quality data sets from a single scan. Ultimately this technique yields the following low-artifact, high-resolution data sets: (1) T2*-weighted images, (2) quantitative R2* maps, (3) SWI, and (4) venography.

Thursday 13:30-15:30 Computer 119

13:30 ***5003*. Resolving Phase: Inversion of SWI-Phase Data in Order to Obtain Its Sources Utilizing the Concept of a Generalized Lorentzian Approximation**

Ferdinand Schweser[1], Moritz Hütten[2], Berengar Wendel Lehr[2], Andreas Deistung[2], Daniel Güllmar[2], Jürgen Rainer Reichenbach[2]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology , Jena University Hospital, Jena, Germany; [2]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany

Phase data acquired at multiple orientations with respect to the magnetic field was inverted to susceptibility, rotation-invariant local shift, and anisotropy-related susceptibility. Results indicate that gray-to-white matter contrast in phase images is dominated by sources from magnetic susceptibilities rather than macro-molecular exchange processes.

14:00 ***5004*. Reconstruction of Multi-Echo High-Resolution T2* and Phase Imaging Data Acquired at 3 Tesla Using a 32 Channel Head Coil**

Claudiu Schirda[1], Anthony Vu[2], Robert Zivadinov[1]
[1]Buffalo Neuroimaging Analysis Center, University at Buffalo, Buffalo, NY, United States; [2]GE Healthcare, Milwaukee,, WI, United States

Susceptibility weighted imaging (SWI) has been shown to be a useful technique for visualization of small veins, of iron deposits and micro bleeds in vivo brain, among other applications. Because the susceptibility effects present in the image are dependent on the echo time, a multi-echo acquisition like SWAN, even when using just the magnitude information, will be able to provide complimentary information. Using the free (no extra acquisition time) information that is found in the phase image, thus SWAN with phase reconstruction, enables one to obtain a wealth of information. A number of challenges are presented when using a 32 channel coil for data acquisition and we present solutions to these challenges.

14:30 ***5005*. Order of Magnitude Speedup for Iterative Algorithms in Quantitative Susceptibility Mapping Using Multi-Core Parallel Programming**

Deqi Cui[1,2], Tian Liu[1], Pascal Spincemaille[3], Yi Wang
[1]Biomedical Engineering, Cornell University, New York, NY, United States; [2]Optic electronics, Beijing Institute of Technology, Beijing, China; [3]Radiology, Weill Cornell Medical College, New York, NY, United States

Iterative susceptibility reconstructions requires four Fast Fourier Transforms in every iteration and hundreds of iterations to converge. Although the iteration is hard to disperse, FFT can be computed in parallel. In this study, a parallelized FFT based on OpenMP was implemented to achieve quasi real-time susceptibility map reconstructions.

15:00 *5006*. **A T_2^* Selective Higher-Order Soliton Preparation Pulse for MRI**

Marcin Jankiewicz[1,2], Jay Moore[1,3], Adam W. Anderson[1,4], John C. Gore[1,4]
[1]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States; [2]Department of Radiology, Vanderbilt University, Nashville, TN, United States; [3]Department of Physics, Vanderbilt University; [4]Department of Biomedical Engineering, Vanderbilt University

The soliton pulses represent a promising solution to the problem of designing T_2^* selective preparation pulses. The pulses are characterized by a set of complex parameters. Their interpretation is only partially understood in the context of MRI. For example, some of them correspond to values of relaxation times for which the magnetization vector will be nulled. A preliminary analysis of the behavior of such pulses is presented here with the goal of demonstrating the versatility of such pulses in producing a range of T_2^* contrasts.

Gating & Triggering

Hall B Monday 14:00-16:00 Computer 120

14:00 *5007*. **Rapid Frame-Rate MR Acquisitions to Reveal Mechanisms of Circular Breathing and Sound Production in the Australian Aboriginal Didgeridoo**

Graham Charles Wiggins[1], Pippa Storey[1]
[1]Radiology, NYU Medical Center, New York, NY, United States

The Australian Aboriginal wind instrument known as the didgeridoo is played using techniques that are unusual in Western music. A continuous sound is maintained through circular breathing, in which the mouth is used as a pump to keep air flowing into the instrument while inhaling through the nose. Traditional playing technique involves interdental articulation that differs from Western tonguing. We used rapid FLASH acquisitions to capture the circular breathing cycle and reveal the mechanics involved. This may serve as an aid to teaching proper playing technique.

14:30 *5008*. **Cardiac Imaging at 7.0T: Comparison of Pulse Oximetry, Electrocardiogram and Phonocardiogram Triggered 2D CINE for Left Ventricular Function Assessment**

Tobias Frauenrath[1], Fabian Hezel[1], Wolfgang Renz[2], Florian von Knobelsdorff-Brenkenhoff[3], Thibaut de Geyer d'Orth[1], Marcel Prothmann[3], Matthias Dieringer[1], Kerstin Kretschel[3], Jeanette Schulz-Menger[3,4], Thoralf Niendorf[1,4]
[1]Berlin Ultrahigh Field Facility, Max-Delbrueck Center for Molecular Medicine, Berlin, Germany; [2]Siemens Medical Solutions, Erlangen, Germany; [3]Franz-Volhard-Klinik for Cardiology, Helios Klinikum Berlin-Buch, Charité Campus Buch, Germany; [4]Experimental and Clinical Research Center (ECRC), Charité Campus Buch, Humboldt-University, Berlin, Germany

As ultrahigh field cardiac MRI becomes more widespread in the (pre)clinical research arena the propensity of ECG recordings to interference from electromagnetic fields and magneto-hydrodynamic effects increases and with it the motivation for a practical gating/triggering alternative. This study compares the feasibility, efficacy and reliability phonocardiogram (ACT), vector electrocardiogram (VCG) and traditional pulse oximetry (pO2) triggered MRI for left ventricular function assessment at 7.0T. ACT's intrinsic insensitivity to interference from electro-magnetic fields and magneto-hydrodynamic effects results in an excellent trigger reliability and renders it suitable for global cardiac function assessment at ultrahigh magnetic field strengths.

15:00 *5009*. **Magnetic Field Gradient Artifact Reduction on ECG for Improved Triggering**

Julien Oster[1,2], Olivier Pietquin[1,3], Michel Kraemer[4], Jacques Felblinger[1,2]
[1]U947, Inserm, Vandoeuvre-les-Nancy, France; [2]IADI, Nancy-Université, Nancy, France; [3]IMS Research Group, Supelec Metz Campus, Metz, France; [4]Schiller Médical, Wissembourg, France

Cardiac MR Acquisitions have to be synchronized with heart activity to prevent from motion artifacts. Electrocardiogram (ECG) is therefore the most accurate tool. Magnetic Field Gradients (MFG) artifacts are unfortunately induced on ECG signals. In this paper a new real-time MFG artifact reduction method is presented. This technique is based on the merging of both ECG and MFG artifact models. An estimation of the model parameters is recursively updated by nonlinear Bayesian filtering. The MFG signals can then be filtered with the MFG artifact model parameters in real-time. The herein presented method outperforms state-of-the-art algorithms and enables accurate triggering.

15:30 *5010*. **High Resolution, Free-Breathing Coronary Artery Imaging with >99% Respiratory Efficiency: Comparing Beat to Beat Respiratory Motion Correction with Navigator Gating**

Andrew David Scott[1,2], Jennifer Keegan, [1,2], David N. Firmin, [1,2]
[1]National Heart and Lung Institute, Imperial College, London, Greater London, United Kingdom; [2]Cardiovascular Magnetic Resonance Unit, The Royal Brompton Hospital, London, Greater London, United Kingdom

Respiratory motion correction using highly efficient localized beat-to-beat epicardial fat tracking was compared to standard navigator gating using high resolution right coronary artery imaging. Beat-to-beat corrections were applied to 3D spiral acquisitions (99.3% respiratory efficiency) and navigator gating applied to 3D magnetization-prepared balanced steady-state-free-precession acquisitions (44% efficient) in ten healthy subjects. Quantitative comparison was performed using vessel diameter and vessel sharpness. Results were not substantially different between techniques and the study highlights the importance of the localized nature of the beat-to-beat respiratory-motion-correction.

Tuesday 13:30-15:30 Computer 120

13:30 ***5011*. Efficient Navigator-Gated Acquisition of Different Breathing Positions During Free Breathing Applied to Flow Measurements in the Great Vessels**

Sebastian Gruhlke[1], Michael Markl[1], Bernd André Jung[1]
[1]University Hospital Freiburg, Freiburg, Germany

To investigate physiological effects of the breathing position on blood flow, a double navigator-gated sequence was implemented defining two acceptance windows during expiration and inspiration. The method permitted to acquire flow sensitive phase contrast MRI data during both in- and expiration within a single scan with optimal scan efficiency. The sequence was applied to measure the dependency of time resolved blood flow on in- and expiration during breath-hold and free breathing as well as valsalva maneuver in the major vessels. In-vivo measurements could detect respiration related difference in blood flow even during free breathing

14:00 ***5012*. Retrospective Bellows-Based Reconstruction for Cardiac MRI: Preliminary Experience**

Claudio Santelli[1], Reza Nezafat[1], Warren J. Manning[1,2], Sebastian Kozerke[3], Dana C. Peters[1]
[1]Cardiology, Beth Israel Deaconess Medical Center, Boston, MA , United States; [2]Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States; [3]D-ITET, ETH Zurich, Institute for Biomedical Engineering, Zurich, Switzerland

We evaluated the relationship between the respiratory bellows, placed on the chest, and the abdomen, and the superior-inferior displacement of the navigator signal, the lung-liver interface, and the heart, in single-heart-beat ECG-gated images. The diaphragmatic bellows correlated better than the chest wall bellows, and bellows correlated best with the navigator. Using a bellows based criteria, 3D coronary MRI was reconstructed retrospectively, based on the bellows data only. Our preliminary experience suggests that bellows-gating should be revisited.

14:30 ***5013*. Prospective Diaphragm Position Prediction for Cardiac MR Using Multiple Navigators**

Ian Hamilton Burger[1], Jennifer Keegan[2,3], Ernesta Meintjes[1], David Firmin[2,3]
[1]Human Biology, University of Cape Town, Cape Town, Western Cape, South Africa; [2]CMR Unit, Royal Brompton Hospital Trust, London, United Kingdom; [3]Imperial College London

Prediction of the diaphragm position during imaging segments by multiple navigators and a predictor estimator during the preceding systole. The control system compares the navigator records to a model and feeds back the difference between the model and recorded value to prevent the model from diverging. This data can then be used to improve prospective slice following and increase acceptance window and increase respiratory efficiency.

15:00 ***5014*. Motion Compensated Reconstruction for Thoracoabdominal Dynamic Contrast-Enhanced MRI in Free-Breathing**

Marina Filipovic[1,2], Pierre-André Vuissoz[1,2], Andrei Codreanu[3], Michel Claudon[4], Jacques Felblinger[1,5]
[1]INSERM-U947, Nancy, France; [2]Laboratory IADI, Nancy-Université, Nancy, France; [3]Centre Hospitalier de Luxembourg; [4]University Hospital Nancy; [5]INSERM-CIC801

Physiological motion often impairs the analysis of abdominal and thoracic dynamic contrast-enhanced MRI, by causing motion-induced artefacts and misregistration. A previously published reconstruction algorithm, GRICS, corrects for motion-induced artifacts in a single image reconstruction. A novel method has been developed by modifying GRICS with the purpose of performing whole motion compensation in dynamic contrast-enhanced MRI. The performance is demonstrated on 6 myocardial perfusion MRI data sets and on one simulated data set. The results present elastic registration and motion-artefact correction of the image series, in order to allow for more accurate time-intensity curves analysis and for a simplified post-processing.

Wednesday 13:30-15:30 Computer 120

13:30 ***5015*. 3D Free-Breathing Cardiac Cine Imaging with Respiratory and Cardiac Self-Gating and 3D Motion Correction**

Jing Liu[1], Thanh D. Nguyen[1], Pascal Spincemaille[1], Noel CF Codella[1], Martin R. Prince[1], Yi Wang[1]
[1]Radiology, Weill Cornell Medical College, New York, NY, United States

A 3D radial cardiac cine imaging technique provides reliable 3D motion tracking from the data acquisition for image reconstruction. 3D tracked motions are used for robust respiratory and cardiac self-gating and also allows 3D motion correction.

14:00 ***5016*****.** **High Spatial and Temporal Resolution Free Breathing Cardiac CINE-GRICS : 512x512 Vs 128x128 Matrix**

Pierre-André Vuissoz[1,2], Freddy Odille[3], Brice Fernandez, [1,4], Maelene Lohezic, [1,4], Adnane Benhadid[1,2], Damien Mandry[2,5], Jacques Felblinger[1,6]

[1]Imagerie Adaptative Diagnostique et Interventionnelle, Nancy-Université, Nancy, France; [2]U947, INSERM, Nancy, France; [3]Centre for Medical Image Computing, University College London, London, United Kingdom; [4]Global Applied Science Lab., GE healthcare, Nancy, France; [5]Departments of Radiology, University Hospital Nancy, Nancy, France; [6]CIC801, INSERM, Nancy, France

In cardiac MRI, myocardium function is usually studied through breath hold acquisitions, limiting the achievable spatial and temporal resolution. The recently proposed CINE-GRICS algorithm allows reconstructing cardiac cine images from free-breathing scans without any limitation regarding spatial resolution, as motion is corrected for by a motion model. In 2D short axis balanced-SSFP scans, we assess the benefit of using the motion-compensated strategy for high spatial and temporal resolution CINE, with matrix sizes from 128x128 to 512x512. Resulting images were assessed visually and using entropy-based metrics, and showed improved sharpness and better depiction of fine cardiac structures.

14:30 ***5017*****.** **Reducing the Sensitivity to Respiratory Motion of Modified Look-Locker with Saturation Recovery for Cardiac T1 Mapping**

Ting Song[1,2], Vincent B. Ho[2,3], Glenn Slavin[1], Maureen N. Hood[2,3], Jeffrey A. Stainsby[4]

[1]GE Healthcare Applied Science Laboratory, Bethesda, MD, United States; [2]Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD, United States; [3]Radiology, National Navy Medical Center, Bethesda, MD, United States; [4]GE Healthcare Applied Science Laboratory, Toronto, ON, Canada

To address cardiac motion, data acquisition is limited to quiescent periods of the cardiac cycle necessitating a segmented method. However, respiratory motion resulting from failed breath holding remains an issue. If a subject fails to maintain a consistent breath hold throughout the entire scan the acquired K-space data is not consistent across segments and this can result in motion artifacts. A new scheme of segment arrangement is proposed in this context. Phantom and human studies were evaluated with the two schemes.

15:00 ***5018*****.** **Simulation of Motion-Induced Dark-Rim Artifacts for Cartesian and Spiral Pulse Sequences**

Michael Salerno[1], Christopher M. Kramer[2], Craig H. Meyer[3]

[1]Department of Medicine, Cardiology, University of Virginia, Charlottesville, VA, United States; [2]Department of Radiology, University of Virginia, Charlottesville, VA; [3]Biomedical Engineering, University of Virginia, Charlottesville, VA

Simulation of interleaved spiral data acquisition demonstrates reduced sensitivity to motion-induced dark-rim artifacts as compared to conventional Cartesian data acquisition. Thus, spiral data acquisition strategies may be advantageous for first-pass myocardial perfusion imaging.

Thursday 13:30-15:30 Computer 120

13:30 ***5019*****.** **Combination of Motion Adapted Gating with Non-Rigid Motion Correction for Free-Breathing MRI**

Yuji Iwadate[1], Yoshihiro Tomoda[2], Yoshikazu Ikezaki[2], Tetsuji Tsukamoto[1]

[1]MR Applied Science Laboratory, GE Healthcare Japan, Hino, Tokyo, Japan; [2]MR Engineering, GE Healthcare Japan, Hino, Tokyo, Japan

The motion adapted gating (MAG) approach accelerates respiratory gating but still requires considerably longer scan time compared to a single breath-hold scan. In this work, we combined the non-rigid motion correction technique with the MAG approach to reduce scan time to the level comparable to breath-hold. A volunteer study showed that the scan time was less than 1.1-fold longer than non-gating scan and motion artifacts remaining with the MAG were reduced by non-rigid motion correction. This technique can be applied to various abdominal applications such as free-breathing dynamic contrast enhanced imaging.

14:00 ***5020*****.** **Using Respiratory Biofeedback Games in Pediatric MRI Examinations to Increase Patient Comfort and Facilitate Scanning – a Pilot Study**

Lena Douglas[1], Rose-Marie Claesson[2], Bo Ehnmark[2], Thröstur Finnbogason[2], Anna-Märta Lång[2], Bo Nordell[1], Morten Bruvold[3], Jouke Smink[3], Permjit Jhooti[4]

[1]Department of Medical Physics, Karolinska University Hospital, Stockholm, Sweden; [2]Department of Pediatric Radiology, Astrid Lindgren Children's Hospital, Karolinska University Hospital, Stockholm, Sweden; [3]Philips Healthcare, Best, Netherlands; [4]Radiological Physics, University Hospital of Basel, Basel, Switzerland

MRI examinations of pediatric patients can be challenging partly because many children have difficulties in lying still. The aim of this work is to introduce in respiratory controlled sequences a biofeedback game in which the child can control the flight of an airplane on a screen through the diaphragm position, as registered by standard navigator echoes. Given a task to focus on children are less likely to move during scanning leading to less motion artifacts. When playing the game the breathing pattern also becomes smoother with a more regular end-expiratory position, leading to more efficient and shorter examinations.

14:30 **5021. Self-Gating Reconstruction of Multiple Respiratory Phases Using Undersampled Golden-Radial Phase Encoding Trajectory**
Christian Buerger[1], Tobias Schaeffter[1], Claudia Prieto[1]
[1]Division of Imaging Sciences, King's College London, London, United Kingdom

A new self-gating acquisition scheme allowing the retrospective reconstruction of several respiratory phases is proposed. This approach takes advantage of the recently introduced Golden-Radial Phase Encoding (G-RPE) trajectory and uses the, inherently acquired, central k-space profiles to derive the respiratory motion signal. The method was tested in in-vivo data using a 32-channel coil and 3 different respiratory phases were reconstructed from undersampled data using non-Cartesian SENSE reconstruction.

15:00 **5022. Phase Navigator for Respiratory Triggering**
Alto Stemmer[1], Berthold Kiefer[1]
[1]Healthcare Sector, Siemens AG, Erlangen, Germany

In this work the signal for respiratory triggering is derived with a navigator that measures respiratory induced off-resonance effects. The advantages compared to a liver dome navigator are the compatibility with short bore scanners and that no navigator positioning is necessary.

Prospective Motion Correction

Hall B Monday 14:00-16:00 Computer 121

14:00 **5023. Combination of Prospective and Retrospective Motion Correction for Multi-Channel MRI**
Chaiya Luengviriya[1,2], Jian Yun[1], Oliver Speck[1]
[1]Department of Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Germany; [2]Department of Physics, Kasetsart University, Bangkok, Thailand

Real-time prospective correction is a very promising method to avoid image quality degradation caused by subject motion in MRI of human brain. The inaccuracy of measured motion data is limiting the efficiency. Simulations showed that residual motion artifacts after a prospective correction increased with the level of inaccuracy. Even for an ideal accurate case, artifacts can appear in multi-channel MRI because of coil sensitivity map errors. A retrospective correction was proposed and showed that the image quality can be further improved, especially for strong motion. In all cases, smooth motion resulted in fewer artifacts than abrupt motion.

14:30 **5024. MR Compatible Sensor for Motion Artifact Corrected Reconstruction Method**
Laure Rousselet[1,2], Maélène Lohezic, [23], Damien Mandry, [2,4], Cédric Pasquier[5], Jacques Felblinger[1,2]
[1]IADI, Nancy-Université, Nancy, France; [2]U947, Inserm, Nancy, France; [3]Global Applied Science Lab., GE Healthcare, Nancy, France; [4]CHU de Nancy, Nancy, France; [5]CIC801, INSERM, Nancy, France

The goal of this work was to develop a MR compatible sensor which aims at measuring the acceleration of a localized region of the body. It has been integrated to a motion compensated reconstruction (GRICS) as a physiological input to reduce respiratory artifacts and improve image quality.
GRICS reconstructions, performed with respiratory belt and with accelerometer, were compared to breath-hold images and averaged free breathing acquisitions. Accelerometer gives similar results to respiratory belts and to breath-hold. Moreover, it is easier to install on patient.

15:00 **5025. Self-Encoded Marker Design for Adaptive Optical Real-Time Motion Correction**
Christoph Forman[1], Murat Aksoy[2], Matus Straka[2], Joachim Hornegger[1], Roland Bammer[2]
[1]Pattern Recognition Lab, Department of Computer Science, Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany; [2]Department of Radiology, Stanford University, Stanford, CA, United States

Patient motionis one of the unsolved problems in MRI. In this study, we propose a novel large field of view marker design to be used with a monovision based system to correct for rigid head motion. The proposed marker design has gives better accuracy and can correct for larger patient head motion.

15:30 **5026. Fast Cross-Calibration Between MR Scanner and Optical System for Prospective Motion Correction**
Murat Aksoy[1], Christoph Forman[1], Matus Straka[1], Samantha Jane Holdsworth[1], Stefan Tor Skare[1,2], Joachim Hornegger[3], Roland Bammer[1]
[1]Department of Radiology, Stanford University, Stanford, CA, United States; [2]Karolinska Institute, Stockholm, Sweden; [3]Computer Science, Friedrich-Alexander-University Erlangen-Nuremberg, Erlangen, Germany

Optical systems have been proposed as a way to achieve rigid head motion correction with minimal changes to the pulse sequence. However, the usability of these systems in clinical practice have been limited mostly due to the tedious scanner-optical system cross-calibration routine that is required to link the frame of references of the optical system and the MR scanner. In this study, we propose a fast cross-calibration routine that is easy and takes only a couple of seconds. The variability of the scanner-camera cross calibration parameters with varying sequence parameters was investigated.

Tuesday 13:30-15:30 Computer 121

13:30 ***5027*. Prospective Motion Correction for MRI with a Single Retro-Grate Reflector Target and a Single Camera**

Maxim Zaitsev[1], Brian S. R. Armstrong[2], Brian Andrews-Shigaki[3], Todd P. Kusik[2], Robert T. Barrows[2], Kazim Gumus[3], Ilja Y. Kadashevich[4], Thomas Prieto[5], Oliver Speck[4], Thomas M. Ernst[3]

[1]Dept. of Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Electrical Engineering and Computer Science, UW-Milwaukee, Milwaukee, WI, United States; [3]John A. Burns School of Medicine, University of Hawaii, Honolulu, HI, United States; [4]Biomedical Magnetic Resonance, Otto-von-Guericke University,, Magdeburg, Germany; [5]Medical College of Wisconsin, Milwaukee, WI, United States

Even subtle motions degrade MR image quality. With optical stereoscopic motion tracking it is possible to correct for head motion in 6 degrees of freedom. However, it is extremely difficult to realise in the tight geometric constraints of the MR scanner, while keeping up with comfort and handling requirements of the clinical routine. Optical motion tracking with a single retro-grate reflector (RGR) target and a single camera has a great potential due to its versatility and accuracy. Reported here is the successful implementation of a prospective real time motion correction with RGR tracking, aiming at developing easy-to-handle motion correction strategies.

14:00 ***5028*. Breathing Motion Artifact Reduction for MRI with Continuously Moving Table Using Motion Consistent Retrospective Data Selection**

Matthias Honal[1], Jochen Leupold[1], Tobias Baumann[2]

[1]Dept. of Diagnostic Radiology, Medical Physics, University Hospital Freiburg, Freiburg, Germany; [2]Dept. of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany

A retrospective breathing motion compensation technique for axial MRI with continuously moving table is proposed. Redundant free breathing acquisitions are performed and motion consistent undersampled k-spaces are retrospectively extracted for parallel imaging reconstruction. Compared to a conventional reconstruction from free breathing data artifacts are significantly reduced. Except for increased noise, the achieved image quality is comparable to a reconstruction from a breath-hold acquisition.

14:30 ***5029*. 3D PROMO MRI with Online Automatic Slice Positioning**

Nathan Scott White[1], Josh Kuperman[2], Beth Ripley[2], Ajit Shankaranarayanan[3], Eric Han[3], Anders Dale[2,4]

[1]Dept. of Cognitive Science, University of California, San Diego, La Jolla, CA, United States; [2]Dept. of Radiology, University of California, San Diego, La Jolla, CA, United States; [3]Global Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [4]Dept. of Neuroscience, University of California, San Diego, La Jolla, CA, United States

We present an extension to the real-time 3D "PROspective MOtion correction" (PROMO) framework for online correction of between-scan motion in 3D sequences through automatic slice plane positioning. Initial results demonstrate an intra-subject alignment precision of better than 1 mm/deg, despite initial position/landmark differences of over 13 mm. Given current scanner and computer hardware capabilities, the alignment procedure can be done in about a second or two, making it suitable to be integrated as part of a routine automatic pre-scan procedure.

15:00 ***5030*. Motion-Induced Frequency and Shim Variations During Localized 1H MR Spectroscopy with Prospective Motion Correction**

Brian Keating[1], Thomas Ernst[1]

[1]Department of Medicine, John. A. Burns School of Medicine, University of Hawaii, Honolulu, HI, United States

Motion during brain 1H MR spectroscopy may cause susceptibility-induced changes in B0. We used a PRESS sequence with prospective motion correction (PMC) to quantify the effects of motion on center frequency and shim quality. Subjects performed x- and z-head rotations while the MRS voxel tracked head motion. The center frequency displays a linear dependence on both Î¸x (0.01ppm/deg) and Î¸z (0.002ppm/deg). The FWHM is approximately a quadratic function of the Î¸x, but is largely independent of Î¸z. Our results indicate that PMC requires real-time frequency and shim updates in order to recover high-quality spectra in the presence of subject motion.

Wednesday 13:30-15:30 Computer 121

13:30 ***5031*. Head Pose Prediction for Prospectively-Corrected EPI During Rapid Subject Motion**

Julian Maclaren[1], Rainer Boegle[1], Michael Herbst[1], Jürgen Hennig[1], Maxim Zaitsev[1]

[1]Medical Physics, Dept. of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany

The final goal of this project is fMRI of moving subjects using prospective motion correction. An optical tracking system provides head pose data in six degrees of freedom, which are used to prospectively update the imaging volume. However, latency delays in the tracking system, and the effective echo time of the sequence, result in a time lag between position measurement and the acquisition of the central k-space line. This causes in errors in slice registration. This work shows that motion prediction using a Kalman filter can solve this problem.

14:00 ***5032*. Prospective Motion Correction for Single-Voxel ^{1}H MR Spectroscopy**

Brian Keating[1], Weiran Deng[1], J Cooper Roddey[2], Nathan White[3], Anders Dale[2], V Andrew Stenger[1], Thomas Ernst[1]
[1]Department of Medicine, University of Hawaii, Honolulu, HI, United States; [2]Department of Neuroscience, University of California at San Diego, La Jolla, CA, United States; [3]Department of Cognitive Science, University of California at San Diego, La Jolla, CA, United States

Motion during brain ^{1}H MR spectroscopy acquisitions can compromise spectral quality. We adapted an image-based adaptive motion correction module for use with a PRESS sequence. Sets of three orthogonal spiral navigator images are acquired in each TR period, to estimate head motion in real-time. By applying the appropriate rotations and translations, the voxel can be made to remain stationary with respect to the brain. Adaptive motion correction recovered original metabolite values (Cho/Cr ratio) to within a few percent even for extensive head movements (20-30°), whereas non-navigated spectra showed marked changes in metabolite levels as well as increased variability.

14:30 ***5033*. PROspective MOtion Correction (PROMO) Results in Improved Image and Segmentation Quality of High-Resolution MRI Scans of Children**

Joshua M. Kuperman[1,2], Timothy T. Brown, [23], Matthew J. Erhart, [23], J Cooper Roddey, [23], Nathan Cooper White, [2,4], Ajit Shankaranarayanan[5], Eric T. Han[5], Daniel Rettmann[6], Anders M. Dale, [23]
[1]Radiology, UCSD, La Jolla, CA, United States; [2]Multimodal Imaging Lab, UCSD, La Jolla, CA, United States; [3]Neurosciences, UCSD, La Jolla, CA, United States; [4]Cognitive Science, UCSD, La Jolla, CA, United States; [5]Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [6]Applied Science Lab, GE Healthcare, Rochester, MN, United States

In order to test the utility of PROspective MOtion correction (PROMO) for pediatric MRI research, nine children, ages 9-12, were scanned four times with a high-resolution T1-weighted sequence. For each subject, PROMO on and off scans were collected in a counterbalanced alternating pattern. Results show a qualitative enhancement in image clarity and reduction of apparent motion artifacts with the use of PROMO. Furthermore, automated segmentations of PROMO-enabled images show significant improvements in quality and reliability as compared to PROMO-off images. Volumetric segmentations of structures show consistently greater percent volume overlap when PROMO is enabled.

15:00 ***5034*. Pulsed Continuous Arterial Spin Labeling (PCASL) with Prospective Motion Correction (PROMO)**

Jian Zhang[1,2], Greg Zaharchuk[2], Michael Moseley[2], Eric Han[3], Nate White[4], Cooper Roddey[4], Daniel Rettmann[5], Anders Dale[4], Joshua Kuperman[4], Ajit Shankaranarayanan[3]
[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Department of Radiology, Stanford University, Stanford, CA, United States; [3]Global Applied Science Lab, GE Healthcare, Menlo Park, CA, United States; [4]Department of Neuroscience, University of California, San Diego, La Jolla, CA, United States; [5]Global Applied Science Lab, GE Healthcare, Rochester, MN, United States

Pulsed Continuous Arterial Spin Labeling (PCASL) is a promising whole-brain perfusion imaging technique, with good properties such as high efficiency, 3D multi-slice capability, and low hardware demands. However, this sequence is vulnerable to patient motions due to its long scan time. We demonstrate an improved perfusion imaging strategy by integrating the original PCASL sequence with a PROspective MOtion (PROMO) correction module. The new sequence is much more robust against brain motion with little interference between the imaging volume and PROMO navigators.

Thursday 13:30-15:30 Computer 121

13:30 ***5035*. Catadioptric RGR Motion Tracking for Prospective Motion Compensation in MR Acquisitions**

Brian S. R. Armstrong[1], Todd P. Kusik[1], Robert T. Barrows[1], Brian Andrews-Shigaki[2], Julian Maclaren[3], Maxim Zaitsev[3], Oliver Speck[4], Thomas Prieto[5], Thomas Ernst[2]
[1]Electrical Engineering, Univ. Wisc.-Milwaukee, Milwaukee, WI, United States; [2]Medicine, University of Hawaii, Honolulu, HI, United States; [3]Dept. of Diagnostic Radiology, University Hospital Freiburg, Freiburg, Germany; [4]Biomedical Magnetic Resonance, Otto-von-Guericke University; [5]Neurology, Medical College of Wisconsin, Wauwatosa, WI, United States

A retro-grate reflector (RGR) optical system for tracking motion in an MR bore is presented, including an RGR motion tracking camera comprising a camera, lighting system and custom drive electronics in an RF enclosure, and a rib that has been engineered to grip the inside surface of the MR bore and support a mirror, which permits viewing through a head coil opening with the RGR camera positioned outside the head end of the MR bore. Evaluations of RF interference, mirror stability and tracking system noise are presented.

14:00 ***5036***. **Real-Time Motion Correction for High-Resolution Imaging of the Larynx: Implementation and Initial Results**

Joëlle Karine Barral[1], Juan M. Santos[1], Dwight G. Nishimura[1]
[1]Electrical Engineering, Stanford University, Stanford, CA, United States

Respiratory motion is currently the main limitation to high-resolution MR imaging of the larynx. A novel algorithm integrating Compressed Sensing and the Diminishing Variance Algorithm is proposed and implemented within the framework of the real-time system RTHawk. The effectiveness of the approach is demonstrated on phantoms and in vivo.

14:30 ***5037***. **Real-Time Motion Detection for Structural Brain Imaging Using Multi-Coil FID Navigators**

Tobias Kober[1,2], José P. Marques[1,3], Rolf Gruetter[1,4], Gunnar Krueger[2]
[1]Laboratory for functional and metabolic imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; [2]Advanced Clinical Imaging Technology, Siemens Suisse SA - CIBM, Lausanne, Switzerland; [3]Department of Radiology, University of Lausanne, Switzerland; [4]Departments of Radiology, Universities of Lausanne and Geneva, Switzerland

Subject motion is often affecting the quality of MRI data. In this work, we investigate the feasibility to detect motion by monitoring repetitive FID navigator signals from arrays of receive coils. Object motion is shown to induce changes in the FID signal intensity. For proof of concept, the technique was applied to structural MP-RAGE scans of the brain. Subject motion was reliably detected. The technique has the potential to provide a scan quality measure and motion parameters for real-time or retrospective correction. It could be used in other MR sequences without time or signal penalty.

15:00 ***5038***. **Real-Time Intra-Volume Motion Correction in EPI Using Active Markers**

Melvyn Boon King Ooi[1,2], Sascha Krueger[3], William J. Thomas[2], Truman R. Brown[1,2]
[1]Biomedical Engineering, Columbia University, New York, NY, United States; [2]Radiology, Columbia University, New York, NY, United States; [3]Philips Research Europe, Hamburg, Germany

Head motion is a fundamental problem in fMRI. A prospective, slice-by-slice compensation strategy for rigid-body motion is presented for EPI sequences. Before the acquisition of each EPI-slice, a short tracking pulse-sequence is used to measure the positions of three micro RF-coil "active markers" integrated into a headband worn by the subject. During head motion, the rigid-body transformation that realigns these markers to their initial positions is fed back to update the image-plane – maintaining it at a fixed orientation relative to the head – before the next EPI-slice is acquired. EPI time-series are obtained that demonstrate real-time image-plane realignment during volunteer motion.

Image Correction - Non-Motion

Hall B Monday 14:00-16:00 Computer 122

14:00 ***5039***. **Application of K-Space Energy Spectrum Analysis for Inherent and Dynamic B_0 Mapping and Distortion Correction in DTI**

Trong-Kha Truong[1], Nan-kuei Chen[1], Allen W. Song[1]
[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States

Diffusion tensor imaging (DTI) is vulnerable to spatial and temporal B_0 variations due to susceptibility effects, eddy currents, subject motion, physiological noise, and system instabilities, resulting in geometric distortions and subsequent errors in the derivation of the diffusion tensor. Here, we propose a novel method based on k-space energy spectrum analysis, which can inherently and dynamically generate a B_0 map from the k-space data for each baseline ($b = 0$) and diffusion-weighted image, without requiring any additional data acquisition, to effectively and efficiently correct for such artifacts and achieve a high spatial fidelity and accuracy.

14:30 ***5040***. **A Blood Flow Navigator for Assessing Physiologic Noise in EPI Data**

Andre van der Kouwe[1], Matthew Dylan Tisdall[1], Oliver Hinds[1], Aaron Hess[2], David Salat[1], Douglas Greve[1]
[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States; [2]Biomedical Engineering, University of Cape Town, Cape Town, South Africa

A rapid single slice EPI acquisition (neck blood flow navigator) is interleaved between slices of a conventional multislice 2D BOLD EPI acquisition in a single sequence that provides information with high temporal resolution describing blood flow in the major arteries of the neck. This signal is tightly coupled to blood flow in the brain and may be used to assess and correct for physiologic noise in the BOLD signal. Navigator images are reconstructed in real-time during acquisition and it is shown that the timing of the cardiac signal derived from the navigators closely matches the timing of the photoplethysmograph.

15:00 ***5041***. **CINE Images of a Beating Rodent Cardiac Phantom**

Steven Fortune[1], Ian Marshall[1], Maurits A. Jansen[1], Peter R. Hoskins[1], Tom Anderson[1]
[1]Medical Physics, University of Edinburgh, Edinburgh, United Kingdom

Small animal cardiac MRI is challenging due to small dimensions and fast heart rates. In order to assist in the development and testing of MRI sequences a rodent cardiac phantom has been designed and tested. It consists of a single chamber of PVAC housed in a water bath, expanded by an external pump. Initial CINE images of the phantom show this phantom functions with similar parameters to a rat left ventricle. Strong flow artefacts are present in the image. Thus this phantom could be used for the development of flow compensation methods as well as fast imaging methods.

15:30 ***5042***. **ECG-Triggered FASTERMAP Shimming Allows for Reproducible Shim Convergence in Spinal Cord Spectroscopy**

Andreas Hock[1], Anke Henning[2], Michael Schär[3,4], Alexander Fuchs[1], Spyros Kollias[5], Peter Boesiger[1]

[1]University and ETH Zurich, Institute for Biomedical Engineering, Zurich, Switzerland; [2]University Hospital of Zurich, Institute for Biomedical Engineering, Zurich, Switzerland; [3]The Johns Hopkins University School of Medicine, 1Russel H. Morgan Department of Radiology and Radiological Science, Baltimore, MD, United States; [4]Philips Healthcare, Cleveland, OH, United States; [5]University Hospital of Zurich, Institute of Neuroradiology, Zurich, Switzerland

ECG-triggered FASTERMAP shimming is introduced and compared to conventional FASTERMAP shimming and shimming based on ECG-triggered B0 field mapping for single voxel proton spectroscopy at 3T. This investigation shows that the use of ECG-triggered FASTERMAP seems to be a robust and applicable method for clinical spinal cord spectroscopy. It is significantly faster than ECG-triggered B0 mapping and in contrast to the conventional FASTERMAP shimming artifacts due to pulsatile CSF flow introduced by cardiac motion may have less influence.

Tuesday 13:30-15:30 Computer 122

13:30 ***5043***. **A Three-Dimensional Magnetic Resonance Imaging Geometric Distortion Correction Algorithm for Radiotherapy**

Scott Hanvey[1], John Foster[2]

[1]Radiotherapy Physics, Beatson West of Scotland Cancer Centre, Glasgow, Lanarkshire, United Kingdom; [2]MRI Physics, Beatson West of Scotland Cancer Centre, Glasgow, United Kingdom

The following article describes the testing of a three-dimensional geometric distortion correction algorithm, with applications in radiotherapy planning. Magnetic resonance imaging is well known to suffer from geometric distortion and although in-plane distortion is now routinely corrected, in general, through-plane distortion remains uncorrected. This study investigates a three-dimensional and a two geometric distortion correction algorithm using a variety of test objects to establish their accuracy in the axial and coronal planes. An acceptable clinical range for radiotherapy is established for the two-dimensional and three-dimensional distortion correction algorithms using three slices and many slices.

14:00 ***5044***. **Evaluation of Geometrical Distortion in a Head-Sized Phantom at Ultra-High-Field (7 Tesla) MRI**

Philipp Dammann[1], Oliver Kraff, Stefan Maderwald, Elke Gizewski[2], Mark Ladd, Thomas Gasser[3]

[1]Neurosurgery, University of Duisburg-Essen, Germany and Erwin L. Hahn Institute for Magnetic Resonance Imaging, Essen, NRW, Germany; [2]Department for Diagn. and Interv. Radiology and Neuroradiology, University of Duisburg-Essen, Germany; [3]Department of Neurosurgery, University of Duisburg-Essen, Germany

In this study we assess geometrical distortion over a head-sized phantom at ultra-high-field MRI (7 Tesla). As field inhomogenity is proportional to B0, system-related distortions of spatial encoding are expected to increase with the field strength. This may interfere with potential image-guided applications in ultra-high-field MRI. This study revealed that distortion is lower than expected, showing no significant difference in distortion at 7 Tesla compared to lower field strength within a range of 91 mm from the magnetic center. Image distortion correction reduced local distortion maxima but didn`t significantly reduce mean distortion over the whole volume.

14:30 ***5045***. **Accuracy the Spatial Position of Gold Markers in MR Images**

Tufve Nyholm[1], Joakim Jonsson[1], Magnus G. Karlsson[1], Mikael Karlsson[1]

[1]Umeå University, Umeå, Sweden

MR has potential to replace CT as basis for radiotherapy of prostate cancer. To be able to use the MR images for patient positioning at treatment, the position of the internal gold markers needs to be correct in the MR images. A phantom was created and scanned to evaluate the dependence between the apparent position and relevant sequence parameters. It was found that use of 2D sequences introduces errors in the position, and that the apparent marker position is dependent on the tissue type surrounding the marker. The apparent position is not dependent on band-width or frequency encoding direction.

15:00 ***5046***. **Attenuation Correction of a Simple Phantom from Simultaneous SPECT and MR Imaging**

Mark Jason Hamamura[1], Seunghoon Ha[1], Werner W. Roeck[1], Lufti Tugan Muftuler[1], Douglas J. Wagenaar[2], Dirk Meier[2], Bradley E. Patt[2], Orhan Nalcioglu[1]

[1]Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, CA, United States; [2]Gamma Medica-Ideas, Inc., Northridge, CA, United States

Accurate SPECT imaging requires attenuation correction (AC) of the nuclear projection data. In this study, we simultaneously acquired SPECT and MRI data of a simple cylindrical phantom using a novel MR-SPECT system. This MRI data was then used to

perform the AC of the SPECT data. The results demonstrate the feasibility of performing AC using data acquired from simultaneous MR and SPECT imaging.

Wednesday 13:30-15:30 Computer 122

13:30 ***5047***. **Application of IDEAL for the Correction of Chemical Shift Artifacts in MREIT**

Mark Jason Hamamura[1], Orhan Nalcioglu[1], Lufti Tugan Muftuler[1]
[1]Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, CA, United States

Chemical shift artifacts in magnetic resonance electrical impedance tomography (MREIT) degrade the accuracy of the reconstructed conductivity. In this study, we investigated the use of the iterative decomposition of water and fat with echo asymmetry and least-squares estimation (IDEAL) algorithm to remove these artifacts in a simple fat/water phantom. The results demonstrate that this technique can be used to correct for chemical shift artifacts in MREIT.

14:00 ***5048***. **SSFP Banding Artefact Removal in Large FOV Images at 3T**

Sonia I. Gonçalves[1], Maria L.W. Ziech[1], Jaap Stoker[1], Aart J. Nederveen[1]
[1]Radiology, AMC, Amsterdam, Netherlands

Banding artefacts are a serious obstacle to the use of B-FFE sequences in large FOV images and (ultra-)high field strengths. It is more so because the shortening of TR to minimize this type of artefacts is often not possible because of SAR constraints. In this work, it is shown that by combining scans with different phase cycling schemes one is able to correct for banding artefacts in large FOV abdominal images at 3 T, with as few as 6 different phase cycling schemes, independently of the chosen TR.

14:30 ***5049***. **Ramp Sampling Strageties for High Resolution Single-Pass Dixon Imaging at 3T**

Ken-Pin Hwang[1], Basak E. Dogan[2], Zachary W. Slavens[3], Anthony T. Vu[3], Wei Tse Yang[2], Jingfei Ma[2]
[1]MR Applied Science Laboratory, General Electric Healthcare, Houston, TX, United States; [2]Department of Diagnostic Radiology, University of Texas MD Anderson Cancer Center, Houston, TX, United States; [3]GE Healthcare, Waukesha, WI, United States

Errors in Dixon fat-water separation may occur when acquired echo times deviate far from those expected by the separation algorithm. Single pass, dual-echo sequences are particularly vulnerable when pursuing high resolution at higher field strengths, where the increased frequency shift of lipid demands shorter in- and out-of-phase echo times. This study examines the effect of improper echo times on a Dixon algorithm and corrects them with the use of ramp sampling methods. Suppression is improved and artifacts are reduced by aligning the echo times closer to those expected by the algorithm, with no observable degradation of image quality.

15:00 ***5050***. **SERA: A Technique to Improve the Performance of the 3D Sequence by Reducing Aliasing Artifacts in Edge Slices**

Yanle Hu[1]
[1]Imaging Research Center, University of Texas at Austin, Austin, TX, United States

When the object being imaged is larger than the field of view in slice-selection direction (zFOV), wrap-around aliasing artifacts will be observed in 3D sequences even with the use of a high performance excitation pulse. Although throwing away a couple of edge slices can solve the problem, it reduces the efficiency of the 3D method. In this work, a new technique is introduced. It excites and saturates spins in two thin slices immediately outside of zFOV before the slab excitation. As a result, aliasing artifacts in edge slices can be suppressed and the efficiency of 3D acquisition can be preserved.

Thursday 13:30-15:30 Computer 122

13:30 ***5051***. **An A-Priori Supported Image Correction Method for Severe Intensity Non-Uniformities at 3 T**

Christian Würslin[1], Fritz Schick[1]
[1]Department of Diagnostical and Interventional Radiology, Section on Experimental Radiology, University Hospital Tübingen, 72076 Tübingen, Germany

Images, acquired at high field strengths usually suffer from a high amount of image non-uniformities (INUs), which cause a large amount of automatic post-processing techniques (e.g. for quantification) to fail. This applies especially for abdominal image slices, where INUs are particularly strong and common INU correction schemes do not apply. The authors therefore propose a correction algorithm which incorporates anatomic information for the compensation of heavily corrupted images. The algorithm was validated on real and simulated image data and showed a high potential in the reduction of INUs, enabling further post-processing procedures, such as thresholding, at high field strengths.

14:00 ***5052***. **A Robust and Simple Technique for the Suppression of Artifacts Arising from Long T1 Species in Segmented Inversion Recovery Sequences**

Wolfgang Gerhard Rehwald[1], Pooja Aggarwal[2], Igor Klem[2], Han Kim[2], Raymond J. Kim[2]
[1]Siemens Healthcare, Chicago, IL, United States; [2]Duke Cardiovascular MR Center, United States

This is only a Test.

14:30 ***5053*. Improvement of the Arterial Input Function Considering B_1-Inhomogeneities**

Robert Merwa[1], Karin Kapp[2], Franz Ebner[3], Thorsten Feiweier[4], Gernot Reishofer[3], Rudolf Stollberger[5]
[1]Medical Engineering, FH OÖ - Upper Austria University of Applied Sciences, Linz, Austria; [2]Department of Radiation Therapy, Medical University of Graz, Graz, Austria; [3]Department of Radiology, Medical University of Graz, Graz, Austria; [4]Healthcare, Siemens AG, Germany; [5]Institute of Medical Engineering, Graz University of Technology, Graz, Austria

DCE MRI was performed at 3 T in combination with a special sequence in order to determine B_1 inhomogenities. AIF and tissue concentrations were calculated and the kinetic parameters K^{trans} and V_e were determined with a generalized kinetic model. The absolute deviation of the maximum value of two comparable AIFs can be improved by a factor up to 70 and the root mean square deviation concerning the two AIFs can be decreased by a factor up to 30 if B_1 inhomogeneities are corrected. Also the deviations of Ktrans and Ve in respect of the two AIFs are significantly lower.

15:00 ***5054*. Stent Imaging Using Metal Artifact Reduction Sequence**

Sang-Young Zho[1], Min Oh Ghim[1], Dong Joon Kim[2], Dong-Hyun Kim[1,2]
[1]Electrical and Electronic Engineering, Yonsei University, Seoul, Korea, Republic of; [2]Radiology, Yonsei University College of Medicine, Seoul, Korea, Republic of

We examine a method for high-resolution stent imaging using metal artifact correction sequence and parallel imaging technique.

EPI Correction

Hall B Monday 14:00-16:00 Computer 123

14:00 ***5055*. Robust Elimination of EPI Nyquist Ghosts Via Spatial and Temporal Encoding**

W Scott Hoge[1], Huan Tan[2], Robert A. Kraft[2]
[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States; [2]Virgina-Tech Wake Forest School of Biomedical Engineering, Winston-Salem, NC, United States

Nyquist ghosts are an inherent artifact in EPI acquisitions. We propose here a method that fuses ghost correctuion methods based on spatial encoding (via multiple coils) and temporal encoding (via cyclic variations in the acquisition sequence). Post acquisition, PLACE is employed to cancel ghosting artifacts in data used to estimate self-referenced parallel MR imaging reconstruction coefficients. The improved pMRI reconstruction coefficients are then employed on each frame, to reconstruct a ghost free image. We demonstrate that this self-referenced approach significantly reduces Nyquist ghosts, and is robust to temporal variations such as magnetic field drift with minimal latency.

14:30 ***5056*. Optimized Acquisition Strategy for Reference-Free Reduction of Nyquist Ghosting in EPI at 7 T**

Benedikt A. Poser[1,2], Pål Erik Goa, [1,3], Markus Barth, [1,2]
[1]Erwin L Hahn Institute for Magnetic Resonance Imaging, University Duisburg-Essen, Essen, Germany; [2]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, Netherlands; [3]Department of Medical Imaging, St. Olavs University Hospital, Trondheim, Norway

Nyquist (N/2) ghosting in EPI tends to become particularly problematic at ultra-high field. Strongly dependent on imaging parameters –especially echo spacing and readout bandwidth– ghosting may pose considerable practical limitations when setting up fMRI protocols at 7 T and above.
We here show that residual ghosting is caused by an often appreciable mismatch between phase correction and imaging data. We propose a small but powerful sequence modification, namely an optimized timing of the phase-correction navigators, to overcome this problem and thereby remove the practical restrictions due to ghosting. Phantom and in vivo results demonstrate ghost reductions by up to factor four.

15:00 ***5057*. Robust Method for EPI Ghost Correction**

Frank Godenschweger[1], Myung-Ho In[1], Oliver Speck[1]
[1]Biomedical Magnetic Resonance, Institute for Experimental Physics, Otto-von-Guericke University, Magdeburg, Germany

A Nyquist ghost correction of EPI is propose, which determines the phase correction differences between channels and slices with high accuracy in a preparation step from a set of navigator echoes. Taking this calibration into account, only one single correction needs to be determined dynamically for all slices and channels during the EPI series, greatly improving stability.
The robustness of the proposed technique was tested on phantom and in-vivo data. The proposed technique for EPI ghost correction dramatically improves the image quality.

15:30 ***5058*.** **Reducing Ghosting in EPI Using Trajectory Based Reconstruction with Dixon Method Fat Suppressed Navigator Echoes at 7T**

Oliver Josephs[1], Chloe Hutton[1], Joerg Stadler[2], Johannes Bernarding[3], Oliver Speck[3], Nikolaus Weiskopf[1]

[1]Wellcome Trust Centre for Neuroimaging, University College London, London, United Kingdom; [2]Leibniz Institute for Neurobiology, Magdeburg; [3]Otto-von-Guericke University, Magdeburg

At 7T, navigator echoes, acquired at short TE, and used in EPI to reduce Nyquist ghosting, can be significantly compromised by fat signal. Usually, in EPI, fat is suppressed by applying a fat saturation pulse before slice selective excitation but at 7T this significantly increases the required SAR. We present a two point Dixon technique for suppressing the fat signal in the navigator echoes and demonstrate its effectiveness in human brain imaging. The new technique is an efficient alternative for improving phase navigators and can be used in additon to fat saturation and other artifact suppression methods.

Tuesday 13:30-15:30 Computer 123

13:30 ***5059*.** **Navigator-Free Dynamic Phase Correction for Echo-Planar Imaging Based Functional MRI**

Dan Xu[1], R. Scott Hinks[1], Bruce D. Collick

[1]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States

In echo-planar imaging based functional MRI, non-phase-encoded navigator echoes are sometimes collected to enable correction of temporal frame dependent even-odd-echo phase modulation. However, the navigator-based method assumes that the additional modulation that the center echoes experience is the same as that predicted by navigator echoes, which is not true when there is additional modulation building up across echoes. Therefore, the modulation of the center echoes would not be well corrected, leading to ghost drift. We propose a method to use scan data itself to more faithfully estimate the per-temporal-frame modulation than the navigator-based method, which significantly reduces ghost drift.

14:00 ***5060*.** **Robust 2D Phase Correction for Echo-Planar Imaging Under a Tight Field-Of-View**

Dan Xu[1], Kevin F. King[1], Yuval Zur[2], R. Scott Hinks[1]

[1]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States; [2]GE Healthcare, Haifa, Israel

The existing 2D phase correction methods to reduce Nyquist ghost in echo-planar imaging (EPI) have several unaddressed issues that largely affect their practicality. These issues include uncharacterized noise behavior, image artifact due to unoptimized phase estimation, and most seriously a new image artifact under tight FOV. We propose a modified, more robust method that addresses all the abovementioned issues. Various EPI results show that the proposed method can robustly generate images free of Nyquist ghost and some other image artifacts even in oblique scans or when cross-term eddy current terms are significant.

14:30 ***5061*.** **Comparison of Applying 1D Phase and 2D Phase N/2 Ghost Correction Prior to PROPELLER-EPI Reconstruction**

Hing-Chiu Chang[1,2], Chun-Jung Juan[3], Tzu-Chao Chuang[4], Yi-Jui Liu[5], Chao-Chun Lin[2,6], Hsiao-Wen Chung[2]

[1]Applied Science Laboratory, GE Healthcare Taiwan, Taipei, Taiwan; [2]Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan; [3]Department of Radiology, Tri-Service General Hospital, Taipei, Taiwan; [4]Electrical Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan; [5]Department of Automatic Control Engineering, Feng Chia University, Taichung, Taiwan; [6]Department of Radiology, China Medical University Hospital, Taichung, Taiwan

PROPELLER-EPI consists of EPI signal readout with alternative echoes, thereby the phase inconsistencies between odd and even echoes generate N/2 ghost artifact in each rotating blade as well as conventional EPI imaging. The 1D correction method fails in oblique scan (rotating blades) because the phase inconsistencies along both readout and phase direction. A 2D phase correction method can overcome this problem by modifying the reference scan manner. In this work, we compare the quality of reconstructed PROPELLER-EPI images by applying 1D phase and 2D phase N/2 ghost correction prior to PROPELLER-EPI reconstruction.

15:00 ***5062*.** **In FMRI a Dual Echo Time EPI Pulse Sequence Can Induce Sources of Error in Dynamic Magnetic Field Maps**

Andrew Hahn[1], Andrew Nencka[1], Daniel Rowe, [1,2]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States; [2]Mathematics, Statistics, and Computer Science, Marquette University, Milwaukee, WI

Estimations of main magnetic field inhomogeneity are often acquired for correction of image warping in echo planar images (EPI) resulting from vulnerability to off-resonance effects of EPI. Many established methods exist for field estimation, one of which involves two EPI acquisitions with different echo times. The method is fast, easily implemented and can be performed in-line with fMRI experiments. However, inconsistencies in the MRI scanner hardware, specifically with the RF pulse, as well as physiologic phenomena that alter the off-resonance characteristics between image acquisitions such as motion or respiration can induce errors in field maps estimated in this manner.

Wednesday 13:30-15:30 Computer 123

13:30 ***5063*. Jacobian Weighting of Distortion Corrected EPI Data**

Stefan Skare[1,2], Roland Bammer[1]
[1]Radiology, Stanford University, Stanford, CA, United States; [2]MR Center, Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden

By acquiring EPI data both with positive and negative phase encoding blips one obtains two oppositely distorted images. The reversed gradient polarity (RGPM) method can be used to correct these images by searching for a displacement field that explains their difference. However, even if the estimated displacement field is adequate, the two corrected EPI images have a very low resolution in anatomical regions that have been too compressed. In this work, we use a Jacobian weighting scheme to make an informative choice about the combination of the two images that avoids the inclusion of signals from very compressed regions.

14:00 ***5064*. Using PLACE for EPI Distortion Correction of Diffusion Weighted Images (DWIs)**

Sofia Chavez[1], Elizabeth Ramsay[1], Donald Plewes[1,2], Greg Stanisz[1,2], Q-San Xiang[3]
[1]Imaging Research, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [2]Medical Biophysics, University of Toronto, Toronto, Ontario, Canada; [3]Department of Radiology, University of British Columbia, Vancouver, B.C., Canada

A feasibility study for the application of PLACE, an EPI distortion correction, to diffusion weighted images (DWIs) is presented. PLACE requires a minimum of two input images which differ by an extra “blip” along the phase encode (PE) direction. The phase relation between the images encodes the PE coordinate, allowing for correction of the EPI-based distortion along the PE direction. Results show successful distortion correction for DWIs of a phantom despite the lower SNR, partial k-space and ramp sampling typical of standard DWI sequences. In vivo application of PLACE to DWI is currently under investigation.

14:30 ***5065*. Accelerating Phase Modulation for Correcting EPI Geometry Distortion by Modern GPGPU Parallel Computation.**

Yao-Hao Yang[1], Teng-Yi Huang, Fu-Nien Wang[2], Nan-Kuei Chen[3]
[1]National Taiwan University of Science and Technology, Taipei, Taiwan; [2]Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua university; [3]Brain Imaging and Analysis Center, Duke University Medical Center

Phase modulation combined with field mapping can correct the EPI geometry distortion but it is a time-consuming algorithm. We proposed to incorporate the GPGPU technique into phase-modulation calculation to reduce the whole computation time. Applying on the PROPELLER EPI data set, the parallel algorithm reduced the computation time from ~1750 seconds to ~100 seconds. We conclude that the GPU computing is a promising method to accelerate EPI geometry correction.

15:00 ***5066*. Probabilistic Reconstruction of Undistorted EPI Images Using a Rician Noise Model**

Jesper Leif Roger Andersson[1], Mark Jenkinson[1]
[1]fMRIB, Oxford University, Oxford, Oxfordshire, United Kingdom

We have developed a method for estimating and correcting distortions from reverse-blip data with poor SNR. It is based on a forward model that allows us to make predictions about the images and a Rician noise model that enables us to calculate the probability of observed images. Bayesian inversion is used to find the most probable distortion-free image and field. It performs well even on data with very poor SNR.

Thursday 13:30-15:30 Computer 123

13:30 ***5067*. New Calculation Method of Pixel Shift Map on PSF Mapping Technique: A Study on 7T MRI**

Se-Hong Oh[1], Jun-Young Chung[1], Myung-Ho In[2], Maxim Zaitsev[3], Oliver Speck[2], Young-Bo Kim[1], Zang-Hee Cho[1]
[1]Neuroscience Research Institute, Gachon University of Medicine and Science, Incheon, Korea, Republic of; [2]Department of Biomedical Magnetic Resonance, Institute for Experimental Physics, Otto-von-Guericke University Magdeburg, Magdeburg, Germany; [3]Department of Radiologic Research, Medical Physics, University Hospital of Freiburg, Freiburg, Germany

Echo-planar imaging (EPI) is one of the fastest and most widely used MRI pulse sequences in the field of MRI. Compared to conventional imaging sequence, EPI is more prone to a variety of artifacts. A prominent EPI artifact is geometric distortion due to strong magnetic field inhomogeneity and susceptibility. Previous PSF mapping method, which was implemented by Zaitsev et al. used GE (Gradient Echo) StdDev (standard deviation) image as a base and produced a ¡°mask¡± to extrapolate pixel shift map. Flow artifact as well as setting of the parameters (i.e. threshold value) can affect the result of mask. And the extrapolated shift map which resulting shift maps with extrapolation eventually have error. Consequently corrected images will also have errors induced by mask errors and flow artifacts. So we propose new mask calculation method based on using a 2D PSF data based, not based on the GE StdDev image as previously used. This method is capable of making automatic mask calculation procedure, along with the advantage of eliminating flow induced ghost artifact all together.

14:00 ***5068*.** **Accelerated Point Spread Function Mapping Using Compressed Sensing for EPI Geometric Distortion Correction**

Iulius Dragonu[1], Juergen Hennig[1], Maxim Zaitsev[1]
[1]Diagnostic Radiology, University Hospital Freiburg, Freiburg, Baden Wuerttemberg, Germany

Single-shot echo-planar imaging (EPI) is a fast technique allowing the acquisition of an image following a single RF excitation. The high temporal resolution of EPI makes it the method of choice for applications such as fMRI or diffusion tensor imaging. However, EPI is prone to geometric and intensity distortions in the presence of magnetic field inhomogeneities. Several correction techniques have been proposed in the past based on field map acquisitions or point spread function (PSF) acquisitions. Parallel imaging techniques were employed for accelerating the PSF data acquisition. In this work we demonstrate that compressed sensing (CS) reconstruction can be used for acquiring the PSF data set with high acceleration factors for accurate geometric distortion corrections.

14:30 ***5069*.** **Distortion Correction for Echo Planar MR Imaging Using the Point Spread Function (PSF) Map with Bregman Iteration**

Yu Cai[1], Weili Lin, Qingwei Liu, Craig Hamilton[2], Hongyu An
[1]Department of Radiology, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States; [2]Wake Forest University

Point Spread Function (PSF) mapping techniques have shown promise for geometric distortion correction in Echo Planar Imaging (EPI)(1), where the distortion information is mapped by applying additional phase encoding gradients with a constant time (PSF encoding). Cai et al(2) introduced the inverse solution of the PSF map with the Tikhonov regularization method for EPI distortion correction. The smoothness penalty in the Tikhonov regularization causes it sensitive to the aliasing artifact in its reconstructed image and fine textile structure blurring. Here we apply the total variation (TV) regularization with Bregman iteration method(3) to the PSF map in which the penalty term is adaptively updated based on the Bregman distance, which is immune to the above effects. The proposed approach compared with the Tikhonov regularization methods were evaluated at 3.0T with human subjects while at 9.4T with rats.

15:00 ***5070*.** **Improved PSF-Based EPI Distortion Correction in Human Imaging at 7 Tesla**

Myung-Ho In[1], Jun-Young Jung[2], Se-Hong Oh[2], Maxim Zaitsev[3], Zang-Hee Cho[2], Oliver Speck[1]
[1]Department Biomedical Magnetic Resonance, Institute for Experimental Physics, Otto-von-Guericke University Magdeburg, Magdeburg, Germany; [2]Neuroscience Research Institute, Gachon University of Medicine and Science, Inchoen, Korea, Republic of; [3]Department of Radiologic Research, Medical Physics, University Hospital Freiburg, Freiburg, Germany

This method proposes an improved method with which distortions in EPI images in the ultra high field MRI such as 7.0 Tesla can be correct automatically and with high fidelity. The correction is a modification and extension of the point spread function (PSF) method previously developed. In addition to more precise mapping and correction of blurring, the method removes flow induced artifacts which can cause errors in the shift map derived from the PSF. The advantages of the proposed method for the correction of geometric distortions in EPI are demonstrated in human brain in vivo at 7.0 Tesla.

Topics in Image Analysis

Hall B Monday 14:00-16:00 Computer 124

14:00 ***5071*.** **Automated Analysis of ACR Phantom Data as an Adjunct to a Regular MR Quality Assurance Program**

Lawrence P. Panych[1,2], Lisa Bussolari[1], Robert V. Mulkern, [23]
[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States; [2]Radiology, Harvard Medical School, Boston, MA, United States; [3]Radiology, Children's Hospital, Boston, MA, United States

A Matlab-based package for automatic analysis of phantom images was developed. The package analyzes images of the American College of Radiology (ACR) phantom, performing measurements similar to those required as part of the ACR accreditation program along with other useful measures. Analysis of the data from five 1.5T MR systems acquired during weekly QA scans was performed. Such data can be help to identify potential system problems, such as lower than usual SNR, and serve as an adjunct to a regular program of quality assurance.

14:30 ***5072*.** **Weisskoff Stability Metrics Dependence on K-Space Trajectory**

E. Brian Welch[1,2], Ad Moerland[3], Elizabeth A. Moore[3], J. Christopher Gatenby[1], John C. Gore[1]
[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States; [2]MR Clinical Science, Philips Healthcare, Highland Heights, OH, United States; [3]MR Clinical Science, Philips Healthcare, Best, Netherlands

Measurement of an MR scanner's signal stability is important for clinical and research sites acquiring data known to be adversely affected by system instabilities such as functional MRI. In particular, the Weisskoff plot and its associated radius of decorrelation (RDC) metric are often used to compare systems. The RDC is known to be influenced by the noise level of the data. However, it has not been widely reported that the observed RDC is also affected by k-space trajectory. Here we present stability measurements from a single scanner collected using four distinct k-space acquisition trajectories: Cartesian, multivane (propeller), spiral and radial.

15:00 **5073. Array Coil Signal-To-Noise Ratio Measurement: A Comparison of Methods**

Elizabeth M. Tunnicliffe[1], Martin J. Graves[1]
[1]Department of Medical Physics and Clinical Engineering, Cambridge University Hospitals, Cambridge, CB2 0QQ, United Kingdom

This phantom study compares six signal-to-noise ratio (SNR) measurement methods in two eight-channel head arrays. While the methods are equivalent for well de-coupled elements, this is not the case once noise correlations exist, which can indicate that an array is failing. In the absence of longitudinal SNR data, a comparison between the background region standard deviation SNR method and the noise power SNR method can provide evidence of array failure. In this situation the noise power method provides the most accurate estimate of the underlying SNR in a single image acquisition.

15:30 **5074. Protocol for Regular Quality Control of MRI Scanners in a Clinical Setting**

Joost Kuijer[1], Erwin Kist[2], Mark Hofman[1]
[1]Physics and Medical Technology, VU University Medical Center, Amsterdam, Netherlands; [2]Radiology, VU University Medical Center, Amsterdam, Netherlands

A protocol for MRI Quality Control (QC) testing within 15 minutes was developed in a clinical setting including phantom positioning and image evaluation. The set-up consisted of a scan protocol using the ACR phantom, based on the ACR 2004 QC Manual. The images were sent from the scanner to a central server using a DICOM transfer, automatically analysed and compared to predefined action limits, based on clinical relevance and short-term reproducibility. Parameters included SNR, ghosting, image homogeneity and 3D geometric accuracy. Web-based reporting allowed direct feedback at the scanner, while trend plots provide insight in long-term stability.

Tuesday 13:30-15:30 Computer 124

13:30 **5075. On Accelerated Dynamic Contrast-Enhanced Lung Perfusion Using K-T BLAST**

Jia-Shuo Hsu[1], Shang-Yueh Tsai[2], Yi-Ru Lin[3], Hsiao-Wen Chung[1]
[1]Institute of Biomedical Electronics and BioInformatics, National Taiwan University, Taipei, Taiwan; [2]Dept. of Electrical Engineering, Chang-Gung University, Taoyuan, Taiwan; [3]Dept. of Electronic Engineering, National Taiwan University of Science and Technology, Taipei, Taiwan

k-t BLAST accelerates dynamic contrast-enhanced lung imaging with only limited penalty in RMS error. Yet its restrictions including initial-overshooting and temporal-smoothing cast uncertainties on perfusion quantifications and corresponding studies. This work shows that while those restrictions influence intensity estimation on patient images as predicted, little impact is inflicted on the corresponding perfusion quantification, suggesting feasibility of accelerated lung images in clinical studies.

14:00 **5076. Nonrigid Registration Based Segmentation for the Analysis of Real-Time Cardiac Flow Images.**

Freddy Odille[1], Jennifer Steeden[1], Vivek Muthurangu[2], David Atkinson[1]
[1]Centre for Medical Image Computing, University College London, London, United Kingdom; [2]Centre for Cardiovascular MR, UCL Institute of Child Health, London, United Kingdom

Cardiac flow measurements can be obtained from real-time phase contrast MRI. Due to the compromised spatial resolution and signal-to-noise ratio, automatic segmentation of great vessels is challenging. Here, we propose to use nonrigid registration of the time series of magnitude images (148 frames) to propagate the segmentation performed manually in a reference frame. The registration, based on optical flow, includes smoothness constraints in both space and time, and is computationally very efficient. Flow measurements generated by manual and registration-based segmentations, as well as stroke volumes, were compared in data from 10 volunteers (rest and physical exercise), and showed good agreement.

14:30 **5077. Center Point Trajectory Model for Cardiac Wall Motion Abnormality Assessment Compared with Echocardiography Strain**

Ting Song[1,2], Alexander I. Bustamante[3], Jeffrey A. Stainsby[4], Maureen N. Hood[2,5], Vincent B. Ho[2,5]
[1]GE Healthcare Applied Science Laboratory, Bethesda, MD, United States; [2]Radiology, Uniformed Services University of the Health Sciences, Bethesda, MD, United States; [3]Cardiology, National Navy Medical Center, Bethesda, MD, United States; [4]GE Healthcare Applied Science Laboratory, Toronto, ON, Canada; [5]Radiology, National Navy Medical Center, Bethesda, MD, United States

A quantitative method, Central Point Trajectory (CPT), of assessing myocardial wall motion is evaluated in this paper. This center point trajectory method is compared and validated against echocardiography systolic peak strain maps and myocardial delayed enhancement images, which shows strong correlation in terms of detection of abnormal regions with reduced wall motion.

15:00 **5078. Postprocessing Tool for 3D Strain Quantification from 3D Tagging Data**

Marco Piccirelli[1], Roger Luechinger[1], Peter Boesiger[1]
[1]Institute for biomedical Engineering, University & ETH Zurich, Zurich, Switzerland

Tagging acquisition of the orbit during eye movement have proven to give new inside into the mechanical properties of orbital tissues, and to be a valuable tool for investigating ocular diseases etiologies. 3D tagging acquisition have been shown to be feasible. We present here a model-free method enabling to quantify out of 3D tagging data the inhomogeneous deformation along extraocular muscles. This tool able 3D strain quantification and is adaptable to other tissues, like the heart.

Wednesday 13:30-15:30 Computer 124

13:30 ***5079*. Quantitative Analysis of Projection Breast Density Changes at Different Compression Angles Based on 3D MRI**

Tzu-Ching Shih[1,2], Jeon-Hor Chen[2,3], D Chang[3], K Nie[3], M Lin[3], O Nalcioglu[3], Min-Ying Lydia Su[3]
[1]Department of Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan; [2]Department of Radiology, China Medical University Hospital, Taichung, Taiwan; [3]Tu & Yuen Center for Functional Onco-Imaging, University of California, Irvine, CA, United States

This study aims to demonstrate the effect of compression angle on the projection breast density at different compression ratios based on the patient-specific three-dimensional MR images. The fibroglandular tissue and tatty tissue were described by 3,488 and 11,803 tetrahedral elements. Within 50% to 70% compression ratio, the variation of the measured projection breast density was approximately 7%. In contrast, the variation of the projection breast density was nearly 11% for MOL view compression. This study provides a novel computer simulation approach to simulate the large deformation of breast compression. Compression angle of deviation may affect the measured projection breast density.

14:00 ***5080*. Interactive Intensity Thresholding Based Breast Density Assessment in Sequential MR Examinations**

Sadie Nicola Reed[1], Gokhan Ertas[1], Martin O. Leach[1]
[1]Cancer Research UK and EPSRC Cancer Imaging Centre, Institute of Cancer Research, Sutton, Surrey, United Kingdom

Breast density has been shown to be a strong risk factor for breast cancer. MR imaging allows direct volume estimation of the fibroglandular breast tissues providing an accurate breast density assessment. In this study, we investigate the value of interactive intensity thresholding in the assessment of breast density from sequential MR examinations. The results have shown a good consistency between the left and right breasts and a high level of reproducibility for sequential patient visits. The ability of the technique to highlight variations from normal breast development in sequential images could give valuable information in assessment of breast cancer risk.

14:30 ***5081*. A Maximum Likelihood Method for Partial Volume Segmentation of Magnitude Breast MR Data**

Melanie Freed[1,2], Christian Graff[1], Maria I. Altbach[3], Jacco A. de Zwart[4], Jeff H. Duyn[4], Aldo Badano[1]
[1]CDRH/OSEL/DIAM, FDA, Silver Spring, MD, United States; [2]Department of Bioengineering, University of Maryland, College Park, MD, United States; [3]Department of Radiology, University of Arizona, Tucson, AZ, United States; [4]NINDS/LFMI/Advanced MRI Section, National Institutes of Health, Bethesda, MD, United States

We apply maximum likelihood estimation techniques to magnitude MR images as a method for partial volume segmentation. The method is validated on noisy inversion recovery and saturation recovery images of a simulated MR breast phantom created from human CT data and then applied to inversion recovery images of a physical breast phantom. The segmentation algorithm is able to successfully separate tissue types in both simulated and phantom MR images.

15:00 ***5082*. DIVA+QUADRANT: Novel Visualisation Software for DCE-MRI to Aid Breast Cancer Diagnosis and Neoadjuvant Chemotherapy Monitoring**

Martin Lowry[1], David John Manton[1], Martin D. Pickles[1], Lindsay W. Turnbull[1]
[1]YCR Centre for MR Investigations, Hull-York Medical School, Hull, East Yorkshire, United Kingdom

The clinical utility of dynamic contrast-enhanced MRI (DCE-MRI) is well established, but the analysis of data by radiologists can be time-consuming. Novel visualisation software, called DIVA+QUADRANT, has been developed which quickly and clearly indicates those regions within a tumour which display the highest contrast agent enhancement (uptake) rate and the greatest degree of contrast agent wash out (signal decay); both well-established indicators of malignancy following the BIRADS-MRI lexicon. The software can also be used to monitor response to chemotherapy as it can map out areas where enhancement and washout rates have decreased, i.e. areas where vasculature shutdown is occurring.

Thursday 13:30-15:30 Computer 124

13:30 ***5083*. Local Rigid and Volume Preserving Deformable Registration Method with Applications to Liver MR Data**

Atilla Peter Kiraly[1], Christophe Chefd'Hotel[1], Clifford R. Weiss[2], Ralph Strecker[3]
[1]Imaging and Visualization, Siemens Corporate Research, Princeton, NJ, United States; [2]Department of Radiology, The Johns Hopkins Univeristy School of Medicine, Baltimore, MD, United States; [3]MR Oncology, Siemens Healthcare, Erlangen, Germany

A novel approach to ensure local rigidity and volume preservation with existing registration methods is presented. A modification to the deformation field is performed before application to the moving image. It adds little additional runtime and can be quickly

implemented. Results are shown on T1 MR liver data with simulated enhancing structures to demonstrate the volume preserving properties.

14:00 ***5084***. **Non-Rigid Motion Compensation in MR Prostate Perfusion Imaging**

Gert Wollny[1], Isabel Casanova[1], Thomes Hambrock[2], Andres Santos[1], Maria Jesus Ledesma-Carbayo[1]
[1]BIT-DIE, ETSI Telecomunicación, UPM, Madrid, Spain; [2]Department of Radiology, Radboud University Nijmegen Medical Centre, Nijmegen, Netherlands

Dynamic Contrast enhance MRI has been established as accurate method in detection and localization of prostate cancer. Time series of three-dimensional datasets of the prostate are acquired and used to obtain per-voxel signal-intensity vs. time curves. These are then used to differentiate cancerous from non-cancerous tissue. However, rectal peristalsis and patient movement may result in spatial-mismatching of the serial datasets and, therefore, incorrect enhancement curves. In this work, we present a method based on image registration to compensate for these movements, and validate the method by comparing pre-and postregistration intensity time curves to manually obtained ones.

14:30 ***5085***. **Validation of Deformable Registration of Prostate MRI with and Without Endorectal Coil for IMRT Planning**

Marnix Christiaan Maas[1], Corijn Kamerling[1], Simon van Kranen[1], Sara Muller[2], Jelle Teertstra[2], Floris Pos[1], Christoph Schneider[1], Jan Jakob Sonke[1], Marcel van Herk[1]
[1]Radiotherapy, NKI-AVL, Amsterdam, Netherlands; [2]Radiology, NKI-AVL, Amsterdam, Netherlands

Using an endorectal coil (ERC) greatly improves the quality of prostate MR images, but results in displacements and deformations of the organ and its surrounding tissues, causing systematic errors in intensity modulated radiation therapy (IMRT) planning. We have implemented an image based method for the deformable registration of endorectal to non-endorectal MR images. Here we present a validation of this method using markers placed on corresponding anatomical structures in pairs of fixed and deformed images. The registration method was found to be feasible, and our results suggest that sufficient accuracy for use in radiotherapy planning is attainable.

15:00 ***5086***. **Automatic Segmentation of the Prostate in MR Images Using a Prior Knowledge of Shape, Geometry and Gradient Information**

Yujin Jang[1], Helen Hong[1], Hak Jong Lee[2], Sung Il Hwang[2]
[1]Division of Multimedia Engineering, Seoul Women's University, Seoul, Korea, Republic of; [2]Department of Radiology, Seoul National University Hospital of Bundang, Seongnam-si, Korea, Republic of

To segment the prostate in MR images with a poor tissue contrast and shape variation, we propose a reliable and reproducible segmentation method using a prior knowledge of shape, geometry and gradient information. The prostate surface is generated by 3D active shape model using adaptive density profile and multiresolution technique. To prevent holes from occurring by the convergence of the surface shape on the local optima, the hole is eliminated by 3D shape correction using geometry information. In the apex of the prostate which has a large anatomical variation, the boundary is refined by 2D contour correction using gradient information.

Image Analysis

Hall B Monday 14:00-16:00 Computer 125

14:00 ***5087***. **Automated Assessment of Ghost Artifacts in MRI**

Sotirios A. Tsaftaris[1,2], Xiangzhi Zhou[2], Rohan Dharmakumar[2]
[1]Electrical Engineering and Computer Science, Northwestern University, Evanston, IL, United States; [2]Radiology, Northwestern University, Chicago, IL, United States

Flow artifacts in MR images can appear as image ghosts within and outside the body cavity. Technical improvements to suppress these ghosts often rely on expert scoring or on semi-automated methods demanding tissue segmentation to evaluate the efficacy of the methods. These approaches can be labor/computation intensive, introduce observer bias, or error-prone if tissue segmentation is used. Herein we propose two fully automated image-processing methods relying on the statistical properties of background pixels to assess the presence of flow artifacts (appearing as image ghosts) without requiring segmentation. We demonstrate that the automated methods are as effective as image scoring approaches that rely on expert reviewers.

14:30 ***5088***. **Total Variation Denoising with Spatially Dependent Regularization**

Florian Knoll[1], Yiqiu Dong[2], Christian Langkammer[3], Michael Hintermüller[2,4], Rudolf Stollberger[1]
[1]Institute of Medical Engineering, Graz University of Technology, Graz, Austria; [2]Institute of Mathematics and Scientific Computing, University of Graz, Graz, Austria; [3]Department of Neurology, Medical University Graz, Graz, Austria; [4]Department of Mathematics, Humboldt-University of Berlin, Berlin, Germany

The Total Variation regularization model is popular in MR research. In this model, a regularization parameter controls the trade-off between noise elimination, and preservation of image details. However, MR images are comprised of multiple details. This indicates that different amounts of regularization are desirable for regions with fine image details in order to obtain better restoration results. This work introduces spatially dependent regularization parameter selection for TV based image restoration. With this technique, the

regularization parameter is adapted automatically based on the details in the images, which improves the reconstruction of details as well as providing an adequate smoothing for the homogeneous parts.

15:00 ***5089*. Modeling Non-Central Chi Distributed Noise in T1-Weighted MR Images: Brain Tissue Segmentation Using Partial Volume Densities**

Hugo Gerard Schnack[1], Rachel Brouwer[1], Hilleke Hulshoff Pol[1]
[1]Psychiatry, UMC Utrecht, Utrecht, Netherlands

A brain tissue segmentation algorithm is developed that includes a non-central Chi description of the MR scanner noise. It is applied to a set of MR images of 16 healthy human volunteers and found to produce significantly different tissue volume estimates, when compared to models incorporating Gaussian noise.

15:30 ***5090*. Automatic Quality Assessment for Multi-Slice 2D FLAIR MR Imaging**

Bénédicte Mortamet[1], Matt A. Bernstein[2], Clifford R. Jack[2], Jeffrey L. Gunter[2], Maria Shiung[2], Reto Meuli[3], Jean-Philippe Thiran[4], Gunnar Krueger[1]
[1]Advanced Clinical Imaging Technology, Siemens Healthcare Sector IM&WS S - CIBM, Lausanne, Switzerland; [2]Mayo Clinic, Rochester, MI, United States; [3]CHUV, Radiology, Lausanne, Switzerland; [4]Signal Processing Laboratory (LTS5) Ecole Polytechnique Fédérale de Lausanne

The FLAIR contrast is increasingly used as part of routine protocol for brain MRI. It provides high sensitivity to a wide range of disease but is susceptible to patient motion. Resulting artifacts may obscure the pathology or mislead automated image analysis algorithms. We propose a method that automates quality classification of T2w 2D-FLAIR data. The validation based on 99 head scans confirms the robustness and reliability of the method. It could greatly improve clinical workflow as, in particular if integrated in online image reconstruction, it could provide immediate feedback to the MR technologist to repeat low-quality scans within the same session.

Tuesday 13:30-15:30 Computer 125

13:30 ***5091*. A Fully Automatic Cerebellum Segmentation Method Using an Active Contour Model with Shape Prior**

Jinyoung Hwang[1], Junmo Kim[1], HyunWook Park[1]
[1]Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Korea, Republic of

The segmentation of cerebellum in human brain is not widely used since the boundary between cerebrum and cerebellum is indistinguishable due to the partial volume effect. Although some literatures proposed the methodology in cerebellum segmentation, they are not the purpose of the cerebellum segmentation. In this work, we present fully automatic cerebellum segmentation method using shape priors in brain MR images, which already skull-stripped volume. We evaluated the proposed method to images from BrainWeb, 1.5T, and 3T MR scanner. The proposed method shows fine segmentation results, and it could be used for cerebellum generation in human brain.

14:00 ***5092*. A Fully Automated White Matter / Gray Matter Segmentation of Mice Spinal Cord on DTI Images**

Michaël Sdika[1], Virginie Callot[1], Mathias Hebert[1], Guillaume Duhamel[1], Patrick J. Cozzone[1]
[1]CRMBM/CNRS UMR6612, Faculté de médecine, Université de la Méditérranée, Marseille, France, France

In this work, a fully automated method is proposed to segment mice SC white matter (WM) and gray matter (GM) tissues on Diffusion Tensor Imaging (DTI) images. The proposed method is based on three main step: first a small patch containing the SC is detected using a machine learning procedure, then a mask of the SC is computed within this patch and finally WM/GM segmentation is performed. Specific attention has been paid to choose an appropriate modality for each steps. The segmentation results has been evaluated by visual assessment by two experts on the images of 13 mice.

14:30 ***5093*. Extracellular Fluid Volume Measurements with Complex Signal Analysis**

John David Dickson[1], Guy Barnett Williams[2], Thomas Adrian Carpenter[2], Richard E. Ansorge[1]
[1]Department of Physics, Cambridge University, Cambridge, Cambridgeshire, United Kingdom; [2]Wolfson Brain Imaging Centre, Cambridge University, Cambridge, Cambridgeshire, United Kingdom

It has been suggested that extracellular fluid spins undergo bulk dephasing from those in intracellular fluid. This study provides direct evidence for this phenomenon and exploits it to make quantitative measurements of both the intra/extracellular fluid volume fractions and precession frequencies. This is achieved by fitting the data from a Gradient Echo Sampling of a Free Induction Decay (GESFID) sequence with a complex signal model.

15:00 **_5094_. Automatic Segmentation of Brain Tumors on Non-Contrast-Enhanced Magnetic Resonance Images Using Fuzzy Clustering**

Yi-Min Liu[1], Chun-Chih Liao[1,2], Furen Xiao[1,3], Jau-Min Wong[1], I-Jen Chiang[1,4]
[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan; [2]Department of Neurosurgery, Taipei Hospital, Department of Health, Taipei, Taiwan; [3]Department of Neurosurgery, National Taiwan University Hospital; [4]Institute of Biomedical Informatics, Taipei Medical University, Taipei, Taiwan

An automated brain tumor segmentation method is desirable for helping human experts to obtain tumor location and volume estimation. This study was aimed to automatically segment brain tumor with two non-contrast-enhanced MR images, T1 and T2 images, via an unsupervised fuzzy c-means clustering method combined with region merging and knowledge-based analysis. The overall quantitative results percent match and correspondence ratio of this system are 0.842 and 0.716, respectively.

Wednesday 13:30-15:30 Computer 125

13:30 **_5095_. Modeling of T2* Decay in Water/fat Imaging: Comparison of One-Decay and Two-Decay Models**

Diego Hernando[1], Zhi-Pei Liang[1], Peter Kellman[2]
[1]Electrical and Computer Engineering, University of Illinois, Urbana, IL, United States; [2]National Institutes of Health, Bethesda, MD, United States

In quantitative water/fat imaging, modeling the T2* decay of the signal is necessary in order to avoid significant bias. A two-decay model with separate decay rates for water and fat has recently been proposed as an alternative to the one-decay model where water and fat share a common decay rate. Even though the two-decay model is more realistic, it suffers from increased noise sensitivity with respect to the one-decay model. In this work, we analyze quantitatively this tradeoff between bias and standard deviation using simulation, phantom and in vivo data. Our results show that a one-decay model is preferable for a clinically relevant range of fat fractions and SNRs.

14:00 **_5096_. A Method for De-Scalping Human Brain MRI Data Using Lipid Ratio Map**

Anup Singh[1], Mohammad Haris[1], Kejia Cai[1], Ari Borthakur[1], Hari Hariharan[1], Ravinder Reddy[1]
[1]CMROI, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

De-scalping the brain data is a very critical step in MRI data post-processing and analyzing. Many applications related to brain MRI either require, or benefits from the ability to accurately segment brain from the non-brain tissue. Here we present a simple, fast and robust technique for brain de-scalping. Current de-scalping procedure utilizes lipid ratio map obtained from MRI images without and with lipid saturation pulse, which are normally acquired at clinical scanners. MRI whole brain data from different clinical scanners was successfully de-scalped using current procedure.

14:30 **_5097_. Chemical Shift-Based Water/fat Separation: Comparison of Fitting Models**

Diego Hernando[1], Zhi-Pei Liang[1], Peter Kellman[2]
[1]Electrical and Computer Engineering, University of Illinois, Urbana, IL, United States; [2]National Institutes of Health, Bethesda, MD, United States

Quantitative water/fat separation in MRI requires careful modeling of the acquired signal. Multiple signal models have been proposed in recent years, but their relative performance has not yet been established. This abstract presents a comparative study of 12 signal models for water/fat separation. The models were selected according to three criteria: magnitude or complex fitting, single-peak or multi-peak fat spectrum, and modeling of T2* decay. Our results show that a complex-fitting, multi-peak fat, one-decay model is preferable over a wide range of clinically relevant fat fractions and SNRs.

15:00 **_5098_. Comparison of Magnitude and Complex Data Fitting for Quantitative Water/fat Imaging**

Diego Hernando[1], Zhi-Pei Liang[1], Peter Kellman[2]
[1]Electrical and Computer Engineering, University of Illinois, Urbana, IL, United States; [2]National Institutes of Health, Bethesda, MD, United States

Magnitude fitting has been proposed as an alternative to complex data fitting for quantitative chemical shift-encoded water/fat imaging. Potential advantages of magnitude fitting include the removal of sensitivity to phase errors in the signal and suppression of B0 field inhomogeneity effects. However, the noise performance of magnitude fitting, relative to complex fitting, has not been established. In this abstract, we present a quantitative comparison of both methods, based on the bias and standard deviation of their estimates. Our results show that complex fitting is preferable to magnitude fitting for quantitative water/fat imaging, both in theory and in practice.

Thursday 13:30-15:30 Computer 125

13:30 ***5099*. Correction of the Kinetic Parameters of Human Tissue Considering RF-Field Inhomogeneities**

Robert Merwa[1], Gernot Reishofer[2], Thorsten Feiweier[3], Karin Kapp[4], Franz Ebner[2], Rudolf Stollberger[5]
[1]Medical Engineering, FH OÖ - Upper Austria University of Applied Sciences, Linz, Austria; [2]Department of Radiology, Medical University of Graz, Graz, Austria; [3]Healthcare, Siemens AG, Germany; [4]Department of Radiation Therapy, Medical University of Graz, Graz, Austria; [5]Institute of Medical Engineering, Graz University of Technology, Graz, Austria

Dynamic contrast-enhanced MRI was performed at 3 T in combination with a flip angle mapping sequence in order to correct the kinetic parameters of human tissue. Due to the local magnitude of these inhomogenities the values for the AIF and tissue concentrations are widespread which lead to an overestimation or underestimation of K^{trans} and V_e. The peak of the arterial input function decreases of about 60 % and the absolute difference of K^{trans} and V_e obtained with the AIF in two comparable arteries can be improved by a factor up to 33 if the dynamic data are corrected accordingly.

14:00 ***5100*. Registration of Histology and MR Images Using Local Rigid Registration and Differential Evolution**

Zhengyi Yang[1], Viktor Vegh[1], Deming Wang[1], David Charles Reutens[1,2]
[1]University of Queensland, Brisbane, Queensland, Australia; [2]Royal Brisbane and Women's Hospital, Brisbane, Queensland, Australia

Registration of histological sections and the corresponding MR images is a critical step in MR constrained histology volume reconstruction. Histological sections with dislocated segments are problematic. This issue is addressed by employing a local rigid registration method. The dislocated segments are identified by morphological operations and connectivity analysis. These segments are treated as rigid bodies having independent degree-of-freedom of motion. The registration was to find the transformation matrix for each segment to maximize the similarity, which was normal mutual information, between the transformed histological section and target MR image. The method of differential evolution was used to find optimal registrations.

14:30 ***5101*. A Method for Planning Interventions in the Brain with Straight Access Paths**

Nikhil Navkar[1], Zhigang Deng[1], Jason Stafford[2], Jeffrey Weinberg[3], Nikolaos V. Tsekos[1]
[1]Computer Science, University fo Houston, Houston, TX, United States; [2]Imaging Physics, MD Anderson, United States; [3]Neurosurgery, MD Anderson, United States

The aim of the work is to designed visualization techniques for preoperative planning of neurosurgical interventional procedures using straight tabular tool. The visualization techniques include calculation of access maps on the surface of patient head, which help the neurosurgeon in selecting the optimum point for insertion. The preliminary results show that it is possible to plan the trajectory of the interventional tool to hit a target in such a way that it minimizes the trauma to vital structures inside the brain.

15:00 ***5102*. Input Function Detection in MR Brain Perfusion Using a Blood Circulatory Model Based Algorithm**

Azimeh Noorizadeh[1], Hassan Bagher-Ebadian[2,3], Reza Faghihi[1], Jayant Narang[4], Rajan Jain[4], James Russel Ewing[2,3]
[1]Department of Nuclear Engineering, Shiraz University, Shiraz, Fars, Iran; [2]Department of Neurology, Henry Ford Hospital, Detroit, MI, United States; [3]Department of Physics, Oakland University, Rochester, MI, United States; [4]Department of Radiology, Henry Ford Hospital, Detroit, MI, United States

MR Quantification of the hemodynamic maps such as Cerebral Blood Volume, Mean Transit Time, and Cerebral Blood Flow in perfusion studies is highly susceptible to selection of the correct Arterial Input Function (AIF) and a correct AIF selection could substantially reduce bias in hemodynamic parameters. This study uses a blood circulatory model to construct an automatic and model-based algorithm for AIF detection in MR perfusion studies. The algorithm is used to detect the AIF from MR perfusion of four patients with 19 slices. This study introduces a new and reliable (performance: 84%) algorithm for AIF detection in MR perfusion studies.

Novel Image Analysis Techniques

Hall B Monday 14:00-16:00 Computer 126

14:00 ***5103*. DIR Imaging Using GRAPPA for Cortical Thickness Estimation**

Narae Choi[1], Yoonho Nam[1], Dong-Hyun Kim[1,2]
[1]Electrical and Electronic Engineering, Yonsei University, Sinchon dong, Seoul, Korea, Republic of;
[2]Radiology, Yonsei University, Sinchon dong, Seoul, Korea, Republic of

Most gray matter volumetric studies use T1-weighted imaging such as MP-RAGE because it provides good contrast between white matter and cortex. However, due to susceptibility artifact coming from the air-tissue interface, a reliable and accurate measurement is difficult in the regions near the air-bone interface for T1-wieghted schemes. One way to alleviate this problem is to perform gray matter spin-echo imaging through DIR sequence. One drawback of the DIR sequence, however, is its long scan time. We applied one

of the parallel imaging reconstruction schemes, GRAPPA scheme, to DIR imaging to evaluate measurement changes as a function of reduction factor.

14:30 ***5104*. Enhancing Subcortical Image Segmentation Based on Age Dependent Intensity Normalization**

Mustafa Ulas Ciftcioglu[1], Didem Gokcay[1]
[1]Medical Informatics Department, Informatics Institute, Middle East Technical University, Ankara, Turkey

Automatic algorithms for subcortical segmentation often suffer due to the complex anatomic structure of this area and intersubject variability. To overcome this problem, a method that incorporates age dependent tissue volume statistics with atlas based intensity normalization is proposed. Age dependent regression equations for volumetric ratios of the tissues are constructed and included in a segmentation performed by Maximum Likelihood (ML) approach. For intensity normalization, the intensity distribution from a single subject atlas is utilized, after registering the given image with the atlas image. Improvement on the proposed method is documented by comparison with a widely accepted segmentation tool.

15:00 ***5105*. Automated Evaluation of Structural Characteristics and Extension of Cerebral Gliomas Using DTI-MR 3D Texture Analysis**

Giorgio De Nunzio[1,2], Antonella Castellano[3,4], Gabriella Pastore, [1,2], Marina Donativi[2], Giuseppe Scotti[3], Lorenzo Bello[5], Andrea Falini[6]
[1]INFN (National Institute of Nuclear Physics), Lecce, Italy; [2]Department of Materials Science, University of Salento, Lecce, Italy; [3]Neuroradiology Unit and CERMAC, Scientific Institute and University Vita-Salute San Raffaele, Milan, Italy; [4]Institute of Radiological Sciences, University of Milano, Milan, Italy; [5]Neurosurgery, Department of Neurological Sciences, University of Milano, Milan, Italy; [6]Neuroradiology Unit and CERMAC, , Scientific Institute and University Vita-Salute San Raffaele, Milan, Italy

This work illustrates the development and validation of a semi-automated Computer-Assisted Detection technique (CAD) for the recognition of cerebral glioma in Diffusion Tensor MR images (DTI-MR). The described system adheres to the classic scheme of a CAD software tool, with a data preprocessing step followed by feature calculation and supervised tissue classification. The chosen discriminating features come from 3D statistical Texture Analysis. Segmentation results are also correlated with histopathological findings from specimens obtained from image-guided tumor biopsies.

15:30 ***5106*. Texture Analysis of MRI of Juvenile Myoclonic Epilepsy Patients**

Márcia Silva de Oliveira[1,2], Luiz Eduardo Betting, [23], Fernando Cendes, [23], Gabriela Castellano[1,2]
[1]Neurophysics Group, State University of Campinas (Unicamp), Campinas, SP, Brazil; [2]CInAPCe (Cooperação Interinstitucional de Apoio a Pesquisas sobre o Cérebro), São Paulo State, Brazil; [3]NeuroImage Laboratory, State University of Campinas (Unicamp), Campinas, SP, Brazil

Juvenile myoclonic epilepsy (JME) is the most frequent subsyndrome of the idiopathic generalized epilepsies. Experimental investigations support that the thalamus is a key structure in the mechanisms of JME. The objective of this study was to investigate the thalamus of patients with JME using texture analysis, a quantitative neuroimaging technique. Patients and controls were submitted to MRI investigation. The T1 volumetric sequence was used for thalamic segmentation and extraction of texture parameters. Texture analysis revealed differences between the thalamus of patients and controls. The present investigation supports the participation of the thalamus in the mechanisms of JME.

Tuesday 13:30-15:30 Computer 126

13:30 ***5107*. Impact of Motion and Symmetry Correction on Perfusion Lesion Segmentation in Acute Ischemic Stroke: Quantitative Evaluation**

Dattesh D. Shanbhag[1], Rakesh Mullick[1], Sumit K. Nath[1], Catherine Oppenheim[2], Marie Luby[3], Katherine D. Ku[3], Lawrence L. Latour[3], Steven Warach[3], - NINDS Natural History of Stroke Investigators[3]
[1]Imaging Technologies, GE Global Research, Bangalore, Karnataka, India; [2]Department of Neuroradiology, Université Paris-Descartes, Paris, France; [3]NINDS, NIH, Bethesda, MD, United States

In context of acute ischemic stroke, we demonstrate that motion correction on PWI data should be used only if motion is detected, rather than as a standard pre-processing recipe in analysis pipeline. A motion detection scheme based on image moments is shown to be effective in capturing motion during phase volumes. Since the motion correction is the “rate-limiting” step in PWI data analysis pipeline, moment based motion detection and selective motion correction can result in significant time saving for processing PWI data. Symmetry correction, a step commonly used for contralateral analysis, produces lower estimates of perfusion lesion volumes if applied retrospectively on quantitative maps rather than on bolus signal volumes.

14:00 ***5108*****. Correction Algorithm for Singular Value Decomposition Artifact in Quantitative Cerebral Perfusion Images Using SCALE-PWI**

Jessy J. Mouannes[1], Wanyong Shin[2], Saurabh Shah[3], Anindya Sen[4], Sameer Maheshwari[1], Timothy Carroll[1,4]

[1]Biomedical Engineering, Northwestern University, Chicago, IL, United States; [2]National Institute on Drug Abuse, National Institute of Health, Baltimore, MD, United States; [3]Siemens Medical Solutions USA, Chicago, IL, United States; [4]Radiology, Northwestern University, Chicago, IL, United States

Self-CALibrated Epi Perfusion Weighted Imaging (SCALE-PWI) MRI pulse sequence produces quantitative cerebral perfusion images in a single MRI scan, using dynamic susceptibility contrast (DSC) and T1 changes in normal white matter in relation to changes in the blood pool after contrast injection. A singular value decomposition algorithmic artifact results in alternating signal intensity modulation in the reconstructed quantitative perfusion maps of consecutive slices. A correction method to eliminate this artifact is presented in this study at 1.5T. The results show a significant effect of this correction on the resulting quantitative maps, which become more accurate and suitable for clinical diagnosis.

14:30 ***5109*****. Pharmacokinetic Modelling of DCE-MRI at Moderate Temporal Resolution: Dealing with Tumours Which Wash Out Extremely Fast**

David John Manton[1], Martin D. Pickles[1], Martin Lowry[1], Lindsay W. Turnbull[1]

[1]YCR Centre for MR Investigations, Hull-York Medical School, Hull, East Yorkshire, United Kingdom

Dynamic, contrast-enhanced MRI was carried out with a temporal resolution of approximately 30 s. When a simple, two-compartment pharmacokinetic model without a significant signal contribution from blood plasma (SSCP) was utilised, the quality of fit was poor in breast tumours demonstrating extremely rapid contrast wash-out. More sophisticated models were then investigated with the best performance being achieved by a Tofts-Kermode-Kety model with an SSCP as modelled by a bi-exponential fit to the latter part of the Parker population arterial input function (i.e. ignoring early bolus peaks and assuming instantaneous mixing). This model also yielded parameters which are more physiologically realistic.

15:00 ***5110*****. A Self Automated Normalization Algorithm of CBV Maps for Glioma Grading**

Ravi Teja Seethamraju[1], Hui You[2,3], Jinrong Qu[4,5], Eric A. Macklin[6], Geoffrey S. Young

[1]MR R and D, Siemens Medical Solutions, USA Inc., Charlestown, MA, United States; [2]Radiology, Peking Union Medical College Hospital, Beijing, China; [3]Neuro Radiology, Brigham and Women's Hospital, Boston, MA, United States; [4]Radiology, Tiantan Hospital, Beijing, China; [5]Radiology, Henan Tumor Hospital, Zhengzhou, China; [6]Biostatistics Center, Massachusetts General Hospital, Boston, MA, United States

The hot spot method is the most widely used technique for analysis of DSC PWI maps. Here, ROIs are selected on the relCBV maps in the portion of tumor that appears to have the highest relCBV. This value is divided by the relCBV of ROI selected in the contralateral normal appearing white matter (NAWM), to yield the normalized CBV (nCBV). The measured nCBV is highly operator dependent, so we present a method for automating the determination of NAWM relCBV in order to reduce the operator dependence of the hot spot and other analytic methods.

Wednesday 13:30-15:30 Computer 126

13:30 ***5111*****. Automated Phase-Based Segmentation of the Cerebral Cortex in 7T MR Images of the Elderly**

Nhat Trung Doan[1], Maarten J. Versluis[2], Sanneke van Rooden, Jeroen van der Grond, Andrew Webb[2], Mark A. van Buchem, Johan H.C. Reiber[1], Julien Milles[1]

[1]LKEB - Department of Radiology, Leiden University Medical Center, Leiden, Zuid Holland, Netherlands; [2]CJ Gorter Center - Department of Radiology, Leiden University Medical Center, Leiden, Zuid Holland, Netherlands

The aim of this work is to implement a phase-based approach for the automated segmentation of the cerebral cortex in T2* data of elderly patients acquired using a 7T MR scanner. These data show essentially no gray/white matter contrast on magnitude images. The method is divided into two stages. The first step makes use of k-means clustering to segment the outer layer of the cortex. The obtained contour is subsequently deformed to match the gray/white matter interface based on the improved contrast in phase images, thereby resulting in a full segmentation of the cerebral cortex.

14:00 ***5112*****. Classification of Calcium Salts: Correlation of Magnetic Susceptibility with Susceptibility Weighted Imaging (SWI)**

Ali Fatemi[1], E Mark Haacke[2,3], Michael D. Noseworthy[4]

[1]Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, Ontario, Canada; [2]Radiology, Wayne State University, Detroit, MI, United States; [3]The MRI Institute for Biomedical Research, Detroit, MI, United States; [4]Electrical and Computer Engineering, School of Biomedical Engineering, McMaster University, Hamilton, Ontario, Canada

We propose that by looking at the local magnetic field pattern of corrected phase images, it is possible to quantify local magnetic susceptibility, which is equivalent to classifying different calcium salts. This may lead to not only identification of breast cancer calcification but their biochemical characterization.

14:30 *5113*. **Dipole Matched Filter with SWIFT**

Curtis Andrew Corum[1,2], Djaudat Idiyatullin[1], Steen Moeller[1], Ryan Chamberlain[1], Michael Garwood[1,2]
[1]Center for Magnetic Resonance Research, Dept. of Radiology, Medical School, University of Minnesota, Minneapolis, MN, United States; [2]Cancer Center, Medical School, University of Minnesota, Minneapolis, MN, United States

The combination of the SWIFT sequence and a secular dipole matched filter give positive contrast at dipole sites.

15:00 *5114*. **Forward-Field Calculations Improve Contrast of Unwrapped MR Phase Images**

Martijn D. Steenwijk[1], Maarten J. Versluis[2], Mark A. van Buchem, Johan H C Reiber[1], Andrew Webb[2], Julien Milles[1]
[1]Division of Image Processing, Leiden University Medical Center, Leiden, Zuid-Holland, Netherlands; [2]CJ Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Zuid-Holland, Netherlands

The aim of this work is to evaluate the gray matter / white matter (GM/WM) contrast improvement obtained by using forward-field calculations when unwrapping MR phase images of the brain. Standard phase unwrapping methods, such as high-pass filtering, prove sub-optimal in eliminating phase wraps with high spatial frequencies. Forward-field calculations can be used to compute geometry-dependent artifact-corrected (GDAC) images in which the residual phase wrapping is reduced significantly. We applied this technique to a high-resolution T2*-weighted sequence at 7T to study its effects on GM/WM contrast. The GDAC technique results in a more favourable trade-off between unwrapping and GM/WM contrast.

Thursday 13:30-15:30 Computer 126

13:30 *5115*. **Segmentation of the Structure of the Mouse Spinal Cord on DTI Images**

Michaël Sdika[1], Virginie Callot[1], Mathias Hebert[1], Guillaume Duhamel[1], Patrick J. Cozzone[1]
[1]CRMBM/CNRS UMR6612, Faculté de médecine, Université de la Méditérranée, Marseille, France, France

In this work, a fully automated method is proposed to segment the sub-structures of the mouse spinal Cord. WM/GM segmentation is used as input of the proposed method and on output, the GM substructures are distributed in Left Ventral and Dorsal GM and Right ventral and dorsal GM whereas substructures of WM were distributed into Left Lateral WM, Right Lateral WM, Ventral WM and Dorsal WM. The method has been evaluated by visual assessment and correlation with manual segmentation on 10 DTI images of mice acquired at 11.75T and show promising results.

14:00 *5116*. **Longitudinal Changes of White Matter Lesions**

Snehashis Roy[1], Aaron Carass[1], Navid Shiee[1], Dzung L. Pham[2], Susan Resnick[3], Jerry L. Prince[1,2]
[1]Electrical and Computer Engg, Johns Hopkins University, Baltimore, MD, United States; [2]Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States; [3]Laboratory of Personality and Cognition, National Institute on Aging, Baltimore, MD, United States

Progression of white matter lesions are important for early detection and monitoring of diseases like Alzheimer's or Multiple Sclerosis. FLAIR images provide superior contrast for lesions compared to traditional T1 or T2 weighted images. But they are often not acquired for time and cost constraints. We developed an atlas based method to synthesize FLAIR images from T1 and T2 acquisitions. We use this method to quantify the progression of lesions on a pool of 20 subjects. Synthesizing FLAIRs can be seen as a potential way to reduce unnecessary data acquisition.

14:30 *5117*. **Accurate Adipose Tissue Segmentation from Single Gradient Echo Phase Images by Adaptive Local Thresholding**

Christian Würslin[1], Frank Eibofner[1], Fabian Springer[1], Fritz Schick[1]
[1]Department of Diagnostical and Interventional Radiology, Section on Experimental Radiology, University Hospital Tübingen, 72076 Tübingen, Germany

In many applications, a quantification of fat is desired. Most (semi-)automatic procedures use T1-weighted spin echo images to accomplish this. These approaches are time-consuming and a precise quantification is usually complicated by a high amount of partial volume effects. We propose a quantification procedure based on one single phase image, acquired with a gradient echo technique and opposed-phase condition. This maximizes the contrast in between fat- and water- dominated tissues and is less time-consuming. The phase divergence, arising from inhomogeneities, is compensated for using an automated algorithm, enabling a precise fat quantification by thresholding. Phantom measurements show a high precision.

15:00 *5118*. **Improving Robustness of Cartilage Segmentation Using IDEAL Water and Fat Images**

Raghu Kokku[1]
[1]MR SW & Apps , GTO-I, Wipro GE Healthcare, Bangalore, Karnataka, India

Accurate and reliable quantification of cartilage volume in MRI is required for diagnosis of many degenerative and inflammatory diseases such as osteoarthritis or rheumatoid arthritis. A Novel approach to segment the anatomical structures and cartilage using

IDEAL knee MRI data is proposed. Variation in the characteristics of similar structures in IDEAL water and fat images is used to generate the guidance map for automated segmentation. Segmented structures are analyzed qualitatively and quantitatively with manually segmented datasets from GE 1.5T scanner. Reported DSC with the experimental datasets (>85%) indicates that the proposed solution improved the robustness of segmentation.

Contrast Mechanisms

Hall B Monday 14:00-16:00 Computer 127

14:00 ***5119*****.** **The Effect of NMR-Invisible Susceptibility Inclusions on Phase Maps.**

Samuel James Wharton[1], Richard Bowtell[1]
[1]Sir Peter Mansfield Magnetic Resonance Centre, University of Nottingham, Nottingham, United Kingdom

Phase images generated at high field show exquisite anatomical contrast resulting from small changes of the NMR frequency linked to variation of the local magnetic susceptibility across tissues. When a significant contribution to the average susceptibility comes from NMR-invisible inclusions, the average NMR frequency offset is not however simply proportional to the average susceptibility. Here, we derive a simple expression based on the use of the conventional sphere of Lorentz, which allows the average NMR frequency offset to be calculated for compartments containing inclusions of varying shape and concentration. The expression is tested by comparison with the results of simulations.

14:30 ***5120*****.** **MRI Signal Response Mapping (SIRMA) to Dephaser to Quantify Susceptibility Gradient**

florence franconi[1], Jean-Jacques Le Jeune[2], Pascal Richomme[1], Laurent Lemaire[2]
[1]PIAM, Université d'Angers, Angers, France, Metropolitan; [2]UMR-S646, INSERM, Angers, France

SIgnal Response MApping to dephaser (SIRMA) method is proposed to quantify susceptibility gradient. In gradient echo acquisitions, the SIRMA method measures the echo shifts in k-space of susceptibility affected spins from a series of dephased images collected with additional incremental slice refocusing gradient offset or incremental reconstruction window off-centering. SIRMA applicability and performances have been demonstrated in vitro through quantization of susceptibility gradient induced in a cylinder model and in vivo through the quantitative detection of SPIO distribution volume. With respect to its quantitative nature, its computational simplicity, this method deserves further attention for application in molecular or cellular imaging.

15:00 ***5121*****.** **Simultaneous δR1 and δR2* Quantification in 5s to Monitor Blood and Tissue Oxygenation with Dynamic (C)O_2 Enhanced MRI**

Stefanie Remmele[1], Tobias Voigt[2], Jochen Keupp[1], Christian Stehning[1], Julien Sénégas[1]
[1]Philips Research Europe, Hamburg, Germany; [2]University of Karlsruhe, Karlsruhe, Germany

This work presents an approach to simultaneous and dynamic dR1, dR2* estimation that combines the beneficial features of currently used techniques for dynamic R1 quantification in DCE-MRI and for dynamic R2*-quantification in D(C)O2E-MRI. The technique aims at increasing the specificity of R2* BOLD imaging during respiratory challenges. Its accuracy and sensitivity is evaluated in phantom and breathold experiments.

15:30 ***5122*****.** **Susceptibility Weighted Imaging and Susceptibility Mapping (SWIM): A New Means to Visualize Veins and Quantify Susceptibility**

Ewart Mark Haacke[1,2], Jin Tang[3], Yu-Chung Norman Cheng[1], Jaladhar Neelavalli[2,4]
[1]Academic Radiology, Wayne State University, Detroit, MI, United States; [2]The MRI Institute for Biomedical Research, Detroit, MI, United States; [3]McMaster University, Hamilton, Ontario, Canada; [4]Nuffield Department of Surgery, University of Oxford, Oxford, United Kingdom

A new means of visualizing veins which is independent of orientation of vessels (or the head) relative to the main magnetic field is presented. This new venous imaging method is based on direct mapping of the susceptibility using the inverse Green’s function approach.

Tuesday 13:30-15:30 Computer 127

13:30 ***5123*****.** **Feasibility of Brain Lesion Characterization at 1.5T – Whole-Brain Susceptibility Mapping Using A Homogeneous Lesion Constraint**

Ferdinand Schweser[1], Andreas Deistung[2], Berengar Wendel Lehr[2], Jürgen Rainer Reichenbach[2]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology , Jena University Hospital, Jena, Germany; [2]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany

A method is presented for high-quality whole-brain susceptibility mapping based on standard clinical single-shot low-field SWI-data. Feasibility of in-vivo lesion characterization is demonstrated for clinical patient data.

14:00 *5124*. **Towards an In-Vivo and Post-Mortem Characterization of Chronic Multiple Sclerosis Lesions Using Susceptibility Related Mechanisms of Contrast at Ultra-High Field MRI with R2* and Phase Images**

Bing Yao[1], Francesca Bagnato[2], Eiji Matsuura[2], Hellmut Merkle[1], Peter van Gelderen[1], Henry McFarland[2], Jeff H. Duyn[1]
[1]AMRI, NINDS, National Institutes of Health, Bethesda, MD, United States; [2]Neuroimmunology Branch, NINDS, National Institutes of Health

High field magnetic susceptibility-weighted MRI provides information on healthy and diseased human brain. Although the sources that contribute to the R2* and frequency shifts associated with susceptibility contrast are not fully understood, previous studies suggest that iron and myelin content may contribute. In this study, we used in-vivo and post-mortem brain tissues of multiple sclerosis (MS) as a model of disease to investigate the contribution of tissue iron and myelin content to the image contrast. We found that the iron and myelin may affect phase and R2* differently.

14:30 *5125*. **Non-Lorentzian Sphere Behavior of Magnetic Susceptibility Induced MR Signal Frequency Shift in White Matter: Validation Study**

Xiang He[1], Jie Luo[2], Dmitriy A. Yablonskiy[1]
[1]Mallinckrodt Institute of Radiology, Washington University in St Louis, School of Medicine, St. Louis, MO, United States; [2]Department of Chemistry, Washington University in St Louis, St Louis, MO, United States

Previously proposed generalized Lorentzian approach that allows evaluation of magnetic susceptibility induced MR signal frequency shift in brain tissue is validated here using ex vivo fresh rat optic nerve positioned in the buffer solution. The frequency shift within and around the optic nerve is measured using double-echo gradient echo MRI at two orientations of optic nerve – parallel and perpendicular to the external magnetic field. Our results demonstrate that generalized Lorentzian approach, which takes into account cellular anisotropic microstructure of axons, provides satisfactory explanation of experimental data while Lorentzian sphere approximation fails to describe experimental measurements.

15:00 *5126*. **Very Fast T2* Imaging by Using Improved Echo-Shifted Gradient-Recalled-Echo (IESGRE)**

Jian Zhang[1,2], Chunlei Liu[3], Michael Moseley[2]
[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States; [2]Department of Radiology, Stanford University, Stanford, CA, United States; [3]Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, United States

Echo-Shifted Gradient-Recalled-Echo (ESGRE) can be used to acquire GRE images at TE>TR. This property makes it an appealing approach for fast T2* imaging. However, the original method didn't work well with multiple-echo shift due to the ghosting artifacts. We demonstrate an improved ESGRE method here, in which extra crusher gradients are introduced to help establish a single steady-state among all phase encodes. By using this approach, high quality T2* images can be acquired with an arbitrary echo shift index. Very fast 2D/3D T2* imaging can be achieved with iESGRE.

Wednesday 13:30-15:30 Computer 127

13:30 *5127*. **T2 Contrast Due to Signal Decay During Radial Readout in UTE (Ultrashort TE) Sequences**

Jing-Tzyh Alan Chiang[1], Michael Carl[2], Jiang Du[1], Mark Bydder[1], Nick Szeverenyi[1], Robert F. Mattrey[1], Graeme Bydder[1]
[1]Radiology, University of California, San Diego, CA, United States; [2]GE Healthcare

When imaging short T2 objects using ultrashort TE (UTE) pulse sequences, significant T2 decay can occur during radial readout for T2s comparable or less than the readout duration (typically ~1 ms), leading to signal amplitude loss in the image. Here, we study the relationship between T2 and the amount of signal amplitude loss – i.e. T2 contrast due to signal decay during radial readout in UTE. Significant T2 contrast is present, especially for T2s in the 0.1 to 1 millisecond range. We also observe important dependencies of this T2 contrast on object size as well as gradient parameters.

14:00 *5128*. **3D Radial UTE MRI for Serial Assessment of Fibrosis Development and Silicone Implant Distortion in Rat.**

Lindsey Alexandra Crowe[1], Giorgio Petramaggiori[2], Sonia Nielles-Vallespin[3], Peter Speier[3], Enrico Vigato[4], Hicham Majd[4], Jean-Paul Vallée[1]
[1]Department of Radiology, Geneva University Hospital, University of Geneva, Faculty of Medicine, Geneva, Switzerland; [2]Department of Surgery, Geneva University Hospital, Geneva, Switzerland; [3]Siemens AG Medical Solutions, Erlangen, Germany; [4]Department of Surgery, University of Geneva, Faculty of Medicine, Geneva, Switzerland

Fibrotic reaction around implantable medical devices is an increasingly important problem, limiting function and causing pain. Up to 10-15% of silicone breast implants develop capsular contraction, necessitating replacement. A 3D radial MRI technique with ultrashort TE is proposed as an early, pre-clinical quantification method and to serially assess the formation of capsular tissue. With the reduction of chemical shift effect and motion artifacts, and high isotropic resolution, distortion, rupture and tissue build-up around the implants can be segmented and quantified. Results may lead to standardized methods for early detection of excessive capsular formation, decreasing complication rates in patients.

14:30 ***5129***. **Design of Iron Sensitivity Phantom Suitable for Quantitative MRI and Atomic Spectrometry**

Catherine Anusha Mallik[1], David Bellis[2], David J. Lythgoe[1], Rebeca Santamaria-Fernandez[2], Gareth J. Barker[1]
[1]Centre for Neuroimaging Sciences, Institute of Psychiatry, London, United Kingdom; [2]Laboratory of Government Chemists, Teddington, Middlesex, United Kingdom

There is a growing body of MRI research on the effects of abnormal levels of iron in the brain. Validation of quantitative MRI with a phantom of known iron concentrations, is necessary for comparing different MRI measures. To allow cross-validation with Atomic spectrometry (AS) three different AS and MRI compatible phantoms were manufactured using various substrates and concentrations of iron. Phantoms were imaged at 3T with three different iron-sensitive MRI techniques. Imaging results show that a thrombin-fibrinogen gel doped with ferritin is a suitable phantom for both MRI and AS.

15:00 ***5130***. **Liposome-Loaded Microspheres as a Magnetic Susceptibility Agent for PH Sensing**

Kannie W. Y. Chan[1,2], April M. Chow[1,2], Ed X. Wu[1,2]
[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Pokfulam, Hong Kong SAR, China; [2]Department of Electrical and Electronic Engineering, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

MR susceptibility contrast agents have been used for imaging of vasculature and tumors, such as microbubbles and iron oxides. We have developed a susceptibility agent for pH sensing, especially for acidic tumor environment, increasing sensitivity around physiological pH using liposome-loaded microspheres. Our in vitro data showed that both R2 and R2* decreased at low pH, and the percentage change in R2* is larger when compared to controls at pH 6.8-7.2. Liposome-loaded microspheres showed a substantial increase in pH-dependence of R2*, which favoured by localization of liposomes on microspheres, and is first demonstrated to an improve pH sensitivity at 7T.

Thursday 13:30-15:30 Computer 127

13:30 ***5131***. **Experimental Investigation of the Relationship Between Phase Contrast and Orientation of White-Matter Fiber Orientation**

Ferdinand Schweser[1], Berengar Wendel Lehr[1], Andreas Deistung[1], Jürgen Rainer Reichenbach[1], Daniel Güllmar[1]
[1]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital, Jena, Germany

Based on a recently published theoretical framework, we investigate experimentally, the relationship between phase images and white matter fiber orientation with respect to the orientation of the magnetic field of the MR scanner system. A volunteer was scanned in four different positions with respect to the external magnetic field. Phase information was plotted against the different fiber orientation settings and we found that the obtained correlation reflects at least in parts the proposed theoretical dependency.

14:00 ***5132***. **Phase Derived Frequency Shift Mapping and DTI of White Matter Regions at 3T**

Gisela E. Hagberg[1], Andrea Cherubini[1], Umberto Sabatini[1], Carlo Caltagirone[1]
[1]Santa Lucia Scientific Foundation, Rome, Italy

Frequency shift, R2* and DTI-derived parameters (FA,MD) were evaluated in automatically parcellated white matter. The type of phase pre-processing affected the range and spatial contiguity of FS. The rank order of the 48 structures was significantly different between the evaluated parameters. The anterior and posterior limbs of the internal capsule had similar FA and MD, while the FS decreased and the R2* increased. In the commissural fibers, FS and MD values decreased from anterior to posterior while FA increased and T2* was greatest in the callosal body. The combined informational content thus depended both on fiber orientation and myelin density.

14:30 ***5133***. **Maximal Contrasts Using MR Complex Data: With an Application to Visualise Cortical Structure**

Zhaolin Chen[1], Leigh A. Johnston[2], Gary F. Egan[3]
[1]Florey Neuroscience Institutes, Carlton, VIC, Australia; [2]Electrical and Electronic Engineering, University of Melbourne; [3]Centre for Neuroscience, University of Melbourne

Recent developments in MR phase imaging enable analyses of MR signals in the complex domain. However, in clinical diagnoses and anatomical studies, it is necessary to objectively map complex MR signals to a one-dimensional signal for visualisation. The Susceptibility Weighted Imaging (SWI) method uses the phase image to calculate a phase mask that is multiplied with the magnitude image to enhance the contrast caused by tissue susceptibility. SWI has demonstrated great advantage in contrast enhancement for various applications. In this work, we introduce a new method called Maximum Contrast Image (MCI) to further improve the image contrast from complex MR signals. Enhanced image contrasts obtained with the new method have been demonstrated using a 3T dataset of a cortical brain section. Furthermore, in contrast to the nonlinear operation in SWI, the MCI method uses a linear operation, which permits meaningful quantification of the MCI signals.

15:00 ***5134***. **Phase-Imaging Study in Restless Legs Syndrome**

David Neil Manners[1], Giovanni Rizzo[1,2], Claudia Testa[1], Caterina Tonon[1], Roberto Vetrugno[2], Sara Marconi[2], Giuseppe Plazzi[2], Fabio Pizza[2], Federica Provini[2], Emil Malucelli[1], Bruno Barbiroli[1], Pasquale Montagna[2], Raffaele Lodi[1]
[1]Spectroscopy Unit, Department of Internal Medicine, Aging and Nephrology, Università di Bologna, Bologna, BO, Italy; [2]Neurological Sciences, University of Bologna, Bologna, BO, Italy

Objectives. To apply phase imaging to the evaluation of brain iron content in patients with Restless Legs Syndrome. Methods. 11 RLS patients and 11 controls were studied using gradient echo imaging, and localised and whole brain ROIs selected on derived phase maps, sensitive to paramagnetic tissue. Results. In the whole brain analysis, RLS patients showed 10th and 90th percentile phase values significantly different from controls. The 10th percentile for RLS patients correlated with disease duration. Conclusions. Whole brain phase analysis is a suitable technique to study brain iron content and disclose reduced cerebral iron in RLS patients.

Magnetization Transfer

Hall B Monday 14:00-16:00 Computer 128

14:00 ***5135***. **Magnetization Transfer Contrast MRI in GFP-Tagged Live Bacteria**

Valeria Righi[1,2], Melissa Starkey[3], George Dai[2], Laurence G. Rahme[3], A Aria Tzika[1,2]
[1]NMR Surgical Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States; [2]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Athinoula A. Martinos Center for Biomedical Imaging, Boston, MA, United States; [3]Molecular Surgery Laboratory, Department of Surgery, Massachusetts General Hospital and Shriners Burns Institute, Harvard Medical School, Boston, MA, United States

We compared wild-type and GFP-tagged cells of Pseudomonas aeruginosa and Escherichia coli bacteria using MRI with Magnetization Transfer Contrast (MTC). This method was sensitive enough to distinguish between GFP-tagged and non-tagged cells at cell concentrations relevant to those used in animal infection models. The significance of this method is that it can be used to visualize bacterial infections in vivo in real time without being restricted to the use of transparent tissue necessary for optical imaging. This method provides a valuable tool to study the impact of novel antibacterial therapeutics.

14:30 ***5136***. **Enhancement of MT and CEST Contrast Via Heuristic Fitting of Z-Spectra**

Moritz Wilhelm Zaiss[1], Benjamin Schmitt[1], Bram Stieltjes, Peter Bachert[1]
[1]Medical Physics in Radiology, DKFZ, Heidelberg, Germany

Magnetizations transfer processes are quantified by the evaluation of z-spectra. A superposition of Lorentzian line shape functions, a solution of Bloch equations, is discussed as a heuristic but parametric model for z-spectrum fitting. Numerical, phantom and in vivo studies demonstrate the functionality of this method which is less dependent on exact knowledge of the system and provides enhanced contrast through parameter maps compared to standard asymmetry analysis. The heuristic fit is also less dependent on B_0 inhomogeneities and its parameters can be assigned to physical parameters such as concentration and transfer rates, which are markers for tumour activity.

15:00 ***5137***. **A New, 3D GRE Based CEST Imaging Method for Clinical Application and Verification with GagCEST in Articular Cartilage**

Benjamin Schmitt[1], Michael Bock[1], Bram Stieltjes, Peter Bachert[1]
[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

CEST imaging has been introduced as a new method to generate a various number of contrasts for MRI. However, the application of CEST imaging for clinical application has so far been limited by extensive scan-times. These long scan times were necessary to generate reproducible CEST images and often restricted to single-slice acquisitions. We introduce a new, 3D CEST imaging sequence based on RF-spoiled gradient echo which can theoretically be used in a various number of CEST applications. The functionality is exemplified using gagCEST to determine the vitality of knee cartilage in a 3D volume.

15:30 ***5138***. **A Comparison of Three CEST Imaging Methods**

Zhongliang Zu[1], Ke Li[1], Daniel Frank Gochberg[1]
[1]Radiology, Vanderbilt University, Nashville, TN, United States

Three CEST imaging methods including continuous-wave, pulsed-, and spoiled gradient recalled CEST are numerically optimized and compared using simulations and a creatine/agarose tissue phantom. We found that the average irradiation power is a more meaningful sequence metric than is the average irradiation field; We also found that the SPGR-CEST provides an alternative to the EPI based CW- and pulsed-CEST imaging methods that avoids the artifacts inherent to multi-echo acquisitions, though at the cost of lower CNR.

Thursday 13:30-15:30 Computer 128

13:30 ***5147*. The Effect of Tissue Erosions and Segmentation Probability Thresholds on Magnetisation Transfer Ratio Histograms**

Daniel J. Tozer[1], Sameeha Fallatah[1], Leonora Finisku[1], David H. Miller[1]
[1]NMR Unit, Department of Neuroinflammation, UCL Institute of Neurology, London, United Kingdom

Magnetisation transfer ratio histograms are widely used in the study of multiple sclerosis. Histogram generation methods may affect the parameters extracted. This work investigates whether the tissue probability threshold used in segmentation and the number of erosions applied to the tissue segments effect the histogram parameters and whether this differs between healthy controls and multiple sclerosis patients. It is found that the number of erosions has more of an effect on the histogram parameters than the probability threshold used, in particular the first erosion. There were some differences between the behaviour in patients and controls, but this was not systematic.

14:00 ***5148*. Fast Bound Pool Fraction Quantification Using Stimulated Echoes**

Michaela Soellinger[1], Christian Langkammer[1], Thomas Seifert-Held[1], Franz Fazekas[1], Stefan Ropele[1]
[1]Department of Neurology, Medical University of Graz, Graz, Austria

The bound proton pool fraction is linked to the lipid and protein content of myelin. Therefore, fast mapping methods are required for patient studies and clinical routine. We introduce a sequence allowing whole brain BPF determination in within clinically feasible time (~5 min for 11 slices). The method is based on the labelling of the free water pool with stimulated echo amplitude modulation (STEAM). The herewith presented approach was validated with bovine serum albumin (BSA) probes and successfully tested in three healthy volunteers. Regional analysis of white matter was in good agreement with published BPF values.

14:30 ***5149*. Correlation Time Diffusion MRI of Mouse Liver at 11.7T: Magnetization Transfer Effects**

Hernan Jara[1], Stephan W. Anderson[1], Osamu Sakai[1], Jorge A. Soto[1]
[1]Boston University School of Medicine, Boston, MA, United States

Purpose: To map the correlation time diffusion coefficient (CT-D) of ex vivo liver samples imaged at 11.7T and to compare results quantitatively vs. the standard pulsed-field gradient (PFG-D) diffusion MRI. Methods: A CT-D algorithm was applied to mouse liver images obtained with Tandem-TSE at 11.7T. Results: Excellent quantitative agreement was found between this non-PFG diffusion technique vs. the standard PFG diffusion technique. Conclusion: CT-D diffusion MRI is a viable alternative to standard PFG-diffusion MRI that produces higher SNR and is less demanding on the imaging gradients. This work could have implications for diffusion MRI microscopy.

15:00 ***5150*. Novel Magnetization-Prepared Multi-Slice Multi-Shot EPI Pulse Sequence for T1rho Quantitation**

Eric T. Han[1], Weitian Chen[1], Ajit Shankaranarayanan[1]
[1]Applied Science Laboratory, GE Healthcare, Menlo Park, CA, United States

There are numerous clinical scenarios where evaluation of T1ñ in a focal region-of-interest is desired. In such cases, a quantitative multi-slice 2D T1ñ approach may be more appropriate and time-efficient than a 3D technique. We propose a novel 2D multi-slice T1ñ imaging sequence that overcomes many of the shortcomings of current multi-slice T1ñ methods. Using this sequence, in vivo T1ñ maps of the knee, spine, and brain are acquired.