ISSN# 1545-4428 | Published date: 19 April, 2024

Friday, 03 May 2024

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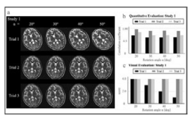
ISMRT Oral

Winning Research Poster Awards

Hall 405E | Friday 18:00 - 19:00 | *Moderators:* Ilse Patterson

(no CME credit)

5181 18:00 Improving Image Quality Using the Pause Function Combination to PROPELLER Sequence in Brain MRI: a brain phantom study



Kousaku Saotome[1], Koji Matsumoto[2], Yoshiaki Kato[3], Yoshihiro Ozaki[4], Motohiro Nagai[3], Tomoyuki Hasegawa[5], Hiroki Tsuchiya[6], and Tensho Yamao[1]

[1]Department of Radiological Sciences, School of Health Sciences, Fukushima Medical University, Fukushima, Japan, [2]Chiba University Hospital, Chiba, Japan, [3]Kameda General Hospital, Kamogawa-shi, Japan, [4]Meiwa Hospital, Nishinomiya-shi, Japan, [5]Hitachinaka General Hospital, Hitachinaka-shi, Japan, [6]QST Hospital, Anagawa-shi, Japan

Motivation: Finding ways to use the PROPELLER sequence as an even more the robustness method to motion.

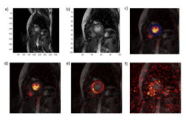
Goal(s): This study investigates whether repositioning the head after pausing during PROPELLER imaging, enhances image quality.

Approach: This study investigated whether image quality improved with repositioning the head after a pause during PROPELLER method with a brain phantom and driver system.

Results: We found that image quality improved at all rotational angles and that pausing multiple times was effective depending on the frequency of motion.

Impact: Incorporating a pause function into the PROPELLER method is expected to be clinically applicable as a practical means to further improve the robustness of the PROPELLER method to motion.

5182 18:10



[Real-time hyperpolarized 13C-pyruvate CMRI imaging pipeline for monitoring of cardiotoxicity]

Fatemeh Khashami[1], Ivan E Dimitrov[2,3], Maximilian Fuetterer[4], Sebastian Kozerke[4], Emily Buchanan[3], Crystal E Harrison[3], Mai Huynh[3], Aneela Afzal[1], Jae Mo Park[3], Zoltan Kovacs[3], Craig R. Malloy[3,5], Anke Henning[3], and Vlad G. Zaha[1,3,6]

[1]Department of Internal Medicine, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]Philips Healthcare, Gainesville, FL, United States, [3]Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States, [4]ETH Zurich, Institute for Biomedical Engineering, Zürich, Swaziland, [5]Dallas VA Medical Center, Dallas, TX, United States, [6]Harold C. Simmons Comprehensive Cancer Center, Dallas, TX, United States

Motivation: Real-time imaging protocol based on hyperpolarized 13C pyruvate to probe metabolic changes in patients undergoing standard-of-care chemotherapy for breast cancer, with cardiotoxic potential.

Goal(s): An imaging protocol that results in high-quality reproducible B0 heart shimming. To implement an echo-shifted mDIXON acquisition with spatial-spectral excitation to detect pyruvate and its major byproducts. A processing pipeline for reconstruction of metabolic images.

Approach: Single-shot EPI acquisitions with shifted echo times (n=6) were acquired following a SpSp excitation, as to generate signal for mDIXON / IDEAL reconstructed images of these metabolites.

Results: We have established a real-time 13C-hyperpolarization and imaging protocol and reconstruction pipeline

Impact: Noninvasive real-time metabolic imaging using hyperpolarized 13C may aid clinical evaluation of possible cardiac toxicity for breast cancer patients

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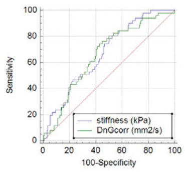
5183 18:20



[Fat-corrected non-Gaussian diffusion MRI in a non-alcoholic fatty liver disease: diagnostic performance for liver fibrosis]

omaima said[1], Sabrina Doblas[1], Gwenaël Pagé[1], Dominique Valla[1,2], Valérie Paradis[1,2], Bernard Van Beers[1,2], and Philippe Garteiser[1]

[1]INSERM, Paris, France, [2]Beaujon University Hospital, Paris, France

Motivation: In nonalcoholic fatty liver disease (NAFLD), hepatic fibrosis is strongly associated with patient survival. Diffusion MRI has been proposed to assess liver fibrosis, but this evaluation is hampered in hepatic steatosis.

Goal(s): Our goal was to evaluate the diagnostic performance of non-Gaussian diffusion MRI in assessing liver fibrosis in 250 patients with NAFLD.

Approach: We developed a method to calculate the non-Gaussian diffusion coefficient, based on non-linear regression and fat correction.

Results: With this corrected diffusion method, NAFLD patients with liver fibrosis could be differentiated from patients without it.

Impact: With this corrected diffusion method, NAFLD patients with liver fibrosis could be differentiated from patients without it.

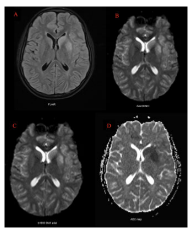
ISMRT Oral

Winning Clinical Poster Awards

Hall 405E | Friday 18:30 - 19:00 | *Moderators:* Ilse Patterson

(no CME credit)

5184 18:30



MRI Features of Stroke in Tuberculous Meningitis: a case report

Patricia Mazwi Maishi[1], James Barnacle[2,3,4], Azhar Seedat[5], and Tessa Kotze[1]

[1]*Human Biology, University of Cape Town, Cape Town, South Africa,* [2]*Francis Crick Institute, London, United Kingdom,* [3]*Infectious Disease, Imperial College London, London, United Kingdom,* [4]*Centre for Infectious Disease Research in Africa, Institute of Infectious Disease and Molecular Medicine, Cape Town, South Africa,* [5]*Radiology, Groote Schuur Hospital, Cape Town, South Africa*

Keywords:

Motivation: TBM is the most severe form of tuberculosis and often leads to death or neurological sequelae. Inflammation caused by a dysregulated inflammatory response can cause stroke, a frequent cause of morbidity and mortality in TBM.

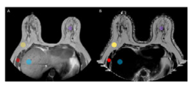
Goal(s): To accurately identify areas affected by stroke in TBM.

Approach: MRI brain scan was performed on 1.5 Tesla, Skyra scanner equipped with an 20 channel coil and parameters were derived from the following acquisitions: 3D T1-MPRAGE pre- and post-gadolinium enhancement imaging; DWI and ADC map, FLAIR, and GRE.

Results: MRI is reliable in identifying stroke features and the imaging findings were pivotal to prompt treatment of TBM.

Impact: 14-year-old with a left CNVI palsy and lower limb weakness, was admitted due to onset of seizure. Tuberculous meningitis complicated by stroke was diagnosed as the cause. The incidence, consequences and MRI features of TBM are discussed in this report.

5185 18:40



3D Radial mDIXON Acquisition for Improved Breast Imaging

Brian Johnson[1], Joel Batey[1], Dave Hitt[1], Robert Lay[1], Tom Lowe[1], Michael Pawlak[1], John Penatzer[1], Gregory Thomas[1], Kristen Williams[1], Mike Williams[1], Paul Worthington[1], Taylor Zastrow[1], and Jonathan Chia[1]

[1]*Philips, Cleveland, OH, United States*

Motivation: Breast magnetic resonance imaging (MRI) is a sensitive technique for staging and screening for breast cancer, however, it is susceptible to motion artifacts and inhomogeneous fat saturation.

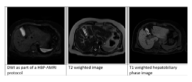
Goal(s): Demonstrate that 3D radial mDIXON acquisition provides robust motion suppression and homogenous fat saturation.

Approach: Compared image quality of 3D radial mDIXON to 3D Cartesian mDIXON and 3D Cartesian with spectral fat saturation. Advanced postprocessing was also performed on the 3D radial mDIXON to see if additional diagnostic information could be obtained.

Results: 3D radial mDIXON of the breast showed constantly high image quality with less motion artifacts and homogenous fat suppression.

Impact: 3D radial mDIXON provides many advantages over Cartesian spectrally fat saturated acquisitions. The radial acquisition is less sensitive to motion artifacts. mDIXON provides consistent fat suppression compared to spectral fat suppression. Advanced postprocessing of mDIXON images provides further diagnostic utility.

5186 18:50



Abbreviated liver MRI (AMRI) as a surveillance method for hepatocellular carcinoma in high risk patients

Helena Oliveira[1]

[1]*MRI, Cambridge University Hospitals, Fulbourn, Cambridge, United Kingdom*

Motivation: The low sensitivity of liver ultrasound precludes the diagnosis of hepatocellular carcinoma, which led to an increased interest in abbreviated liver mri as an alternative diagnostic tool

Goal(s): The goal of this research study was to assess the diagnostic performance of abbreviated liver MRI for the diagnosis of hepatocellular carcinoma

Approach: This study is a literature review, in which the latest available literature relevant to the topic was assessed with the intent of answering the research question

Results: Liver AMRI shows higher sensitivity than ultrasound for diagnosis of HCC and its diagnostic performance is comparable to that seen in a conventional protocol

Impact: In summary, liver AMRI should be considered as an altertative strategy to ultrasound for HCC surveillance. Future research including prospective studies, cost-effectiveness assessments and a consensus on an ideal AMRI protocol should be carried out.

Saturday, 04 May 2024

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Weekend Course

A Cookbook for Validating Contrast Mechanisms for Clinical Use

Organizers: Jessica Bastiaansen, Henrik Odéen, Sune Jespersen, Derek Jones, Sila Kurugol

Nicoll 1 | Saturday 8:00 - 11:55 | Moderators:

Part 1: Gastao Cruz & Eva Peper

Part 2: Elizabeth Powell & Yi Wang

8:00 Recipes To Validate Relaxometry (T1, T2)

Ruud van Heeswijk

Keywords: Contrast mechanisms: Relaxometry, Image acquisition: Quantification, Transferable skills: Reproducible research

Parametric mapping (also known as qMRI, compositional MRI, T1/T2 mapping, etc.) has made critical diagnostic contributions in most subspecialties of radiology because it provides compositional information on the tissue, but it is not always clear what is needed in new technologies. After an introduction on common sources of bias and variance of the relaxation parameters, we will discuss how to validate new mapping techniques. This includes how to quantify metrics such as accuracy, precision, reproducibility, sensitivity, and specificity through numerical simulations, phantoms, animal models, healthy volunteers, and patient cohorts.

8:25 Recipes To Validate Flow

Kelly Jarvis

Keywords: Contrast mechanisms: Flow

Blood flow imaging is widely used for the assessment of cardiovascular health. Methods for 2D flow imaging have become routine in the clinical workflow while the use of 4D flow MRI is gaining prevalence worldwide. This educational talk will review the fundamentals of 2D flow imaging as well as 4D flow MRI. The focus will be on key aspects of integrating these techniques into the clinical workflow. Topics such as selection of acquisition parameters and considerations for data analysis will be covered. Future directions such as real-time 2D flow imaging will also be discussed.

8:50 Recipes To Validate Perfusion

Harrison Kim

Keywords: Contrast mechanisms: Perfusion

Dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) assesses tissue perfusion, which is crucial for diagnosing various diseases. Quantitative analysis improves accuracy but faces challenges due to inter/intra-scanner variability. Proposed solutions include using phantoms with known contrast-agent concentrations. The Point-of-care Portable Perfusion Phantom (P4) addresses this, reducing measurement variations across scanners. Challenges remain in peripheral device portability, but efforts are underway. Despite advancements, ensuring clinical advantage outweighs costs is crucial for effective implementation.

9:15 Recipes To Validate Diffusion

Mariam Andersson

Keywords: Contrast mechanisms: Diffusion, Contrast mechanisms: Microstructure

Diffusion MRI can provide clinically valuable information regarding the microstructural composition of tissue. There exist many signal representations and models that provide different interpretations of tissue structure of components. However, their validation is necessary to ensure their sensitivity and specificity to the underlying anatomy of interest. This lecture aims to outline the key points to consider when evaluating diffusion MRI techniques and outcome measures, and to present recent advancements in MRI validation techniques, including: novel tissue imaging modalities, Monte Carlo simulations on numerical phantoms, and physical phantoms.

9:45 Break & Meet the Teachers

10:15 Recipes To Validate Proton Density Fat Fraction

Michael Middleton

10:40 Recipes To Validate QSM
Hongjiang Wei

Keywords: Contrast mechanisms: Susceptibility

QSM and subvoxel QSM methods have facilitated the quantification of brain iron and myelin in neuroimaging research. These quantitative imaging techniques offer valuable insights into neurodegenerative diseases such as Parkinson's and the potential for studying tissue subvoxel susceptibilities outside of the brain. However, accurately quantifying susceptibility values and distinguishing between different sources of susceptibility pose significant challenges that necessitate robust modeling and analysis techniques. Validating susceptibility measurements against histological or other reference standards and establishing standardized protocols for data acquisition, processing, and validation are crucial steps to ensure the reliability and reproducibility of results across various studies.

11:05 Recipes To Validate HP Contrasts
Jae Mo Park

Keywords: Contrast mechanisms: Hyperpolarization, Contrast mechanisms: Molecular Imaging, Contrast mechanisms: Hyperpolarized MR (Non-Gas)

Applying hyperpolarized (HP) probes to in vivo investigation requires strategic planning and proper interpretation, based on comprehensive understanding of physiology, MR acquisition methods, and chemical properties. This lecture aims to provide general guidance on experimental design, including sample preparation, physiological modulation, hardware selection, MR acquisition, and data analysis, for applying HP probes to evaluate in vivo performance. This evaluation is based on the chemical properties of the probe and the physiological/metabolic targets to be measured.

11:30 Recipes To Validate fMRI
Yen-Yu Ian Shih

Keywords: Contrast mechanisms: fMRI

fMRI contrast often reflects changes in CBV, CBF, and oxygen metabolism, influenced by complex neuronal inputs and microcircuitry activities. Validating these contrasts involves comparing ground truth to fMRI's indirect measurements, with the understanding that fMRI indicates activity events in brain areas with limited insights into the underlying neuronal processes. This lecture discusses literature that contributes to fMRI's specificity and reproducibility improvements and highlights two animal studies: one examines the impact of often-overlooked vasoactive neurochemicals on fMRI readings, and the other explores an fMRI contrast for measuring neuronal activity, along with nuances in its acquisition and analysis that could introduce artifacts.

Weekend Course
Imaging of Fibrosis Across the Body
Organizers: Jonathan Dillman, Dan Wu

Nicoll 2 | Saturday 8:00 - 11:30 | *Moderators:* Richard Ehman & Rianne van der Heijden

8:00 Introduction

8:10 MRI of Cardiac Fibrosis
Lorna Browne

8:40 MRI of Hepatic Fibrosis
Kartik Jhaveri

9:10 MRI of Renal Fibrosis
Lilach Lerman

Keywords: Body: Kidney

Motivation: Early identification of tissue fibrosis may be useful for the management of patients with renal disease but is difficult to achieve in vivo non-invasively.
Goal(s): We evaluated the ability of Magnetic resonance imaging (MRI) techniques to quantify renal fibrosis.
Results: MRI can assess renal fibrosis using through its impact on renal functional, structural, mechanical, and molecular attributes. Some available tools may not be specific to fibrosis alone and could be used in tandem with other indices of kidney damage and dysfunction.
Impact: Modulation of renal microstructure induced by renal fibrosis is detectable by MRI and could be clinically useful.

9:40 Break & Meet the Teachers

10:10 MRI of Intestinal Fibrosis
Kim Beek

10:40 MRI of Pulmonary Fibrosis
Gael Dournes

Keywords: Body: Lung, Image acquisition: Multiparametric, Contrast mechanisms: Non-Proton

To assess interstitial lung disease (ILD), chest MRI has been historically out of the scope of clinical imaging because of technical difficulties such as low proton density and respiratory and cardiac motion. However, technological breakthroughs have emerged that dramatically improve lung MRI quality. At the same time, novel treatment approaches are changing the landscape of clinical care. Also, MRI may offer the ability to differentiate active inflammation vs scarring tissue. This presentation aims to review the most recent developments of lung MRI in ILD, and the perspectives on how these modern techniques may converge and could impact patient care soon.

11:10 Q & A

Weekend Course

fMRI for All

Organizers: Xiao-Qi (Juliana) Huang, Christin Sander, Allen Song, Wietske van der Zwaag

Nicoll 3 Saturday 8:00 - 12:00 *Moderators:* Seong-Gi Kim & Pohchoo Seow

8:00 Basic BOLD Physiology
João Jorge

Keywords: Contrast mechanisms: fMRI, Neuro: Brain function, Neuro: Cerebrovascular

Since its demonstration in the early 90's, the blood oxygen level-dependent (BOLD) contrast has proved to be a revolutionary tool to probe brain function non-invasively. But what lies under the hood? Rather than a direct measure of neuronal activity (or any single physiological parameter), BOLD signals reflect a complex interplay of neuronal, vascular and metabolic factors. In this talk, we will introduce the basic physiology and physics that underlie the BOLD contrast, and which govern the spatial and temporal properties of the signal we measure with fMRI.

8:30 Data Acquisition for fMRI
SoHyun Han

Keywords: Contrast mechanisms: fMRI

This lecture will describe the data acquisition for functional MRI focusing on 2D echo planar imaging (EPI) sequence. Sequence parameters (TE, TR, echo spacing, voxel size, acceleration factors, etc.) will be introduced. Parallel imaging (SENSE, GRAPPA, SMS) methods and typical EPI related artifacts (ghosting, geometric distortions, signal loss) will also be discussed.

9:00 Preprocessing in fMRI
Sungho Tak

Keywords: Neuro: Brain

In this course, we describe an overview of basic pre-processing operations for fMRI data that are typically performed before statistical analysis of regional activation and connectivity. We then present the details of methods used for motion correction, slice timing correction, segmentation, spatial normalization, and physiological noise correction. Additionally, we provide recent advances in the preprocessing methods and discuss future directions. The target audience includes fMRI researchers interested in learning about basic methods and software for preprocessing in humans.

9:30 Task-Based fMRI
Luca Vizioli

10:00 Break & Meet the Teachers

10:30 [Resting-State Basics: why asking your subjects to do nothing can open a window into brain function, cerebral physiology, and data nuisance.]
Stefano Moia

Keywords: Neuro: Brain function, Neuro: Brain connectivity, Neuro: Cerebrovascular

Resting state (RS) functional MRI is a versatile data acquisition paradigm that can be adopted to obtain meaningful information about brain function, cerebral physiology, and data nuisance.
This talk will introduce basics concepts of RS fMRI, starting by exploring the most common data-driven methods to analyse RS data, as well as the metrics used to assess its signal properties, discussing possible interpretations of the results. It will then address perks and pitfalls of RS, as well as the latest developments in the field of functional MRI aiming at overcoming the limitations of RS.

11:00 Interpretation of BOLD fMRI
Natalia Petridou

Keywords: Contrast mechanisms: fMRI, Neuro: Brain function, Neuro: Cerebrovascular

Blood-oxygen-level-dependent (BOLD) fMRI is the most-widely used technique to measure brain function non-invasively. BOLD however is a surrogate measure of brain function as the signals reflect local changes in hemodynamics. Understanding the relationship between neuronal activity and hemodynamics is therefore critical in interpreting BOLD data. This lecture will discuss neuronal and vascular contributions to BOLD in terms of spatial and temporal specificity, and address factors that affect the variability and linearity of the BOLD response. It will also discuss the importance of signal quality and data analysis methods, and the role of models, in interpreting BOLD fMRI data.

11:30 Application of fMRI in Psychiatric Disorders
Qiyong Gong

Keywords: Neuro: Brain

This lecture will provide an overview of the use of fMRI in psychiatric disorders, while also introducing the application of other psychoradiology modalities.

Weekend Course
Advances in Gastrointestinal MRI
Organizers: Sonal Krishan, Takeshi Yokoo

Room 325-326 | Saturday 8:00 - 11:50 | *Moderators:* Elizabeth Hecht & S Senthil Kumaran

8:00 What the Hepatologists, Liver Surgeons & GI Oncologists Want To Know
Yong Eun Chung

Keywords: Body: Liver

MRI plays a crucial role in the management of liver cancer as a tool for screening, diagnosis, treatment planning and surgical guidance. In addition, in patients with NAFLD, which has emerged as a significant concern in recent years, MRI with MR elastography can accurately assess the hepatic steatosis and fibrosis in the liver.

8:25 Non-Invasive Testing for Liver Fibrosis: Multiparametric Liver Quantification
Sudhakar Venkatesh

Keywords: Body: Liver, Contrast mechanisms: Elastography, Image acquisition: Multiparametric

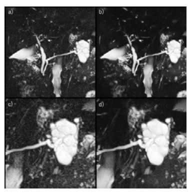
MR Elastography has emerged as the leading non-invasive quantitative imaging marker of liver fibrosis and considered the reference standard. Advanced MRE technique known as "3D MRE" provides an opportunity for evaluation of new mechanical parameters including storage modulus (G'), loss modulus (G"), wave attenuation (α), damping ratio (ζ), and volumetric strain. Multiparametric evaluation including two or more of these MR parameters are promising for differentiating inflammation from fibrosis and improving diagnostic accuracy for liver fibrosis staging. Furthermore, the multiparametric MRE may aid in the diagnosis of portal hypertension and prediction of outcome in chronic liver diseases.

8:50 **The Often-Missed Bile in the Hepatobiliary MRI: Exploiting the Tools in the Box**
Maria Antonietta Bali

Keywords: Body: Digestive

Biliary diseases can be incidentally discovered in clinically asymptomatic patients or during a diagnostic work-up in cholestatic patients. For most pathological conditions, magnetic resonance (MR) with magnetic resonance cholangiopancreatography (MRCP) is recommended as the second step imaging modality after ultrasound.
MR acquisition protocol includes: conventional T2-weighted (T2W) images on coronal and axial planes; heavily 2D/3D T2-weighted MRCP (T2W MRCP) sequences on the coronal and axial planes, the latter centered on the intra-hépatiques bile ducts; axial diffusion-weighted imaging with high b values (>800 s/mm²); 3D T1-weighted after hepato-specific contrast agents administration will provide cholangiogram, besides the assessment of the liver parenchyma.

9:15 **AI in Hepatobiliary MRI: Landing on the Moon or Journey to Mars**
Takeshi Nakaura



Keywords: Education Committee: Clinical MRI

Deep Learning Reconstruction (DLR) evolutionizes MRI with noise reduction and super-resolution. This advancement positions DLR as the likely future standard for MRI examinations. Concurrently, the performance of large language models (LLM) has seen remarkable improvements, epitomized by the development of ChatGPT. The application of these models in the medical arena, particularly in the hepatobiliary sector, marks one of today's most promising AI frontiers. This presentation delves into the fundamentals of Deep Learning, elucidating the underlying mechanisms of DLR and LLM, and showcases their clinical applications with an emphasis on the hepatobiliary and pancreatic regions.

9:40 Break & Meet the Teachers

10:10 MRI of the Pancreas: How & Why I Do It
Saugata Sen

10:35 Evaluating Mesenteric Vasculature in MRI 4D Flow & Beyond: One-Stop Shop
Scott Reeder

11:00 **Magnetic Resonance Enterography for Management Decision in Inflammatory Bowel Disease: Beyond Diagnosis**
Rebecca Dennis

Keywords: Body: Digestive, Cross-organ: Pediatric

Magnetic Resonance Enterography (MRE) is the main imaging modality for the assessment of inflammatory bowel disease (IBD) in children. Beyond its initial diagnostic value, MRE plays a significant role in monitoring therapeutic response and detecting potential complications. This session will delve into the various applications of MRE in managing IBD beyond initial endoscopic diagnosis. We will examine how MRE aids in evaluating treatment response and discuss its use in assessing patients with acute symptoms. Furthermore, we will explore the potential of MRE for identifying extraluminal and non-inflammatory findings that influence therapy and contribute to informed decision-making for optimal patient management.

11:25 MRI for Staging, Local Recurrence & Evolving Management Strategies in Colorectal Cancer: What Is New?
Thian Yee Liang

Weekend Course

X-Nuclei & Spectroscopy: Everything, Everywhere but Not Quite All at Once

Organizers: Marco Palombo, Simon Robinson, Yasuhiko Tachibana, Richard Thompson

Room 331-332 | Saturday 8:00 - 11:50 | *Moderators:* Christian Beaulieu & Anke Henning

8:00 Clinical Applications of MRS & MRSI in the Brain
Evita Wiegers

Magnetic Resonance Spectroscopy (MRS) provides a unique window into tissue composition and metabolism. Its integration into clinical practice has paved the way for a multitude of applications. This educational session delves into the diverse clinical landscape where MRS plays a role, including the brain tumors, neurodegenerative disorders, and neonatal encephalopathies

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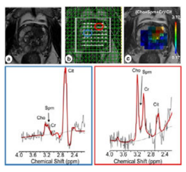
8:25



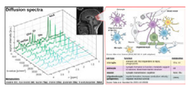
[Clinical Applications of MRS in the Body]

Saadallah Ramadan

Keywords: Body: Body, Contrast mechanisms: Spectroscopy, Education Committee: Clinical MRI

Motivation:MR Spectroscopy (MRS) offers a unique perspective into the body's biochemistry, providing insights into various diseases beyond what conventional imaging techniques can reveal.
Goal(s): To elucidate the clinical applications of MRS, highlighting its role in diagnosing and monitoring diseases.
Approach: To explore MRS techniques, examining its integration with MRI, and discussing specific applications in various pathologies through case studies and recent research.
Results:MRS's effectiveness in precise diagnosis and treatment monitoring,revealing its potential in clinical scenarios from cancer to metabolic disorders.
Impact:MRS's capabilities are highlighted, prompting further research into its diagnostic precision. This enables clinicians to transform how they care for their patients.

8:50



[Diffusion-Weighted MRS: Insights into the Brain Microstructure from Metabolites]

André Döring

Keywords: Contrast mechanisms: Diffusion-Weighted MR Spectroscopy, Contrast mechanisms: Diffusion

Magnetic resonance spectroscopy (MRS) allows quantifying concentrations of cell-type specific metabolites. This enabled to monitor metabolic pathways. However, alongside metabolic changes, alterations in cellular microstructure represent pivotal pathomechanistic shifts in the onset and progression of neurodegenerative-diseases (e.g., glial morphology in neuroinflammation or neuronal integrity in cerebral atrophy). By integrating diffusion-weighting into MRS (**dMRS**), we can measure the diffusion properties of individual, celltype-specific metabolites that can serve as probes for cellular microstructure. In combination with simulation techniques, enabling an absolute quantification of cellular-features, **dMRS** holds immense promise in offering a new class of biomarkers for identifying cell-type specific (patho)morphological alterations.

9:15

[Functional MRS: Neurotransmitters & Brain Metabolism]

Francesca Branzoli

Keywords: Contrast mechanisms: Spectroscopy, Neuro: Brain function

Functional MRS (fMRS) aims to measure, noninvasively, subtle changes in metabolic concentrations upon neural activation induced by sensory or cognitive tasks. fMRS may provide insights onto energy metabolism and brain function that are not captured by functional MRI, which is based on the blood-oxygenation level dependent effect. In this presentation, I will provide an overview of the metabolic changes that have been detected during neuronal activity and will discuss how these findings contributed to our knowledge of brain energy metabolism and neurotransmission. FMRS technical challenges and limitations will also be reviewed.

9:40 Break & Meet the Teachers

10:10

[CEST: Covering the Full Spectrum]

Nirbhay Yadav

Keywords: Contrast mechanisms: CEST & MT, Contrast mechanisms: Molecular Imaging, Physics & Engineering: Physics

Chemical Exchange Saturation Transfer (CEST) signals are often not visible in the MRS spectrum due to exchange-dependent line broadening and/or the effects of water presaturation transferring to solute signals. Conversely, CEST relies on the presaturation of solute signals transferring to water and then detecting the accumulated partial saturation of water. This process retains the molecular specificity of spectroscopy techniques and, the repeated label-tranfer effect during the presaturation period, results in a sensitivity enhancement that is orders of magnitude beyond the solute molecular concentration. This presentation will describe several different types of CEST signals and factors that determine their amplitude.

10:35

[X-Nuclei, biomolecules and their application]

Yoichi Takakusagi

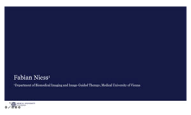
Keywords: Contrast mechanisms: Non-proton, Contrast mechanisms: Spectroscopy, Contrast mechanisms: Hyperpolarized MR (Non-Gas)

Nuclear magnetic resonance (NMR) detects the nuclear spin behavior of observable nuclides as spectra or images using radio frequency (RF) pulses. The H nucleus, which is a component in water molecules that make up 65-70% of the human body, is the main nuclide responsible for MR image acquisition. On the other hand, there are some X-nuclei, which can also be observed via NMR and possess distinctive characteristics unlike H. In this presentation, representative X-nuclei and the biomolecules containing the nuclei will be introduced, associating with the relationship with commonly used MRI elemental techniques.

11:00 A Neutron & a Proton: 101 Guide to Deuterium Imaging

Qingjia Bao

11:25



Advanced Methods in Deuterium Imaging

Fabian Niess

Keywords: Contrast mechanisms: Deuterium

Deuterium metabolic imaging is an emerging magnetic resonance technique for noninvasive imaging of glucose metabolism. Short relaxation times allows 3D imaging with reasonable spatial resolution in clinical feasible scan times using conventional phase encoding approaches. Over the last few years this method has been used extensively by the majority of scientific sites from ultra-high to clinical magnetic field strengths. Recently, novel approaches have been presented to simultaneously obtain complementary anatomical data, boost the achievable SNR and accelerate data acquisition to achieve higher spatial resolution without increasing scan times. This presentation summarises recent developments of advanced methods in deuterium metabolic imaging.

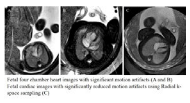
Weekend Course

Clearing the Path: Tackling Motion & Susceptibility Artifacts in MRI

Organizers: Tolga Cukur, Diego Hernando, Yarach Uten, Nan Wang, Mingming Wu

Room 334-336 | Saturday 8:00 - 12:00 | *Moderators:* Mingming Wu & Mahmut Yurt

8:00



Motion Artifacts in Clinical Practice

Su-zhen Dong

Keywords: Education Committee: Clinical MRI, Image acquisition: Artefacts

This talk will cover MRI motion artifacts in clinical practice of fetuses and children, including the understanding of the influence of MRI examination of fetuses and children, and strategies to reduce or minimize the impact of motion artifacts on image diagnostic quality. The strategies to reduce or minimize the impact of motion artifacts will include exam preparation with MRI simulation, optimization of MRI environment, role of child life specialists, noise-reduction, optimization of MRI protocol design, the application of fast sequences and fast scanning technology, and motion-compensation and retrospective motion correction techniques.

8:30 Retrospective Motion Correction: Traditional Versus AI Methods
Dong-Hyun Kim

9:00 Prospective Motion Correction: Navigators, Optical Trackers, Field Probes, Pilot Tone
Ernesta Meintjes

9:30 Break & Meet the Teachers

10:00 Artifacts in Diffusion MRI: The Good, the Bad & the Ugly
Rebecca Rakow-Penner

11:00 Emerging AI Methods To Address Motion & Susceptibility Artifacts
Emine Saritas

11:30 Break & Meet the Teachers

Weekend Course

What Can I Do Next? Careers Inside & Outside Academia

Organizers: Jana Delfino, Ashley Harris, Mathieu Sarracanie

Summit 1 | Saturday 8:00 - 11:30 | Moderators:

Academic Careers Around the Globe: Jutta Ellermann & Tingou Liang

Careers Outside of Academia: Ed Boskamp & Efrat Shimron

8:00

North American Academic Pathway

Avery Berman

Keywords: Transferable skills: Public engagement, Transferable skills: Bias and inclusiveness, Transferable skills: Responsible research

This presentation will give an overview of the path I followed to becoming an Assistant Professor at Carleton University in Ottawa, Canada and a Scientist at the Royal's Institute of Mental Health Research.

8:10 | My Career Journey (Europe: UK)
Stuart Clare

Keywords: Transferable skills: Research coordination, Transferable skills: Public engagement, Transferable skills: Grantsmanship

I discuss my career journey as a scientist, highlighting some of the ups and the downs over the years, and how I have been able to forge an unconventional leadership role within my research institute.

8:20 | Europe: Non-UK
Silvia De Santis

Keywords: Neuro: Neurodegeneration

I am going to speak about my experience in an academic career.

8:30 | Asia
Yi Zhang

Keywords: Transferable skills: Grantsmanship

I am going to speak about my career journey.

8:40 | An academic career in Australia
David Waddington

Keywords: Transferable skills: Research coordination, Transferable skills: Grantsmanship

In this presentation I'll tell the story of my nascent Australian academic journey, aiming to share what I've learnt about finding funding and building teams to those hoping to pursue a research career in MR.

8:50 | South America (Chile)
Carlos Milovic

Keywords: Transferable skills: Responsible research, Transferable skills: History of MR, Transferable skills: Software engineering

In this presentation I will show my carreer path: how I came to the MRI field as an Astronomy undergrad, graduate and postgraduate experiences, and now as a tenure-track professor. I will also highlight the current status of South American MRI research teams, with a special focus in new opportunities opening in Chile.

9:00 | Panel Discussion

9:30 | Break & Meet the Teachers

10:00 | Big MR Industry
Kera Westphal

Keywords: Education Committee: Clinical MRI

I am going to speak about my career journey

10:10 | Smaller MR Industry
Kiarash Emami

10:20 | Pharma
TBD

10:30 | Startup/Outside of MRI
Earl Zastrow

10:40 | Government/Policy/Regulation
Maureen Hood

I am going to speak about my career journey.

10:50 [What Can I do Next? Careers Inside and Outside Academia – Medical Physicist](#)
Brenda Bartnik Olson

Keywords: Education Committee: Clinical MRI

This presentation will give an overview of the pathways to becoming a medical physicist. Particular attention will be paid to education, training, duties, clinical and research opportunities, while touching on differences between certified medical physicists and a medical physicist/MR scientist.

11:00 Panel Discussion

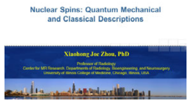
11:30 Meet the Teachers

Weekend Course

MR Physics I

Organizers: Najat Salameh, Rolf Schulte, Andrew Webb, Xiaoliang Zhang

Summit 2 | Saturday 8:00 - 12:00 | *Moderators:* Dafna Ben Bashat & Thomas O'Reilly

8:00 Nuclear Spins: Quantum Mechanical & Classical Descriptions

Xiaohong Joe Zhou

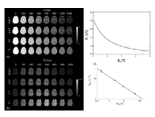
Keywords: Physics & Engineering: Physics

Magnetic resonance (MR) is a phenomenon observed in nuclei that possess nonzero spins (i.e., nuclei with both magnetic moment and angular momentum). These nuclei can be found naturally in the human body (e.g., ^{1}H, ^{13}C, ^{23}Na, and ^{31}P) or introduced as an exogenous agent (e.g., ^{3}He and ^{129}Xe). This lecture will use both quantum mechanical and classical approaches to describe how nuclear spins, through interactions with static and radiofrequency magnetic fields, generate bulk magnetizations and electrical signals. Several MR concepts, such as the Larmor equation and Bloch equations, will also be introduced to pave the way for the subsequent lectures.

8:30 Bloch Equation & Relaxation
Analia Zwick

Keywords: Physics & Engineering: Physics

In this talk, we explore the foundational principles of magnetic resonance imaging (MRI), rooted in quantum physics and the Bloch equations governing nuclear spin dynamics in a magnetic field. We analyze key relaxation mechanisms such as T1 and T2 relaxation, crucial for MRI signal acquisition and contrast generation. Join me to learn these concepts, essential for enhancing MRI scan quality and diagnostic accuracy.

9:00 Field-Dependent Contrast Mechanisms

Peter van Gelderen

Keywords: Physics & Engineering: Physics, Contrast mechanisms: Relaxometry

The utility of MR imaging depends on the information carried by the contrast between different tissue types. This contrast can stem from MR-independent properties, like density, diffusion or susceptibility, but is typically based on MR relaxation parameters, T1, T2 or T2*. All of these depend on the field strength. To be able to compare data acquired at different fields, some of this dependences is necessary. In this presentation, we discuss the basic physics relaxation mechanisms and their field dependence. In addition, we will present data on relaxation parameters in brain imaging measured at various field strength.

9:30 Break & Meet the Teachers

10:00 Signal & Noise Considerations Across B0s

$SNR = \left|\frac{V_{signal}}{V_{noise}}\right| = \frac{\sqrt{2}\omega_0 M_0 |B_1|}{\sqrt{4k_b T\Delta f R}}$

Lawrence Wald

Keywords: Physics & Engineering: Physics

The signal-to-noise ratio is one of the most important determinants of our ability to extract information from a measurement in that it expresses the signal measurement's relative uncertainty. Improving it is a frequent target of technical development and SNR is constantly monitored as a quality assessment. This seemingly simple ratio of the signal level to its uncertainty or "noise" level, would appear a simple and well-defined metric but is more difficult to measure than one would think and it is critical to understand how each component (signal and noise) is modulated by experimental parameters.

10:30	Extended Phase Graphs Matthias Weigel **Keywords:** Physics & Engineering: Physics, Image acquisition: Sequences, Physics & Engineering: Nuclear Magnetic Resonance The Extended Phase Graph (EPG) concept represents a powerful tool for depicting and understanding magnetization response of several MRI and MRS sequences. It allows pictorial understanding of echo generation, simple but elegant classification of echoes, and at the same time fast and accurate computation of echo intensities. It particularly demonstrates its advantages in the application for NMR sequences with multiple gradients and RF pulses. Motion effects (rigid body motion, flow, free diffusion) can also be considered. Overall, the EPG concept is really worth studying to get a deeper insight into the understanding and development of complex NMR sequences.
11:00	Artifacts & Their Subtleties Across Magnetic Field Strengths TBD
11:30	RF Pulses Shams Rashid

Other

Diamond Sponsor: GE Healthcare

Hall 406D — Saturday 9:45 - 10:00

(no CME credit)

Other

Diamond Sponsor: Philips Healthcare

Hall 406D — Saturday 12:00 - 12:15

(no CME credit)

Weekend Course

Emerging Acquisitions & Analysis for EPI-Based Applications

Organizers: Janine Lupo, Yogesh Rathi, Nan Wang

Nicoll 1 — Saturday 13:00 - 17:00 — *Moderators:* Qingping Chen & Congyu Liao

13:00	Advantages of EPI-Based Trajectories Stefan Skare **Keywords:** Image acquisition: Sequences, Physics & Engineering: Pulse design, Neuro: Brain The single-shot echo-planar imaging (EPI) sequence was invented by Peter Mansfield in 1977 and has many clinical and research applications in MRI today. The GE-EPI variant is the most common and time-efficient pulse sequence for fMRI and perfusion, but also for clinical bleeding detection workup. The spin-echo EPI variant has been almost exclusively used for clinical and research diffusion-weighted MRI. Emphasizing the freezing of physiological motion and MRI with less need for anesthesia, Mansfield got many of the benefits of contemporary EPI correct. Notably, EPI's efficiency stems from the high relative fraction of data collection during the scan.
13:25	EPI in the Brain: From DTI to fMRI Lipeng Ning **Keywords:** Neuro: Brain Connectivity, Contrast mechanisms: Diffusion, Contrast mechanisms: fMRI In this course, we first describe several echo planar imaging techniques, including parallel imaging and simultaneous multi-slice imaging. We then overview the physics and modeling techniques for diffusion MRI, including diffusion tensor imaging and advanced microstructural modeling techniques. Further, we will provide an overview of neural physiology related to functional MRI, data acquisition and modeling techniques.

13:50 [Echoplanar Imaging Beyond BOLD: Sequence Modifications & Advanced Applications]
Benjamin Ellingson

Keywords: Image acquisition: Fast imaging, Neuro: Brain, Image acquisition: Sequences

Motivation: Echoplanar imaging (EPI) is instrumental to neuroimaging and applications that require high speed imaging including DTI and BOLD functional MRI.

Goal(s): In this lecture, we will discuss additional sequence modifications and advanced applications beyond DTI and BOLD with the specific goal of characterizing the brain tumor microenvironment (i.e. vascularity, hypoxia, acidity, and salinity).

Approach: The lecture will discuss the use of standard and modified EPI techniques for DSC perfusion imaging, pH-weighted amine CEST, and interleaved multinuclear imaging.

Results: New EPI and image contrasts can be combined to increase spatiotemporal resolution, optimize image acquisition, and provide critical information into brain tumor biology.

Impact: EPI has been instrumental to neuroimaging and applications that require high speed imaging including diffusion and BOLD-based functional MRI. In this lecture, we will discuss sequence modifications with the goal of characterizing brain tumor biology within clinically realistic scan times.

14:15 Echo Planar Trajectories for Metabolic Imaging
Alexander Lin

14:40 Break & Meet the Teachers

15:10 Distortion Correction for EPI
Jie Luo

Keywords: Image acquisition: Artefacts, Image acquisition: Image processing

The Echo Planar Imaging (EPI) sequence is a cornerstone of MRI studies, widely employed in functional MRI (fMRI) and diffusion MRI (dMRI). However, static field inhomogeneities leads to serious image distortions, leading to impaired data integrity, difficulty registering functional images to structural images, and errors in downstream analyses. In addition, MR spectroscopic imaging (MRSI) that employs EPSI readout also suffer from static field inhomogeneities induced spectral distortions. In this course, we will illustrate the common distortions of EPI sequences, review state-of-the-art distortion correction methods, and touch upon some of the efforts that leverage machine learning in EPI distortion correction.

15:35 Accelerating EPI with SMS & Parallel Imaging
Hua Guo

Keywords: Image acquisition: Fast imaging, Image acquisition: Sequences, Physics & Engineering: Physics

EPI is one of the most important MRI techniques, widely used in functional MRI and DWI. Unlike conventional Cartesian sampling methods, EPI can cover k-space in just a single or a limited number of excitations. This distinctive sampling approach also results in a unique signal sampling acceleration mechanism, differentiating it from traditional techniques. This lecture will introduce how parallel imaging is used in EPI. We will begin by discussing the use of conventional parallel imaging for EPI, followed by an introduction of simultaneous multislice imaging. Finally, we will delve into undersampling strategies in 3D EPI for fMRI and DWI.

16:00 EPI Outside the Brain
Jana Hutter

Keywords: Physics & Engineering: Pulse design, Body: Body, Contrast mechanisms: Diffusion

Echo Planar Imaging is a key tool for a range of imaging techniques such as diffusion MRI, elastography and functional MRI outside of the brain. Its efficiency and ability to freeze motion within the slice but also challenges such as vulnerability to susceptibility artifacts, T2* blurring and limits in possible resolution are all emphasized outside of the brain and trigger exciting novel technical developments. EPI is a standard part of the diagnostic pathway in eg breast and prostate cancer. Novel insights into the fiber architecture of the beating heart and the transfer of oxygen across the placenta are enabled.

16:25 **Beyond EPI: exploring EPTI as a new readout technique**
Fuyixue Wang

Keywords: Image acquisition: Sequences

Echo Planar Time-resolved Imaging (EPTI) is a novel readout technique that addresses the limitations of EPI such as distortion and T2/T2* blurring by time-resolving across the EPI readout, while providing additional capability including multi-contrast multi-echo imaging. EPTI was initially introduced as a multi-shot technique highly suitable for high spatial resolution applications, and recent developments have also enabled single-shot EPTI acquisition to achieve high temporal resolution comparable to single-shot EPI, making it highly efficient for dynamic imaging applications as well. This talk will review EPTI-related techniques, the recent developments, and their applications in diffusion MRI, functional MRI, and multi-parametric quantitative imaging.

16:50 Panel Discussion

Weekend Course

IVIM Across Organs

Organizers: Emmanuel Barbier, Jonathan Dillman, Christian Federau, Mami Iima, Dan Wu

Nicoll 2 | Saturday 13:00 - 16:30 | *Moderators:* Andreas Wetscherek & Peter While

13:00 **Perfusion Imaging with IVIM: Why Is It Worth Having a Look?**
Oliver Gurney-Champion

Keywords: Contrast mechanisms: Diffusion, Contrast mechanisms: Perfusion, Cross-organ: Tissue characterisation

Intravoxel Incoherent Motion (IVIM) presents a compelling approach to studying tissue (micro)circulation and perfusion. In this talk, we explore why IVIM is a valuable tool in medical imaging and how it differs from other perfusion measures. By dissecting the principles behind IVIM, we uncover its ability to differentiate between diffusion and (microvascular) perfusion in tissue, offering insights into various pathologies. Moreover, we will touch upon the different mechanisms and assumptions behind the IVIM signal model and discuss when they hold and when not.

13:30 **Comparison of Methods for Estimation of the Intravoxel Incoherent Motion (IVIM) Perfusion Parameters**
Oscar Jalnefjord

Keywords: Contrast mechanisms: Perfusion, Image acquisition: Quantification, Contrast mechanisms: Diffusion

This lecture provides an overview of methodological aspects of the process to generate intravoxel incoherent motion (IVIM) parameter maps. We will cover both image acquisition, (diffusion encoding, readout methods, other preparation modules) and image processing (preprocessing, choice of model, methods for parameter estimation), all with an emphasis on the perfusion-related IVIM parameters.

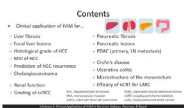
14:00 How To Acquire & Reconstruct IVIM Images: A Consensus Statement
Eric Sigmund

14:30 Break & Meet the Teachers

15:00 Clinical Applications in the Brain
Jacobus Jansen

15:30 Clinical Application in the Breast, Placenta & Muscle
Penny Gowland

16:00 **Clinical Application of IVIM in the Liver, Kidneys, Pancreas & Bowel**
Shintaro Ichikawa



Keywords: Body: Liver, Body: Kidney, Contrast mechanisms: Diffusion

The liver is a highly vascularized organ; therefore, perfusion-related effects are not negligible for diffusivity assessment using DWI. IVIM is an imaging technique used to simultaneously estimate perfusion-related and pure molecular diffusivities through analysis of the signal decay of multi-b-value diffusion-weighted images. Fibrosis and cirrhosis can result in significant changes in the histopathological structure of the liver, which consequently leads to pronounced alterations in the ADC and IVIM parameters. Compared with conventional or morphological imaging, IVIM provides additional information that can aid in screening and diagnosis for the liver, kidneys, pancreas, and bowel.

Weekend Course

Quantitative Neuroimaging in the Era of Precision Health & Personalized Medicine

Organizers: Wei-Tang Chang, Erpeng Dai, Karin Markenroth Bloch, Allen Song

Nicoll 3 | Saturday 13:00 - 16:50 | *Moderators:* Fan Lam & Yu-Chien Wu

13:00 Overview of Quantitative Imaging Techniques I

Mariya Doneva

Keywords: Image acquisition: Quantification

This lecture will provide an overview of the basic quantitative MRI techniques employed in neuroimaging. It aims to familiarize the audience with the theoretical principles and practical considerations of using quantitative imaging techniques. Specifically, we will cover methods to estimate longitudinal relaxation time (T1), transverse relaxation time (T2) as well as methods for studying the microstructure such as myelin water fraction imaging and diffusion and quantitative susceptibility mapping (QSM).

13:25 Overview of Quantitative Imaging Techniques II

Olivier Beuf

Keywords: Image acquisition: Quantification, Neuro: Brain, Image acquisition: Multiparametric

In addition to the previous talks, this lecture is devoted to an overview of quantitative MRI methods in neuroimaging in the scope of personalized medicine. Advanced techniques such as MR elastography (MRE), chemical exchange saturation transfer (CEST), magnetic resonance spectroscopy (MRS), arterial spin labeling (ASL), dynamic contrast-enhanced (DCE) imaging, and X-nuclei imaging will be addressed. Measuring tissue stiffness, characterizing tissue content and organization, mapping metabolic state or assessing tissue perfusion are among information MRI can provide today. This comprehensive overview will highlight the potential of quantitative MRI in personalized healthcare for neurological disorders.

13:50 The Frontiers of Quantitative Imaging

Congyu Liao

Keywords: Contrast mechanisms: Relaxometry, Image acquisition: Multiparametric

Quantitative MRI plays an increasingly significant role in clinical and research studies. Recent advancements in accelerated imaging techniques have made quantitative MRI both feasible and accessible within clinically practical timeframes. In this presentation, we will explore several cutting-edge time-resolved multiparametric mapping techniques, such as Magnetic Resonance Fingerprinting (MRF), Echo-planar Time-resolved Imaging (EPTI), and Magnetic Resonance Multitasking. These methods can furnish invaluable insights into various tissue properties, including longitudinal and transversal relaxation times (T_1 and T_2), transverse magnetization influenced by field inhomogeneity (T_2*), proton density (PD), myelin-water fraction (MWF), mean diffusivity (MD), and fractional anisotropy (FA).

14:15 Quantitative Imaging in Multiple Sclerosis

Cornelia Laule

Keywords: Neuro: Brain, Neuro: White matter, Neuro: Spinal Cord

This lecture will provide an overview of quantitative MRI findings in multiple sclerosis (MS) brain and spinal cord. MS clinical features, tissue changes and the need for advanced MRI biomarkers will be reviewed. Results from magnetization transfer, diffusion MRI, quantitative T_1, quantitative susceptibility mapping, myelin water imaging, magnetic resonance spectroscopy, and non-proton MRI (^{23}Na, ^{31}P) in MS lesions and normal appearing white/grey matter will be summarized. Clinical translation of advanced MRI techniques through normative atlases will be discussed, as well as challenges such as standardization, reproducibility, and integration with other clinical and biological markers for personalized medicine approaches in MS.

14:40 Break & Meet the Teachers

15:10 Quantitative Imaging in Epilepsy & Stroke

Yuriko Suzuki

Keywords: Neuro: Brain, Contrast mechanisms: Perfusion, Image acquisition: Quantification

This lecture will provide an overview of the clinical application of quantitative MRI in Epilepsy and Stroke in the scope of precision health and personalized medicine. While we will explore how quantitative MRI can improve diagnosis, prognosis counselling, and defining treatment strategy in addition to conventional MRI images, we will also discuss how the utilities of quantitative MRI can be translated into clinical care and benefit individual patients.

15:35 **Quantitative Imaging in Brain Tumors**
C. Chad Quarles

Keywords: Neuro: Brain, Image acquisition: Quantification, Cross-organ: Cancer

At the end of this lecture participants should be able to: 1) describe quantitative neuroimaging methods that are currently used across the spectrum of brain tumor patient care; 2) describe current applications of neuroimaging methods for brain tumor patients, including diagnosis, prognosis, neurosurgical and radiotherapy guidance, and response prediction and assessment, and 3) describe emerging neuroimaging methods and their potential uses in brain tumor patient management.

16:00 Quantitative Imaging in AD
Michael Zeineh

16:25 **Challenges, Unmet Needs, and Future of Quantitative MRI for Precision Health and Personalized Medicine**
Andrew Alexander

Keywords: Neuro: Brain, Transferable skills: Metrology of MRI, Transferable skills: Statistics

Neuroimaging for precision health and personalized medicine (PHPM) requires highly precise quantitative imaging measures and large representative and normative datasets. Challenges and unmet needs associated with quantitative MRI for PHPM include sources of measurement variability and errors, measurement standardization, individual brain variation, biological specificity of measures, data processing and analysis complexity, and the cost and accessibility of MRI. Promising new directions include new developments to advanced imaging technologies, open-source MRI sequences, big data, machine learning and point-of-care imaging platforms. These topics will be summarized from the neuroimaging scientist perspective.

Weekend Course

Managing Innovation at the Interface Between Academia & the Industry

Organizers: Agah Karakuzu, Mathieu Sarracanie

Room 325-326 | Saturday 13:00 - 17:00 | Moderators:

Managing Innovation/IP at the Interface:
Academia: Roberta Frass-Kriegl

13:00 Managing Innovation/IP at the Interface I: A View From Academia (Pulse Sequences)
Nicole Seiberlich

13:10 Managing Innovation/IP at the Interface I: A View from Academia
Kawin Setsompop

13:20 **Research & Innovation: Academics Involvement in Startups**
Ludovic de Rochefort

Keywords: Transferable skills: Intellectual Property, Transferable skills: Commercialisation, Transferable skills: Regulatory aspects

Start-ups and academia have traditionally formed isolated systems. However, research and innovation policies are increasingly stimulating interaction between them. It is necessary to understand both worlds in order to build mutual trust, so that win-win situations can emerge from this entanglement. The versatile nature of MRI, from basic science to biomedical applications, is conducive to innovation. In this out-of-the-lab lecture, some of the aspects that scientists should know about technology transfer and start-ups will be briefly presented, with a view to breaking down boundaries.

13:30 Setting Boundaries Regarding Innovation When Having Multiple Affiliations (Academics in Companies)
Stamatia Destounis

13:40 Preserving or Sharing the Laboratory IP When Trained Researchers Leave the Nest I
TBD

13:50 **Preserving or Sharing the Laboratory IP When Trained Researchers Leave the Nest II**
Cristina Granziera

Keywords: Transferable skills: Intellectual Property

There are different ways to develop IP in an academic lab: directely or indirectly through students/trainees that contributed to it . We will discuss ways and options: all will have advantages and disadvantages for the PI and and the student/trainee. None will be THE right one but all can be right in specific situations.

14:00 Panel Discussion

14:40 Break & Meet the Teachers

15:10 Managing Innovation/IP at the Interface II: An Industry Perspective I

Fraser Robb

Keywords: Physics & Engineering: Hardware, Contrast mechanisms: Hyperpolarized MR (Gas), Physics & Engineering: Low-Field MRI

Early concepts of NMR Imaging and Magnetic Resonance Imaging came from a few pioneering universities including Stonybrook, Nottingham and Aberdeen. For NMR Imaging to grow into the dynamic MRI industry of the modern era it has always required close cooperation between academia and industrial partners. In many instances early basic concepts have been best nurtured in the university environment but can be made more accessible to the world through industrial partnership with compliance to IEC and international safety regulations. We shall explore ways how different parts of MR community can move forward together for common benefit.

15:20 Managing Innovation/IP at the Interface II: An Industry Perspective II

Benjamin Robert

Keywords: Transferable skills: Research coordination, Transferable skills: Public engagement

Academic-industry collaborations are becoming increasingly essential for driving innovation in research and development, particularly in technology-intensive domains like MRI. From an industry perspective, partnerships with academia offer unique knowledge, expertise, resources, and market access. However, these collaborations also present challenges such as differences in goals, timelines, cultures, and IP ownership. To ensure successful academic-industry partnerships, it is essential to focus on key success factors such as clear communication, flexible timelines, well-defined IP ownership, effective project management, and a culture of trust. This presentation illustrate the benefits of successful academic-industry collaborations.

15:30 IP in a Growing World of Open Science: How Do They Co-Exist? I

Nikola Stikov

15:40 IP in a Growing World of Open Science: How Do They Co-Exist? II

Gregory Lembersky

15:50 Moving from Academia into your own Startup

Pedro Silva

Keywords: Transferable skills: Commercialisation

The presentation explores the pathway for researchers interested in applying their knowledge within the entrepreneurial landscape. This presentation delves into the essential steps for moving from an academic setting to founding a startup, including identifying commercial opportunities for research, developing a viable business model, securing initial funding, and adapting to the entrepreneurial environment. It aims to provide insightful advice on leveraging academic networks for business advancement and finding a balance between maintaining research integrity and achieving commercial success. Participants will gain a deeper understanding of how to navigate the complexities of transitioning their academic achievements into a thriving business venture.

16:00 Building a Company Around a Research Idea/Moving from Academia Into Your Own Startup II

Laura Sacolick

Keywords: Transferable skills: Commercialisation, Transferable skills: Intellectual Property

This talk will go through some basics of how to convert an academic idea or project into an industry venture. This will be an intro to how to develop an idea/demo, get investment, and create relationships with established companies. Practical info will be presented on how to read and file IP, and how to start a path to regulatory clearance. Examples from startup companies in the MRI space will be discussed.

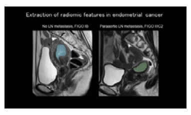
16:10 Panel Discussion

Weekend Course

Gender Imaging: Prostate & Female Pelvis

Organizers: Nandita DeSouza, Durgesh Dwivedi, Mami Iima, Takeshi Yokoo

Room 331-332 | Saturday 13:00 - 16:50 | *Moderators:* Masoom Haider & Masako Kataoka

13:00 [Uterine Cancer: T2W or Texture?]

Yuki Himoto

Keywords: Body: Urogenital

Motivation: Conventional MRI is crucial for uterine cancer in clinical settings. Radiomics, utilizing quantitative imaging features, has rapidly evolved in research. A brief review provides insights for addressing current clinical challenges and guiding future developments.

Goal(s): The goals are to grasp the roles of conventional MRI, achievements in radiomic studies for uterine cancer (particularly endometrial cancer), and the limitations and improvements in imaging quality.

Approach: Reviewing the latest research on MRI and radiomics in uterine cancer, with a primary focus on endometrial cancer.

Results: Despite limitations, radiomics continues to advance. Improvements in conventional MRI quality for gynecologic imaging are clinically significant and enhance radiomics.

Impact: Grasping current improvements in MRI quality and radiomics, along with identifying challenges, offers insights for addressing clinically relevant issues in uterine cancer.

13:25 Cervical Cancer: T2W or Texture?
Luca Russo

Keywords: Body: Urogenital

- The role of conventional MRI in cervical cancer imaging is well-established, with guidelines universally recognizing it as the modality of choice for staging, assessing treatment response, and selecting candidates for fertility-sparing treatments.
- The cutting-edge applications of texture analysis will be explored, highlighting its potential to significantly expand the capabilities of MRI.
- Particular attention should be paid to to currently unmet clinical needs, showcasing relevance and potential impact of texture analysis on patient management.
- This analysis aims to bridge the gap between existing MRI techniques and the evolving demands of management, pointing towards innovative tailored approaches.

13:50 Ovarian Cancer: T2W or Texture?
Aki Kido

Keywords: Body: Pelvis

Motivation:T2WI, i.e. traditional morphological image diagnosis is good at 'present' histopathological diagnosis. On the other hand, recent texture, i.e. radiomics analysis can provide invisible information and make 'future' diagnosis including prognosis and treatment response.
Goal(s): Clinical radiologists need to know the pros and cons of both morphological diagnosis and texture analysis and know how to get the necessary information when we need it.
Approach: -
Results: -
Impact: -

14:15 Advanced Morphofunctional Sequences & AI in the Evaluation of Fetal Growth Anomalies
Lucia Manganaro

Keywords: Image acquisition: Image processing, Image acquisition: Sequences, Image acquisition: Motion Correction

Intrauterine growth restriction (IUGR) is the fetal failure to reach its biological growth potential and placental dysfunction is the main cause IUGR is distinguished into Small for Gestational Age (SGA) and Fetal Growth Restriction (FGR). Ultrasound represents the technique of choice for the diagnosis and the Functional Doppler parameters improve this distinction as established by the Expert Consensus Statement. The differentiation is important: many SGAs are constitutionally small but healthy without risk of poor outcomes unlike FGRs.
Magnetic Resonance Imaging (MRI) and Diffusion weighted imaging (DWI) can evaluate placenta and fetal growth supporting the diagnosis of developmental pathologies

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14:40 Break & Meet the Teachers

15:10 **The Problem with PI-RADS**

Yan Mee Law

Keywords: Body: Urogenital, Cross-organ: Cancer, Image acquisition: Multiparametric

PI-RADS v2.1 is widely adopted by the international radiology and urology communities in risk assessment of clinically significant prostate cancer (csPCa) at multi-parametric MRI (mpMRI) in treatment naïve men. This consensus document, aimed at establishing uniformity in acquisition and interpretation of mpMRI, has been prone to performance variations. A non-negligible number of csPCa are missed at mpMRI as these lesions resemble benign lesions or possess mpMRI features that do not fit a defined PIRADS category. We discuss the limitations and controversies of PIRADS and tips and tricks that may be useful to improve the conspicuity of “MRI occult” csPCa.

15:35 **Radiomic & Radiogenomic Signatures in Prostate Cancer**

Daniel Moses

Keywords: Body: Pelvis, Body: Urogenital, Education Committee: Clinical MRI

Radiomics and genomics have potential to add value in the diagnosis and risk stratification of cancer. Radiomics analyses quantitative imaging biomarkers of tumours in medical images, such as morphological, histogram and texture features, whereas genomics investigates genetic elements of cancer tissue. Combining these into radiogenomics enables the generation of combinations of features, known as signatures, that can predict cancer phenotypes which effect the biological properties and therefore the behaviour of tumours. This presentation examines MRI radiomics and radiogenomics and their use in aiding the screening, detection, classification, treatment, and prognosis of prostate cancer.

16:00 **Two “B” or Not Two “B”: Probing Prostate Tissue Composition**

Aritrick Chatterjee

Keywords: Body: Pelvis, Contrast mechanisms: Microstructure, Image acquisition: Quantification

Diffusion MRI is a key component of prostate MRI. A minimum of 2 b-values are needed to derive ADC map. PIRADS guidelines recommend a minimum of 3 b-values: low (0-100 sec/mm^2), intermediate (800-1000 sec/m^2) and high b-value (≥1400 sec/m^2, either acquired or calculated). The talk will highlight how the choice of b-values can significantly affect ADC estimates. Additionally, we will look at recent advancements in quantitative MRI techniques that probe prostate tissue microstructure. We will look at imaging parameters used and results from these techniques: VERDICT, Restriction spectrum imaging, Hybrid Multi-dimensional MRI, time-dependent diffusion imaging, diffusion-relaxation correlation spectrum imaging, etc.

16:25 **Exploiting AI in Prostate Cancer Assessment**

Amit Mehndiratta

Keywords: Body: Pelvis, Cross-organ: Cancer, Image acquisition: Machine learning

Prostate cancer is sixth leading cause of cancer related death and is one of the most prevalent malignancies in men. Artificial intelligence (AI) methods are potentially useful in prostate cancer management for detection and characterization of prostate lesion. AI solutions are assisting in streamlining patient workflow and optimizing treatment plans for individual patient leading to precision medicine-based approach. Machine learning methods are being used for segmentation of prostate gland and its anatomical structures, image registration, detection of lesions, lesion characterization, automated PI-RADS scoring, and risk stratification, which ultimately leads to enhanced diagnosis, treatment planning, and patient outcomes in prostate-related conditions.

Weekend Course

Getting Things Moving: Basic MRI & AI in Musculoskeletal Imaging

Organizers: Margaret Hall-Craggs, Feliks Kogan, Fang Liu

Room 334-336 | Saturday 13:00 - 16:50 | *Moderators:* Hermien Kan

13:00 **Overview of Joint Anatomy**

Hollis Potter

Keywords: Musculoskeletal: Joints

MRI provides unparalleled evaluation of regional joint anatomy. The structural composition of tissues is reflected in both morphologic and quantitative MRI, which has links to material properties and response to mechanical load. This talk will discuss knee anatomy with a focus on articular cartilage, fibrocartilaginous meniscus, and ligament/tendon, drawing insights into tissue relaxometry as a function of histopathology and function. Imaging data provide information about response to injury and repair, and quantitative evaluation of ACL reconstruction, the repaired meniscus, and tendinopathy will further be provided, with a focus on T2, T2* and T1rho mapping, with and without applied load.

13:25 Imaging of Infection & Neuropathy

Jung-Ah Choi

13:50 Pediatric MRI
TBD

14:15 Imaging of Tumor Behaviour
Jutta Ellermann

14:40 Break & Meet the Teachers

15:10 AI: Basic Principle Upstream: Acquisition & Reconstruction
Shanshan Wang

Keywords: Image acquisition: Machine learning, Image acquisition: Reconstruction

Deep learning (DL) has emerged as a leading approach in accelerating MR imaging. MR imaging involves physics-based imaging processes, unique data properties, and diverse imaging tasks. This domain knowledge needs to be integrated with data-driven approaches. Our review will introduce the significant challenges faced by such knowledge-driven DL approaches in the context of fast MR imaging along with several notable solutions, which include learning neural networks and addressing different imaging application scenarios. The traits and trends of these techniques have shifted from supervised learning to semi-supervised learning, and finally, to unsupervised learning methods.

15:35 AI: Basic Principle Downstream: Analysis & Processing
Erik Dam

Keywords: Image acquisition: Machine learning

Deep learning (DL) methods can generally learn to spot anything that a radiologist can see. We will demonstrate impressive examples of segmentation of organs, automated radiologist scorings, and adaptive MR protocols that optimize the workflow and patient outcome across musculoskeletal and neurological disorders. We will add some intuition on how DL works but also highlight caveats since deep learning is not intelligent and only knows what it has been presented during training. This challenges generalization to other scanner models, protocols, pathological variations, and to other patient populations. Deployment of DL solutions therefore also relies on alert radiology experts.

16:00 AI: Cutting-Edge Methods & Potential Roles in MSK Imaging
Akshay Chaudhari

16:25 AI: Clinical Translation: Unmet Needs & Challenges
Sharmila Majumdar

Weekend Course
Introduction to Trauma
Organizers: Nivedita Agarwal, Jonathan Dillman, Khin Tha

Summit 1 Saturday 13:00 - 16:50 *Moderators:* Mary-Louise Greer & John Port

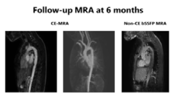
13:00 Epidemiology & Costs of Acute & Chronic Traumatic Injuries
Ling Ling Chan

13:25 Basics of Central Nervous System Trauma: Mechanisms & Acute/Chronic Sequelae of Traumatic Injury (Microscopic to Macroscopic), Including Brain & Spine
Pia Maly Sundgren

In this lecture the underlying external cause for traumatic brain injury will be explained. The typical imaging presentation of different intracranial traumatic injuries will be presented with special focus on MR imaging but not exclusively. The value of advanced MR sequences such as SWI, DTI and fMRI in the diagnosis, follow-up, in prediction of clinical outcome and disability will be discussed. Enhance missing tools and how to transform potential sequences to clinical routine protocols as well as the role of the MR physicist to support and address the clinical need for improved and clinical valuable sequences will be discussed.

13:50 Basics of Musculoskeletal Trauma: Mechanisms of Acute/Chronic Sequelae of Traumatic Injury
Jin Rong Tan

14:15 [Basics of Abdominal Trauma: Mechanisms & Acute/Chronic Sequelae of Traumatic Injury, Including Chest, Abdomen & Pelvis]
Hideki Ota

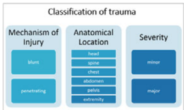


Keywords: Cardiovascular: Angiography, Body: Urogenital, Body: Body

In acute trauma cases, CT is preferred for its accessibility and speed, though concerns arise over radiation and contrast agents. MR imaging supplements CT, particularly in assessing traumatic lesions. For chest trauma, MR aids in blunt thoracic aortic injury assessment, guiding management decisions. It's also useful for chest wall fracture assessment, revealing occult rib fractures. In abdominal trauma, MRCP helps detect pancreatic and biliary duct injuries; Gd-EOB-DTPA also aids in bile duct injury evaluation. MR imaging is valuable in pelvic injuries due to its excellent tissue contrast. Considering radiation exposure, MR imaging would be preferred in pediatrics and pregnant patients.

14:40 Break & Meet the Teachers

15:10 Mid- & Low-Field MRI Imaging of Trauma: Is There a Role?
Anna Lavrova



Keywords: Physics & Engineering: Low-Field MRI, Image acquisition: Visualization, Education Committee: Clinical MRI

Traumatic injuries impose a significant global health burden, resulting in substantial morbidity and mortality. Therefore, their timely and accurate diagnosis is crucial to ensure appropriate management and improve patient outcomes. Magnetic Resonance Imaging (MRI) has revolutionized diagnostic imaging, offering excellent soft tissue contrast and multiplanar capabilities. While high-field MRI scanners have been the cornerstone of trauma imaging, the emerging interest in mid- and low-field MRI systems has raised debates regarding their role in trauma assessment. This review aims to critically evaluate the potential of mid- and low-field MRI in trauma imaging, considering their advantages, limitations, and current evidence.

15:35 How To Operationalise MRI in the Emergency Department
Catherine Mandel

Keywords: Transferable skills: Safety, Transferable skills: Project management, Transferable skills: Value

Magnetic Resonance Imaging (MRI) is now a standard technology in many radiology departments and essential for modern patient care.
It is being used more often in the care of emergency patients, including in trauma, ranging from minor injuries to major trauma. This brings its own risks: in particular patient and staff safety related to the magnetic field.
This talk will discuss:

1. clincal reasons to install MRI in the emergency department
2. matters to consider when deciding where to place an MRI scanner
3. staffing the scanner
4. safety including design, access, patient and staff screening, and training non-radiology staff
5. financial considerations
6. future developments

16:00 MRI & Trauma in Pregnancy
Marielle Fortier

16:25 Panel Discussion

Weekend Course
MR Physics II

Organizers: Maxime Guye, Özlem Ipek, Najat Salameh, Rolf Schulte, Xin Yu

Summit 2 | Saturday 13:00 - 16:25 | *Moderators:* Martina Callaghan & Queenie Chan

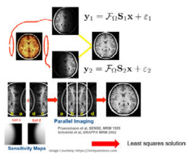
13:00 Spatial Encoding: Gradients & Beyond
Jason Stockmann

Keywords: Image acquisition: Sequences, Physics & Engineering: Physics, Image acquisition: Artefacts

This talk starts from basic principles of the Fourier transform to build intuition for how linear gradient coil fields perform spatial encoding in MRI. We will review k-space and how to set basic imaging parameters related to FOV, resolution, etc. A few basic k-space trajectories and their imaging properties (such as point spread function) and associated artifacts will be discussed. We will then consider imperfections in spatial encoding arising from gradient eddy currents and methods for correcting these effects. Finally, we will look at emerging methods for spatial encoding including the nonlinear gradients and their associated imaging properties and artifacts.

13:25 Image Acquisition & Reconstruction
Jennifer McNab

13:50 Acceleration Through Parallel Imaging & Compressed Sensing
Philippe Ciuciu



Keywords: Image acquisition: Fast imaging, Image acquisition: Reconstruction

Magnetic Resonance Imaging (MRI) is a non-invasive medical imaging technique that has emerged as a pivotal clinical diagnostic tool over the last decades. Yet, its extended scanning times often compromise patient comfort and attainable image resolution. In this course, I will review standard acceleration techniques to shorten MRI scans: First, I will discuss parallel imaging methods based on multicoil acquisition, deterministic under-sampling in k-space and linear image reconstruction. Second, I will expose how Compressed Sensing, which relies on incoherent under-sampling, sparsity and non-linear image reconstruction, has been instantiated in MRI, notably to reach higher acceleration regimes.

14:15 Automated Design of MRI Sequences with Deep Learning
Jongho Lee

Keywords: Image acquisition: Machine learning

This presentation delves into the innovative utilization of deep learning methodologies in crafting MRI sequences. Firstly, the talk addresses the automation of designing specific elements within MRI sequences, such as RF pulse design and gradient waveform design. Then, we will continue to explore how deep learning facilitates the timing of MRI sequence blocks and k-space acquisition order. Related to these topics, the presentation will cover the co-design paradigms of acquisition and reconstruction to achieve optimal performance in final outcomes. Lastly, development of novel MRI sequences targets for specific or even unknown contrasts will be explained.

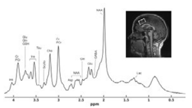
14:40 Break & Meet the Teachers

15:10 Encoding Biophysical Properties
Arvin Arani

Keywords: Contrast mechanisms: Elastography, Contrast mechanisms: Diffusion, Contrast mechanisms: Perfusion

Physical phenomena such as diffusion, perfusion, blood flow, hemodynamics, and tissue biomechanical properties impact the complex MRI signal (magnitude and phase). MRI pulse sequence strategies can be used to efficiently encode the coherent and or incoherent motion associated with these phenomena. Post-processing techniques can then be employed to generate qualitative and/or quantitative images mapping these biophysical properties. This course will look at the basic physics behind each phenomenon, mathematically describe its impact on the MRI signal, and present simple pulse sequence strategies to encode this information.

15:35 Spectral Encoding: Fundamentals & Challenges
Ralf Mekle



Keywords: Contrast mechanisms: Spectroscopy, Contrast mechanisms: Spectroscopic Imaging (MRSI), Neuro: Brain

Spectral encoding provides a means to obtain additional and often complementary information in comparison to magnetic resonance imaging (MRI). Using the chemical shift σ in MR spectroscopy (MRS) metabolic information can be extracted from resulting spectra acquired as single voxel or multi-voxel MR spectroscopic imaging (MRSI) data. The composition of MR spectra for sample molecules is outlined. In addition, typical acquisition protocols and more advanced MRS methodology with a particular importance of required adjustments and including fast MRSI schemes are presented. Metabolite quantification is briefly addressed. Finally, remaining challenges including the relatively low sensitivity and possible amendments are discussed.

16:00 X-Nuclei: Surprising Opportunities Beyond Protons
Yuhei Takado

Keywords: Contrast mechanisms: Non-Proton, Contrast mechanisms: Hyperpolarization, Contrast mechanisms: Spectroscopy

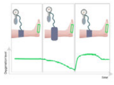
While conventional MRI predominantly focuses on proton imaging due to its superior signal sensitivity, MR imaging inherently extends to all objects with MR-detectable nuclei. This seminar explores the diverse applications of MRI and MRS beyond protons, targeting biologically significant nuclei. Key distinctions from proton imaging include sensitivity variations among nuclei. Understanding these differences unlocks the potential for experiments exploiting X-nuclei MRI. Techniques to enhance X-nuclei sensitivity, such as increasing magnetic field strength, alongside specialized methods like hyperpolarization, are elucidated. The seminar aims to provide valuable insights for conducting experiments with X-nuclei, covering differences, examples, sensitivity enhancement strategies, and specialized methodologies.

ISMRT Oral
Winning Research Oral Presentations

Hall 405E | Saturday 15:30 - 16:15 | *Moderators:* Ilse Patterson

(no CME credit)

15:30



[MRI-based methods for measuring foot perfusion](#)
Malene Bisgaard

Motivation: For patients with peripheral artery disease knowing the perfusion in different areas of the foot might have clinical relevance when treating ischemia.

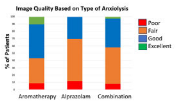
Goal(s): The aim was to measure the reliability of five different MR sequences with quantitative parameters for measuring perfusion when imaging the foot.

Approach: We used a cuff induced ischemia protocol in a test/retest study of 16 healthy volunteers

Results: Flow-sensitive Alternating Inversion Recovery pulsed arterial spin labelling (FAIR) and Blood Oxygenation Level-Dependent (BOLD) sequences had high reliability and were able to distinguish between occluded blood flow and hyperactive response flow

Impact: Reliability test of five different MR sequences for quantitative perfusion measurements in the foot.

15:45



[Exploring the therapeutic benefits of aromatherapy compared traditional medicine for patients undergoing Cardiac Magnetic Resonance Imaging.](#)
Angel Houston

Keywords:

Motivation: Many individuals undergoing MRI scans experience claustrophobia. The resulting anxiety often leads to reduced image quality and even the abandonment of exams.

Goal(s): Our goal is to use aromatherapy in a comprehensive stress reduction approach that we've developed to help improve MRI image quality, decrease nursing intervention and improve patient experience.

Approach: More than 300 patients were involved in retrospective and prospective studies offering aromatherapy and alprazolam for anxiety during Cardiac MRI.

Results: Aromatherapy was associated with improved image quality compared to alprazolam and was a strong predictor of reduced scan duration, nursing time, and number of repeat images.

Impact: Aromatherapy has the ability to mitigate anxiety during MRI scans for patients with claustrophobia, yielding improved quality images and reduced scan time. As a result, implementation of aromatherapy has the ability to improve patient experience and clinical outcomes.

16:00

[Scan With Me (SWiM): A promising train-the-trainer program tailored for resource-limited settings](#)
Cristian Montalba

Keywords:

Motivation: There is a wide discrepancy in MRI accessibility globally, which has created an insurmountable challenge to fulfill the diagnostic healthcare needs of low- and middle- income countries.

Goal(s): To train MRI radiographers who can train their peers in a growing network.

Approach: The RAD-AID Teach-Try-Use approach was used within 6 weeks to deploy basic to advanced cardiac MRI (CMR) knowledge, followed by expert image acquisition demonstrations, and the use of cases to simulate, analyze and optimize scanner-specific imaging protocols for pathologies.

Results: 43 Participants from 16 countries gained practical CMR experience and implemented their own optimized protocols to generate high-quality images.

Impact: A sustainable skill set training approach was used to provide expertise to MRI radiographers who will then serve as trainers of their peers in resource-limited settings. Outcome of the training was measured by trainee evaluations and engagement and the high-quality images acquired by participants.

Sunday, 05 May 2024

[Go to top](#)

Weekend Course

Advances in Perinatal MRI

Organizers: Emmanuel Barbier, Jonathan Dillman, Christian Federau, Dan Wu

Nicoll 1 | Sunday 7:45 - 11:35 | Moderators:

Fetal MRI: Su-zhen Dong & Jana Hutter

Infant MRI: Sean Deoni & Peiying Liu

7:45 Fetal Brain Acquisition & Analysis

Joseph Hajnal

8:10 

Normal Fetal Brain Development & Prenatal Diseases

Guangbin Wang

Keywords: Cross-organ: Antenatal, Neuro: Brain, Education Committee: Clinical MRI

The most rapid growth of the brain occurs in utero. MRI demonstrates the major developmental processes in utero, including the proliferation, migration, organization , gyration and myelination. Awareness of normal fetal brain development contributes to identify abnormalities. The key points for the MRI features of the common abnormalities promote accurate prenatal diagnosis. In our talk, we present the key signs of ventriculomegaly, callosal agenesis, microcephaly, schizencephaly, gray matter heterotopia, holoprosencephaly, intra/extra-cerebral hemorrhage and posterior fossa anomalies.

8:35 Fetal-Placental Interactions

TBD

9:00 Safety Issues in Fetal MRI

Teresa Victoria

9:25 Break & Meet the Teachers

9:55 

Infant MRI Acquisition & Safety Issues

Jian Yang

Keywords: Cross-organ: Neonatal, Image acquisition: Motion correction, Cross-organ: Development

Infant MRI is challenging due to their immaturity, small physical size, and motion artifact. A customized approach tailored to each baby's age and functional status with appropriate combination of dedicated procedure, imaging hardware and software is key. This presentation summarizes several technical and clinical approaches that can help to ensure safety and decrease the need for sedation in infants. These range from feeding and swaddling to specialized small bore scanners and coils, MRI compatible incubators, and noise-reduction methods. New pre- and post-processing techniques with artificial intelligence can also decrease both scan time and motion artifacts to enable a successful scan.

10:20 

Why Big Tools for Small Brains

Pew-Thian Yap

Keywords: Neuro: Brain

The infant brain is not a miniaturized adult brain and undergoes rapid and unique developmental processes. Using computational tools meant for adult MRI to analyze infant brains often leads to subpar results. This presentation discusses resources tailored specifically for analyzing infant MRI across various modalities, aiming to provide clearer insights into early human brain development.

10:45 Normal & Abnormal Infant Brain Development

Yong He

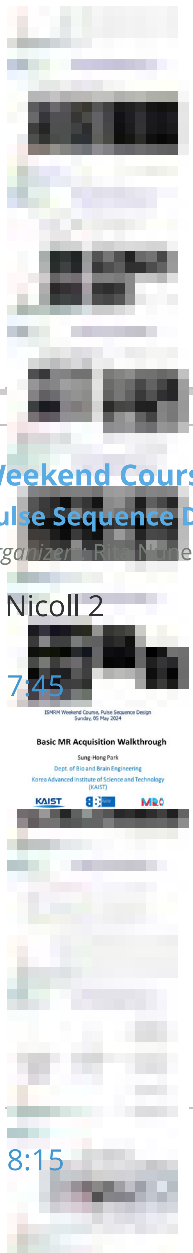
11:10

Infant MRI Applications Beyond the Brain

Yun Peng

Keywords: Education Committee: Clinical MRI

The applications of infant MRI have extended beyond the realm of brain imaging. This lecture will elaborate on the significance of MRI in infant imaging, elucidate the challenges inherent in such imaging endeavors. We address clinical inquir, andies concerning the fundamental concepts essential for acquiring optimal images and deepen the understanding of the distinctive and optimal workflows associated with infant MR imaging. Moreover, we endeavor to present a large number of clinical cases beyond brain imaging, serving to illustrate the extensive applicability of infant MR examination in clinical settings and foster a deeper comprehension of this topic.



Weekend Course

Pulse Sequence Design

Orga[illegible]*es, Dan Ma, Yarach Uten*

Nicoll 2 | Sunday 7:45 - 11:45 | *Moderators:* Yong Chen & Nan Wang

7:45 **Basic MR Acquisition Walkthrough**
Sung-Hong Park

Keywords: Image acquisition: Sequences

MRI involves the sequential application of pulsing in RF and gradient coils, known as pulse sequences. This talk aims to explain fundamental concepts on how the gradient and RF pulsing generates an MR image. It covers the mathematical perspective of Fourier transform and the relation between the integral area of the gradient pulsing and the position in k-space. The presentation describes the combined utilization of RF and gradient pulsing for generating tomographic images, elucidating the role of a k-space trajectory in image formation. Key concepts such as slice selection, frequency encoding, phase encoding, and k-space will be explored.

8:15 **Imaging Acceleration Techniques**
Hua Guo

Keywords: Image acquisition: Fast imaging, Image acquisition: Sequences, Image acquisition: Reconstruction

Since the advent of MRI technology, image acquisition acceleration has consistently been one of the most prominent research topics in the field. Up to now, sampling acceleration still remains a central focus in MR technology research. Numerous acceleration techniques have been developed, with some already incorporated into products. These techniques include fast imaging sequences, partial Fourier-encoding, parallel imaging, compressed sensing, deep learning, and combinations thereof. Imaging acceleration techniques are widely used in anatomical, functional, and dynamic imaging. This lecture will provide a brief explanation of the fundamental principles behind some of these techniques.

8:45 Open-Source Pulse Sequence Design & Simulation
Maxim Zaitsev

9:15 Break & Meet the Teachers

9:45 **Pulse Sequence Design for MR-Guided Interventions**
Adrienne Campbell-Washburn

Keywords: Image acquisition: Sequences, Physics & Engineering: Interventional

During an MR-guided intervention, an invasive procedure is performed while the patient is inside the MRI system, and image guidance is used for real-time device navigation or to assess the therapeutic progress. The workflow for MRI-guided interventions differs from typical diagnostic MRI, and these procedures are more demanding on image acquisition and reconstruction times. Therefore, pulse sequences are designed differently. This talk will describe: interactive real-time imaging to enable the navigation of devices through complex anatomy, sequences to visualize interventional devices, thermometry methods to monitor thermal interventions, tracking motion for MRI-guided radiotherapy, and sequence compatibility with low-latency reconstruction.

10:15 Filling the Gap Between Innovative Sequence Design & Clinical Practice
Jeanette Schulz-Menger

10:45 **AI-driven pulse sequence design**
Ricardo Otazo

Keywords: Image acquisition: Sequences, Image acquisition: Machine learning

Artificial intelligence (AI) provides new tools to solve complex optimization problems, such MRI pulse sequence design. AI can be used to efficiently design the RF pulses and gradient waveforms to achieve the required image contrast and k-space trajectory or to optimize the schedule of acquisition parameters in MR fingerprinting, according to hardware constraints such as gradient amplitude and slew rate. This lecture will review techniques that use AI to design MRI pulse sequences such as AutoSeq, MRZero, and optimization of parameter schedule for MR fingerprinting. The application of ChatGPT for auto-generation of pulse sequence code will be also discussed.

11:15 Ultimate MR Encoding
Lars Kasper

Weekend Course
MRI Safety
Organizers: Brian Hargreaves, Özlem Ipek, Doug Kelley, Andrew Webb

Nicoll 3 | Sunday 7:45 - 11:10 | *Moderators:* Christopher Collins & Tolga Goren

7:45 Static Magnetic Field Safety
Umberto Zanovello

Keywords: Transferable skills: Safety

Motivation: The strong MRI static magnetic field (SMF) may represent a safety concern in many circumstances.

Goal(s): To present conditions and causes that can lead to harmful effects for MR patients and operators. To provide an overview of how relevant guidelines cope with SMF safety in MRI.

Approach: The presentation covers different safety aspects related to the interaction with the MRI SMF.

Results: In the presentation, the effects of the interaction between ferromagnetic objects and the SMF are shown together with the effect of gradient- and movement-induced currents. The most relevant standards are introduced and solutions to measure the SMF are proposed.

Impact: The strong MRI static magnetic field represents a safety concern in many circumstances. An understanding of the conditions and causes leading to harmful events for patients and operators is of key importance to reduce the occurrence of such situations.

8:10 Acoustic Noise
Simone Angela Winkler

8:35 Evaluating Peripheral Equipment
Anthony Price

Keywords: Physics & Engineering: RF Safety, Physics & Engineering: Gradient & B0 Safety, Transferable skills: Safety

This talk will focus on evaluating the safety of peripheral equipment used in the MR environment and discuss the potential hazards and interactions with the scanner. Practical examples will be given of how MR users and those responsible for local safety sign-off might approach testing equipment that either does not meet all the conditions of use listed in certification labelling, or how to tackle bespoke novel research equipment that has not been subjected to any formal testing to regulatory standards.

9:00 Radiofrequency Power Absorption and Specific Absorption Rate in MRI – what are they, how to model them, and how to reduce them?
Emre Kopanoglu

Keywords: Physics & Engineering: RF Safety, Transferable skills: Safety, Physics & Engineering: Pulse design

This talk will introduce what RF power deposition is and what its implications within the context of MRI are, examine how it leads to temperature increase, and discuss why specific absorption rate (SAR) is used as a safety parameter. Then, we will review SAR limits and different SAR definitions applicable in various imaging scenarios. We will discuss how SAR is used in practice and will talk through how SAR is modelled while scrutinizing various potential pitfalls that might lead to mismatches between modelling and reality. Finally, we will investigate factors that contribute to SAR, and explore strategies to reduce SAR.

9:25 Break & Meet the Teachers

9:55 RF Temperature & Field Measurement for MRI Safety
Dursun Korel Yildirim

10:20 Evaluating Implants
Laleh Rad

10:45 [Parallel Transmit RF Safety]
Rene Gumbrecht

Keywords: Physics & Engineering: RF Safety

This educational talk on Parallel Transmit RF safety gives an overview of the challenges and potential benefits of parallel transmit RF coils with respect to RF heating. The concept of local SAR supervision in contrast to conventional global SAR supervision is introduced. The basic process of obtaining and implementing a safe local SAR model for parallel transmit coils is outlined. This includes RF field simulations, SAR model compression, validation and online supervision. Finally, potential benefits of parallel transmit RF coils to control and even reduce SAR are discussed.

Weekend Course
MR Contrasts Across Field Strengths: When Is Less More?
Organizers: Jessica Bastiaansen, Henrik Odéen, Marco Palombo, Simon Robinson

Room 331-332 | Sunday 7:45 - 11:35 | *Moderators:* Ahsan Javed & Nicole Seiberlich

7:45 Introduction to Contrast Mechanisms at Low & Ultra-Low Field
Ed Wu

8:10 Introduction to Contrast Mechanisms at High & Ultra-High Field
Karin Markenroth Bloch

Keywords: Physics & Engineering: High-Field MRI

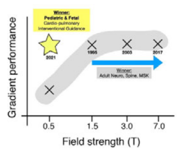
Changes in relaxation parameters give rise to changed image contrasts at high field strengths (≥7T) as compared to lower field. These changes can benefit certain sequences and create challenges in other situations. The presentation will give an introductory overview of contrast mechanisms at high field (≥7T), including T_1, T_2, T_2*, BOLD, flow, MRSI and multinuclear imaging. In addition, artifacts at higher field that have consequences for image contrast will be discussed.

8:35 Diffusion Across Field Strengths
Mara Cercignani

Keywords: Contrast mechanisms: Diffusion

This lecture will discuss the principles and challenges of diffusion MRI (dMRI) at different field strengths. Low field (<1T) poses signal-to-noise ratio challenges, while high field (>3T) faces issues like field inhomogeneity and shorter T2 relaxation times. At high field, strategies to minimize SNR loss include non-Cartesian k-space trajectories and 3D sequences. Conversely, at low field, long scan times hinder data quality, necessitating innovative acquisition and image reconstruction techniques. The talk will discuss the attractiveness and challenges of different field strengths and proposes strategies for addressing dMRI difficulties.

9:00 Perfusion Across Field Strengths
Danny Wang



Keywords: Contrast mechanisms: Perfusion, Physics & Engineering: High-Field MRI, Physics & Engineering: Low-field MRI

Motivation: Ultrahigh field (UHF>=7T) and high performance low field (HPLF<1T) MR systems have greatly expanded the field strengths and associated applications for perfusion MRI.

Goal(s): To summarize recent advances of perfusion MRI across field strengths.

Approach: UHF offers dual benefits for ASL with increased SNR and blood T1, and increased sensitivity for dynamic contrast based perfusion MRI. HPLF systems provide improved field homogeneity and prolonged T2* and is ideal for cardio-pulmonary perfusion imaging.

Results: Perfusion MRI across a wide range of field strengths represent specific opportunities and challenges for specific clinical applications to be further exploited in near future.

Impact: Perfusion MRI across a wide range of field strengths represent specific opportunities and challenges for specific clinical applications to be further exploited in near future.

9:25 Break & Meet the Teachers

9:55 **Susceptibility Effects at Low Field**
Zhiyong Zhang

Keywords: Contrast mechanisms: Susceptibility, Physics & Engineering: Low-field MRI

The magnetic susceptibility effects are generally characterized by geometric distortion, very dark and very bright contrast areas. In this talk, the pros and cons of the susceptibility effects at low field are introduced. Several examples of susceptibility-weighted imaging at low field show the contrast features and their clinical challenges. Opportunities of high sensitivity in-vivo contrast agents for low field MRI are discussed. More importantly, the advantages and opportunities of lower sensitivity to susceptibility effects at low field strengths are highlighted, particularly in applications such as imaging implants and lung tissue.

10:20 Susceptibility Imaging at High Field
Pinar Özbay

10:45 Clinical Applications at Lower Field Strengths
Sean Deoni

11:10 **Clinical Applications at High & UHF**
Siegfried Trattnig

Keywords: Physics & Engineering: High-Field MRI

With the higher-signal to-noise ratio 7T allows improved visualization of cortical lesions, the central vein sign and the detection of paramagnetic rim lesions in MS for differential diagnosis to non-MS lesions and disease progression and small structures in MSK. High resolution MR spectroscopic imaging at 7T has provided new insights into tumor grading and tumor recurrence, early stages of inflammation and correlation with clinical disability of MS patients.
Multi-nuclear clinical applications such as sodium imaging have shown high potential for definition of responder to neoadjuvant chemotherapy in breast cancer and the evaluation of repair tissue quality after cartilage transplantation.

Weekend Course
Basics of Cardiovascular MR

Organizers: Michael Atalay, Hajime Sakuma, Andrew Scott

Room 334-336 | Sunday 7:45 - 11:30 | *Moderators:* Dara Kraitchman & Camila Munoz

7:45 **Segmented & Rapid Imaging: Methods**
Jennifer Steeden

Keywords: Image acquisition: Fast imaging, Cardiovascular: Cardiac, Image acquisition: Sequences

MRI is an extremely valuable imaging technique, but it is inherently slow. This results in long acquisition times and sensitivity to motion. This makes imaging of the heart particularly challenging due to both cardiac and respiratory motion. There has been a lot of work on speeding up acquisition of data – many of these rely on efficient trajectories, as well as reducing the amount of data collected (including undersampling). This presentation will cover the main methods for speeding up cardiac MRI and the main advantages and disadvantages of each method.

8:10 **Segmented & Rapid Imaging: Applications**
Teo Lynette

Keywords: Image acquisition: Fast imaging, Cardiovascular: Cardiac function, Cardiovascular: Myocardium

Time is of the essence in any busy MRI service and CMR scans take up a significant proportion of scanner time. We have the tools for rapid image acquisition but many of us find it difficult to break away from segmented imaging techniques as accelerated acquisitions often come at the expense of image quality. There are concerns that subtle abnormalities in wall motion or small amounts of myocardial fibrosis may be missed using such techniques. This talk will illustrate segmented and rapid imaging techniques and it is for the user to decide what is best for their constraints and practice.

8:35 Tissue Characterization in CMR: Methods
Masa Bozic-Iven

9:00 Tissue Characterization in CMR: Applications
Jeanette Schulz-Menger

9:25 Break & Meet the Teachers

9:50 Myocardial Perfusion Imaging: Methods
Behzad Sharif

10:15 	Myocardial Perfusion Imaging: Applications Stephen Cheung **Keywords:** Cardiovascular: Cardiac, Cardiovascular: Hemodynamics, Cardiovascular: Myocardium Quantitative myocardial perfusion is now ready for clinical use and is available on platforms provided for vendors. It adds to qualitative perfusion by providing additional information about regional myocardial blood flow and reserve. After excluding artefacts the perfusion maps provide valuable overall impression of perfusion status and a normal map is a reliable exclusion of significant ischemia. Quantitative perfusion also enable diagnosis of microvascular dysfunction which is not always possible with qualitative analysis. Diagnosis of triple vessel disease is also more confident since it does not depends on comparison with regions that are supposed to be of normal perfusion.	
10:40	Motion in Cardiovascular MR: How the Heart Moves with the Cardiac & Respiratory Cycles Zhaoyang Fan	
11:05	Putting It All Together: An Efficient CMR Exam Wendy Strugnell **Keywords:** Cardiovascular: Cardiac As new imaging techniques are developed and the clinical applications of CMR expand, implementing efficient workflow practices has become increasingly important in clinical practice. To complete a comprehensive examination in a clinically acceptable timeframe with high quality imaging requires considerable forethought and planning. Developing and applying a systematic approach to all aspects of the examination can save considerable scanner time, even if the operator is proficient in the placement of imaging planes. This presentation will outline practical ways to improve the efficiency of a CMR exam in the clinical environment.	

Weekend Course

Is There a Role for MRI in Acute Body & MSK Trauma?

Organizers: Jana Delfino, Nandita DeSouza, Ashley Harris

Summit 1	Sunday 7:45 - 9:55	*Moderators:* Wilfred Peh & Katja Pinker

7:45	PRO: There Is a Role for MRI in Acute Trauma: M.D. Perspective Edwin Oei **Keywords:** Neuro: Spinal cord, Musculoskeletal: Joints In this presentation the MD perspective on the important role of MRI in acute trauma is presented. A particular emphasis is placed on the critical role of MRI in the evaluation of traumatic injury of the spine and the extremities. The added value of MRI compared to other imaging modalities, such as radiography and CT, to demonstrate significant injuries that require immediate attention and treatment, will be demonstrated. Implementation of MRI in the acute trauma setting can be enhanced by rapid MRI protocols.
8:05	CON: There Is No Role for MRI in Acute Trauma: M.D. Perspective James Hallinan
8:25	PRO: There Is a Role for MRI in Acute Trauma: Ph.D. Perspective Walter Block
8:55	CON: There Is No Role for MRI in Acute Trauma: Ph.D. Perspective Oliver Wieben
9:15	Panel Discussion
9:35	Break & Meet the Teachers

Weekend Course

MR Engineering I: MRI System (Non-RF)

Organizers: Maria Engel, Shaoying Huang, Özlem Ipek, Doug Kelley, Xiaoliang Zhang

Summit 2	Sunday 7:45 - 11:10	*Moderators:* Clarissa Cooley & Hui Han

7:45 

[Magnet Design for Ultra-Low Field MRI Systems]
Pablo Prado

Keywords: Physics & Engineering: Low-field MRI, Physics & Engineering: Hardware

Low-field MRI scanners offer imaging solutions for point-of-care settings with simplified facility needs. The lower magnetic field range could lead to reduced scanner costs and footprint, facilitating installations in economically disadvantaged regions. However, performance and cost challenges often restrict low-field units to specific clinical applications such as brain and extremity imaging. Developing low-field magnets for clinically valuable applications requires balancing magnetic field homogeneity, strength, and footprint. The presentation explores market trends and details of low-field magnet development.

8:10

Gradient Coil Design
Ergin Atalar

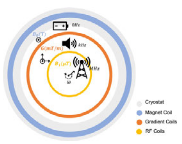
s

8:35 

[Shim Coil Design]
Alexis Amadon

Keywords: Physics & Engineering: Hardware, Physics & Engineering: High-Field MRI, Neuro: Brain

We review methods to design shimming coils, starting from basic Spherical Harmonic coils to anatomy-driven multi-coil arrays. Assuming cylindrical surface geometries for the sought shim currents, we focus on a recent simple numerical method to find the stream function (SF) producing whatever target field. Applying this to brain B0 maps, we perform a SF principal component analysis and translate its main components into current lines gathered around SF extrema. We then segment coil windings into multi-channels to add flexibility in the shimming process. The same strategy can be applied to design shim arrays dedicated to other parts of the anatomy.

9:00 

[MRI System Engineering]
Natalia Gudino

Keywords: Physics & Engineering: Hardware, Physics & Engineering: High-Field MRI, Physics & Engineering: Low-Field MRI

The aim of this presentation is to review the main hardware components in the MRI system and its engineering based on MRI physics.

9:25

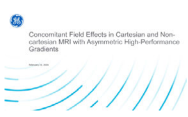
Break & Meet the Teachers

9:55

[Peripheral Nerve Stimulation]
Valerie Klein

Keywords: Physics & Engineering: Gradient & B0 Safety, Physics & Engineering: Hardware

Time-varying MRI gradient fields induce electric fields in the patient (Faraday induction) that can stimulate excitable tissues such as peripheral nerve fibers. Peripheral nerve stimulation (PNS) can be experienced as a mild tingling or tapping sensation but can lead to muscle contractions and even pain at higher levels, which must be avoided. With new gradient coil designs and increasing power levels, PNS has become a major limitation to gradient performance and thus imaging speed and resolution. This talk addresses different approaches to characterize and mitigate PNS in MRI and will touch upon other gradient-patient interactions, including cardiac and retina stimulation.

10:20 

[Concomitant Field Effects in Cartesian and Non-cartesian MRI with Asymmetric High-Performance Gradients]
Afis Ajala

Keywords: Physics & Engineering: Gradient & B0 Safety, Physics & Engineering: Physics

The use of higher-performance gradient coils results in stronger second-order concomitant fields, which can lead to image artifacts such as signal dropout, blurring, and phase errors that cannot be corrected by pre-emphasis of gradient waveforms and/or radio frequency modulation alone. We developed (1) an axially symmetric second-order field coil that is insertable, and demonstrate its ability to prospectively correct the additional phase generated by second-order concomitant fields in 2D phase contrast and spiral-out gradient echo imaging in a 3.0 T high-performance head-gradient (MAGNUS) system and (2) a retrospective second-order concomitant field correction method and demonstrate its efficacy using perfusion MRI.

10:45

[Who Is the Power Hog? Energy Consumption of an MRI System]
Johan Overweg

Keywords: Physics & Engineering: Hardware

Superconducting MRI scanners have a high baseline power consumption, This is caused by the cryocooler which is on all the time. There is potential to reduce this power by operating the cryoycooler such that does not generate more cooling than the magnet needs.

Member-Initiated Session

From Basics to Applications: MRI of Neuromodulation Using TMS & FUS

Room 325-326 | Sunday 7:45 - 9:45

(no CME credit)

7:45	Basics of Transcranial Magnetic Stimulation
8:02	What Can Bring TMS to MRI & Vice Versa?
8:19	Applications of Combined TMS & MRI in Neuroscience & Clinical Practice
8:36	Applications of Combined TMS & MRI in Neuroscience & Clinical Practice
8:53	Basics of FUS for Neuromodulation
9:10	What Can Bring FUS to MRI & Vice Versa?
9:27	Clinical Applications of FUS/MRI

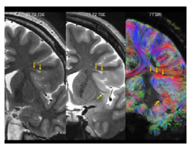
ISMRT Oral

Winning Clinical Oral Presentations

Hall 405E | Sunday 8:15 - 9:00 | *Moderators:* Ilse Patterson & Haidee Patterson

(no CME credit)

8:15



Combining 7T and 3T MRI in Epilepsy Diagnosis: A Collaborative Approach to Enhance Surgical Decision-Making

Vi Phan

Motivation: Epilepsy can be imaged at 3T utilizing typical imaging sequences, but improved quality and resolution can be achieved using 7T, enabling better detection of lesions and subsequently better chances of a successful treatment outcomes.

Goal(s): Provide higher quality images for patients with epilepsy on 7T.

Approach: 146 patients were evaluated for epilepsy using 7T MRI. Among these, 117 patients also had prior 3T MRI for comparison.

Results: Combining 3T and 7T MRI has demonstrated promise in improving the diagnostic and surgical decision-making process for epilepsy patients for our neurologists and neurosurgeons.

Impact: In conjunction with 3T imaging, our findings at 7T consistently detect a greater number of lesions in epilepsy patients, resulting in greater confidence in localizing and characterizing lesions that were questionable or not identified at 3T.

8:30

Effect of noise exposure during 7 Tesla MRI.

Linda Wennberg

Motivation: Ensuring the proper use of hearing protection during extensive scanning at a 7T system with high acoustic noise levels is crucial.

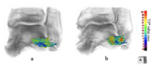
Goal(s): We investigate if MRI examinations have acute and/or persisting effects on the hearing even if hearing protection is used.

Approach: Otoacoustic emissions (OAE) were used to evaluate the effects of noise exposure after two MRI scanning sessions in a single day. OAE measurements were conducted prior to and after each scanning and with a one-week follow-up.

Results: We found no significant differences in outer hair cell function between the baseline measurement and the first MRI and the follow-up OAE measurement.

Impact: Research protocols at a 7T system often involve long scanning sessions using sequences with high acoustic noise levels. When hearing protection is adequately used, MRI scanning can be performed without effects on the participant`s hearing.

8:45 Quantitative assessment of the anterior talofibular ligament after arthroscopic repair using T2* values



Yoshihiro Akatsuka

Keywords:

Motivation: Although anterior talofibular ligament (ATFL) repair is commonly performed as part of chronic lateral ankle instability (CLAI) surgical treatment, there are no reports that quantitatively evaluate the repaired ATFL.

Goal(s): Our goal was to investigate longitudinal changes in T2* values within ATFL after primary ATFL repair.

Approach: We compared preoperative and 6 months postoperative T2* values of the ATFL using high-resolution T2* map images.

Results: There was a 118% change in the T2* value at 6 months after ATFL repair, including a 130% change on the fibular side.

Impact: These findings provide basic data to help understand the healing process after ATFL repair surgery and provide quantitative values may help predict recurrence and clinical outcomes.

Member-Initiated Session

Ultrahigh Spatial Resolution Imaging in the Presence of Motion

Room 325-326 Sunday 9:45 - 11:45

(no CME credit)

9:45 Motion Correction for Ultrahigh-Resolution Brain Imaging

10:09 Experiences Scanning Infants & Children in Cape Town

10:33 High-Resolution Functional Imaging (in the Presence of Motion)

10:57 Motion in the Spinal Cord? Influences, Strategies & Needs!

11:21 Prevention Is Better Than Cure? Approaches To Improve Head Stabilization for High-Resolution MRI

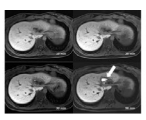
Weekend Course

Body Trauma: Scalpels, Seatbelts & Childbirth

Organizers: Nandita DeSouza, Mami Iima, Takeshi Yokoo

Summit 1 Sunday 10:00 - 11:40 *Moderators:* Chang Hee Lee

10:00 Hepatobiliary Trauma: Bilious Attack



Yon-Cheong Wong

Keywords: Body: Liver, Image acquisition: Visualization, Education Committee: Clinical MRI

Contrast-enhanced magnetic resonance cholangiography (CEMRC) utilizing gadoxetic acid disodium, a gadolinium-based MRI contrast agent, where approximately 50% is excreted by hepatocytes, proves advantageous in evaluating the biliary tree. Research has indicated that CEMRC not only detects post-traumatic bile leaks but also aids in characterizing their morphology. However, the duration for image acquisition can vary significantly, ranging from 20 to 180 minutes. In this presentation, the speaker will discuss the experience at Chang Gung Memorial Hospital regarding optimal CEMRC acquisition times, the feasibility of bile leak detection, and the characterization and significance of various types of bile leaks.

10:25 Breast Trauma: The Problem with Silicone

Chidi Nwachukwu

Keywords: Body: Breast

Motivation: This presentation seeks to contribute to the understanding of breast implant-related trauma.

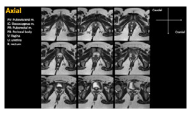
Goal(s): After reviewing this lecture, learners should be able to explain the different appearances of breast implant rupture and understand the differences in appearance across multiple modalities.

Approach: The content of this didactic is mainly presented in the form of cases detailing different aspects of implant-related trauma.

Results: Multiple cases with predominantly multimodality findings reviewing the sequelae of implant-related trauma are presented.

Impact: This didactic overall attempts to contribute to the body of available content detailing imaging findings characteristic of implant rupture.

10:50



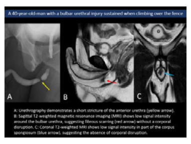
[Pelvic Floor Trauma: Hazards of Parturition]

Gigin Lin

Keywords: Body: Reproductive, Body: Body

This lecture explores the critical role of MRI in assessing postpartum pelvic floor trauma, crucial for improving women's postpartum quality of life. It discusses the challenges and advantages of using MRI in this context, highlighting the importance of accurate diagnosis and tailored treatment strategies. Through comprehensive discussion of pelvic floor anatomy, trauma types, and MRI sequences, supplemented by clinical case studies, it showcases MRI's superior diagnostic capabilities. The correlation between MRI findings and clinical symptoms underscores its value in guiding interventions. This talk encourages further research into optimizing MRI protocols, with potential benefits for postpartum care and women's health outcomes.

11:15



[Kidney & Bladder Trauma: Urine Trouble]

Yuki Arita

Keywords: Body: Urogenital, Body: Kidney, Body: Pelvis

Motivation: MRI's role in evaluating kidney and bladder trauma is growing due to its superior imaging capabilities.
Goal(s): To assess the current and future potential of MRI in diagnosing and managing urinary trauma.
Approach: Reviewing MRI sequences for trauma assessment, addressing limitations, and discussing technological advancements.
Results: MRI provides detailed imaging but is limited in acute settings. Technological improvements are addressing these challenges.
Impact: Enhanced MRI technology and artificial intelligence integration are expected to improve patient outcomes and healthcare efficiency in urinary trauma management.

Other

Diamond Sponsor: United Healthcare

Hall 406D | Sunday 12:30 - 12:45

(no CME credit)

Weekend Course

On the Run: Advanced MRI in Musculoskeletal Imaging

Organizers: Alissa Burge, Iman Khodarahmi, Feliks Kogan

Nicoll 1 | Sunday 13:15 - 17:00 | *Moderators:* Hamza Alizai & Akio Hiwatashi

13:15

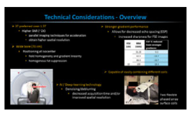
[Imaging of Synovitis: Techniques & Applications]

John Waterton

Keywords: Musculoskeletal: Joints, Musculoskeletal: Tendons, Contrast mechanisms: Contrast agents

Synovitis – inflammation of the synovial membrane – is important in several conditions including osteo- and rheumatoid arthritis. Gadolinium contrast-enhanced (CE) and dynamic contrast-enhanced (DCE) techniques are technically preferable, although non-contrast-enhanced techniques are emerging. Scoring systems provide ordered categorical biomarkers of extent of synovitis, and volume of enhancement also provides an extensive-variable biomarker. If intensity of inflammation is of interest, DCEMRI provides intensive-variable biomarkers based either on heuristics or on compartmental modelling. Choice of synovitis biomarker depends on context of use: prognostic or predictive biomarkers demand reproducibility while monitoring and response biomarkers demand repeatability and sensitivity to change.

13:40



[Still Nerve Racking? Updates on Peripheral Nerve MRI]

Philip Colucci

Keywords: Education Committee: Clinical MRI

Magnetic resonance imaging of peripheral nerves (MR neurography) is an important adjunct to electrodiagnostic testing. It is helpful for lesion localization and aids in preoperative planning, resulting in smaller incisions and reduced surgical time. Advances in coil design as well as acquisition and post-processing techniques have led to improved image quality with decreased acquisition time. The resultant increase in spatial resolution coupled with isotropic 3D imaging allows for more accurate diagnostic evaluation. As such, MR neurography is increasingly utilized as an important tool in clinical decision-making and the formulation of treatment strategies for peripheral nerve abnormalities.

14:05 Metal Madness: Imaging of Metal-Containing Body Parts
Kevin Koch

Keywords: Physics & Engineering: Implants, Image acquisition: Artefacts

Metal implants are commonly encountered in MRI and negatively impact image quality, causing artifacts that obscure anatomy and pathology. Artifacts are managed clinically through conventional sequence parameter optimization and advanced MRI methods. However, residual artifacts persist, limiting diagnostic value near implants. New multi-spectral imaging approaches leverage material properties to mitigate artifacts. Understanding artifacts and current clinical approaches sets the stage for discussion on these emerging techniques. Optimizing workflows requires recognizing implants' prevalence, artifacts' effects on MRI interpretation, applying specialized protocols to maximize diagnostic yield for critical evaluations near implants.

14:30 Stretch Your Legs: Quantitative & Functional Imaging of Muscle
Valentina Mazzoli

Keywords: Musculoskeletal: Skeletal, Contrast mechanisms: Microstructure

.

14:55 Break & Meet the Teachers

15:20 More Is Better: Multi-Transmit & Multi-Excite Musculoskeletal Imaging
Cem Deniz

Keywords: Physics & Engineering: High-Field MRI, Musculoskeletal: Joints

The use of high field strengths opened new venues for MR imaging of MSK tissues. In this educational lecture, we will focus on parallel transmission techniques that will overcome challenges associated with high field strengths. The audience will learn the basic principles of parallel transmission and its use in MSK applications.

15:45 Low-Field, High-Value: Updates on Musculoskeletal Applications of Low-Field MRI
Krishna Nayak

16:10 Real-Time MRI of Joint Motion
TBD

16:35 Imaging of Bone: Osteoporosis, Obesity & Metabolic Bone Disease
Marco Barbieri

Weekend Course

Classical & AI Methods for Image Recon: From Fundamentals to Translation

Organizers: Berkin Bilgic, Tolga Cukur, Yogesh Rathi

Nicoll 2 | Sunday 13:15 - 17:00 | *Moderators:* Yohan Jun & Lipeng Ning

13:15 Image Encoding in MRI & Bayesian Image Reconstruction
Suyash Awate

Keywords: Image acquisition: Image processing

This talk presents the fundamentals underlying magnetic resonance imaging, including various parallel-imaging schemes, and the fundamentals of (Bayesian) image reconstruction methods from subsampled multicoil k-space data.

13:40 Low-Rank Methods for MR Image Reconstruction
Fan Lam

Keywords: Image acquisition: Reconstruction

Low-rank models that exploit the intrinsic redundancy in multidimensional MR signals for image reconstruction from sparse, noisy, and/or corrupted data have been widely used. These models serve as effective constraints for high-dimensional imaging problems that arise in many applications, e.g., dynamic MRI, quantitative MRI, and spectroscopic imaging. This talk will review what low-rank models are, how low-rank structures emerge or can be purposely induced from multidimensional MR data, and how they may be used in image reconstruction. Potential synergy with recent deep learning based reconstruction approaches will also be discussed.

14:05 Frontiers in Image Recon: Rapid & Reproducible Quantitative MRI
Nan Wang

14:30 **Supervised Deep Learning for MRI Recon**
Thomas Kuestner

Keywords: Image acquisition: Reconstruction, Image acquisition: Machine learning

Motivation: See synopsis

Goal(s): See synopsis

Approach: See synopsis

Results: See synopsis

Impact: See summary of main findings

14:55 Break & Meet the Teachers

15:25 **Unsupervised Methods for Deep MRI Recon**
Dong Liang

Keywords: Image acquisition: Reconstruction

In recent years, deep learning has made significant advancements in MRI reconstruction. However, conventional methods often require full-sampled MRI data, presenting challenges in data acquisition. Consequently, unsupervised learning methods have garnered attention. This discussion delves into various unsupervised deep learning approaches for MRI reconstruction, including unpaired, self-supervised, and zero-shot (untrained) learning. Moreover, we foresee a promising future for unsupervised learning in MRI reconstruction, particularly in collaboration with large-scale foundation models, thereby facilitating further progress in MRI technology.

15:50 **Opportunities & Challenges in Clinical Translation**
Susie Huang

Keywords: Image acquisition: Reconstruction, Image acquisition: Fast imaging

This lecture will provide a brief overview of the considerations involved in the clinical translation of classical and artificial intelligence approaches to image reconstruction. The systematic evaluation and validation of new reconstruction methods will be discussed in the context of fast imaging methods for acquisition and reconstruction, with an emphasis on prioritizing image quality, minimizing artifacts, and maximizing diagnostic impact. A multidisciplinary, team-based approach with close collaboration between MRI physicists, engineers, data scientists, radiologists, and radiologic technologists is of paramount importance to ensure that new reconstruction methods are integrated seamlessly into the clinical workflow.

16:15 **Expectations from New DL Methods: How Can Academia Contribute?**
Mariya Doneva

Keywords: Image acquisition: Machine learning

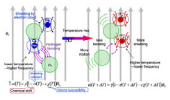
The collaboration between academia and industry is vital for advancing the research, translation, and practical implementation of new deep learning techniques for MR reconstruction. There are multiple ways in which academia can contribute, which will be discussed in this lecture.

16:40 Panel Discussion

Weekend Course
Brain Thermometry: MR Measurements, Modeling & Clinical Applications
Organizers: Seena Dehkharghani, Candace Fleischer

Nicoll 3 | Sunday 13:15 - 16:45 | *Moderators:* Megan Poorman & Dongsuk Sung

13:15 An Introduction to Thermoregulation in the Human Brain
Caroline Le Ster

13:45 How To Measure Brain Temperature Using MR

Kagayaki Kuroda

Keywords: Contrast mechanisms: Thermometry, Physics & Engineering: Interventional, Neuro: Brain

Different levels of techniques and accuracy should be adopted for MR thermometry. Proton resonance frequency (PRF) shift with phase mapping technique is suitable for monitoring brain thermal therapy using laser or high intensity focused ultrasound. For monitoring hypothermia therapy or for detecting ischemia and traumatic brain injury, PRF shift detected spectroscopically with internal reference such as NAA, chorine and creatine may help. However, careful consideration regarding variation of bulk susceptibility, distributions of electrolyte and macromolecules as well as status of pH should be made. The purpose of this lecture is to discuss thermometry techniques and the factors influencing temperature quantification.

14:15 Brain Thermal Modeling
J. Thomas Vaughan

14:45 Break & Meet the Teachers

15:15 Clinical Applications: Brain Cooling
Adam Goldman-Yassen

15:45 Clinical Applications: Brain Heating & Ablation
Henrik Odéen

16:15 Clinical Applications: Ischemia & TBI
Shunrou Fujiwara

Keywords: Neuro: Brain, Neuro: Cerebrovascular, Neuro: White matter

Brain temperature (BT) had traditionally been discussed whether it may be a simple parameter depending on body (core) temperature or it may regulate the neural activities. Recent reports with magnetic resonance (MR) imaging system demonstrated BT was strongly associated with the cerebral perfusion and metabolism in patients with ischemic change. Based on these results, we should refocus and reconsider on BT and the alteration mechanism using MR. Here, we reviewed BT measurement techniques with MR and discussed the pathologic conditions causing BT alteration relating to the cerebral perfusion and metabolism.

16:45 Adjourn & Meet the Teachers

Weekend Course
Advanced Cardiovascular MRI Techniques

Room 331-332 | Sunday 13:15 - 17:05 | *Moderators:* Andreas Schuster & Nicole Seiberlich

13:15 Regional Function & Strain
Frederick Epstein

13:40 Real-Time & Free-Breathing Techniques
Haikun Qi

Keywords: Cardiovascular: Cardiac function, Image acquisition: Fast imaging, Image acquisition: Reconstruction

Motivation: Real-time MRI can resolve cardiac and respiratory motion and has unique advantages for cardiac imaging. An overview of this active research area is necessary.

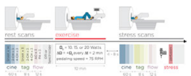
Goal(s): Introduce various reconstruction methods of accelerated real-time imaging and highlight its applications.

Approach: Undersampled real-time MRI reconstruction techniques improving the spatial-temporal resolution are covered, including k-t methods, parallel imaging, compressed sensing and low-rank methods, and recent advances that enable extreme acceleration.

Results: Real-imaging imaging has demonstrated superior performance in cardiac function evaluation, flow analysis, and tissue characterization, and MR-guided treatment.

Impact: The audience can grasp basic and advanced reconstruction techniques of real-time MRI and its potential applications.

14:05 **Cardiac MRI During Exercise**



Manuel Morales

Keywords: Cardiovascular: Cardiovascular

This educational talk presents an overview of cardiac MRI during exercise, highlighting its challenges and recent advancements. We explore technical specifications for optimal imaging during exercise and advancements in Ex-CMR sequences and image reconstruction techniques. The aim is to shed light on the complexities of capturing accurate cardiac images during physical stress and the potential of these techniques in diagnosing and managing cardiovascular diseases.

14:30 Multiparametric & Fingerprinting in Cardiac MRI: Everything All at Once

Claudia Prieto

14:55 Break & Meet the Teachers

15:25 **Cardiac MRI to Characterize Diastolic Function**

Masaki Ishida

Keywords: Cardiovascular: Cardiac, Cardiovascular: Cardiac function, Cardiovascular: Myocardium

Diastolic dysfunction, a significant contributor to HFpEF, presents a formidable diagnostic challenge due to its diverse etiologies and complex pathophysiology. While cardiac catheterization is currently considered the reference standard for assessing LV diastolic function, it has inherent limitations, notably its invasiveness. Cardiac MRI offers a range of non-invasive, objective, and reproducible measures of diastolic function, including ventricular and atrial volumes, myocardial strain, native T1 and ECV, 4D flow, and exercise real-time cine index. These advanced CMR techniques substantially enhance noninvasive and objective evaluation of diastolic function and refine clinical management strategies for patients with diastolic dysfunction and HFpEF.

15:50 **AI-Driven CMR**

Chen Qin

Keywords: Image acquisition: Machine learning, Cardiovascular: Cardiac

Artificial intelligence (AI) is making a significant impact on all aspects of cardiovascular magnetic resonance (CMR) imaging. In this talk, we will focus on discussing the recent development of DL in CMR imaging workflow, from the reconstruction of accelerated signals to automatic quantification of clinically useful information. Specifically, we will describe how DL methods can be used for reconstruction of accelerated dynamic cine CMR imaging. We will also show the utility of DL for CMR analysis, with a particular focus on CMR segmentation and motion tracking. Finally, we will briefly discuss about their current limitations, challenges, and future opportunities.

16:15 Radiomics in CMR

Reza Nezafat

16:40 **4D Flow MRI**

Susanne Schnell

Keywords: Cardiovascular: Hemodynamics, Contrast mechanisms: Flow, Image acquisition: Quantification

Phase-contrast MRI is an angiography technique that uses bipolar gradients to encode tissue or fluid motion into the MRI signal phase. If measured in 2D with 1-directional encoding this is termed 2D Phase-Contrast MRI. Extended to a time-resolved heart or pulse rate-triggered 3D sequence with 3-directional velocity encoding, this is termed 4D flow MRI. Error sources will be described throughout the course as well as data analysis and quantification approaches. Further extensions such as dual- and multi-venc, and 5D flow MRI will be described. Finally, applications in the thorax, head, and abdomen will be introduced.

Weekend Course

Breast MRI from Basics to Cutting-Edge Advances

Organizers: Nandita DeSouza, Mami Iima

Room 334-336 | Sunday 13:15 - 15:15 | *Moderators:* Min Sun Bae & Ritse Mann

13:15 **BI-RADS & More**

Maya Honda

Keywords: Body: Breast

The need for breast MRI is expanding to include its role as a screening method and as an adjunct to personalized and minimally invasive treatment. The next BI-RADS 6th edition will include several additional non-contrast MR methods, which can complement dynamic contrast-enhanced MRI to more accurately evaluate breast lesions and address expanding clinical needs. This talk will focus on the standard dynamic contrast-enhanced MRI as well as non-contrast sequences that will be published in BI-RADS 6th edition to take advantage of the new edition.

13:45	Harnessing AI for Advancements in Breast MRI Sarah Eskreis-Winkler	
14:15	DWI to Enhance Interpretation of Breast MRI Paola Clauser	

Keywords: Body: Breast, Contrast mechanisms: Diffusion, Cross-organ: Cancer

Breast magnetic resonance imaging (bMRI) plays a central role in breast cancer diagnosis and management. Diffusion weighted imaging (DWI) is a helpful additional tool for the characterization of bMRI enhancing lesions. Apparent diffusion coefficient (ADC) values vary depending on the lesion type, benign or malignant, and the information on ADC can aid in the differential diagnosis. Benign lesions typically present with a high ADC. Thus, the measurement of high ADC values in a lesion can safely rule out malignancy. ADC values also correlate with cancer aggressiveness, with more aggressive cancers presenting with lower ADC value.

14:45 Revolution of DCE: Abbreviated MRI & Ultrafast Imaging
Yiming Gao

Keywords: Body: Breast

Future directions in breast MRI aim not only to improve accuracy of breast cancer detection, but also to reduce barriers for wider adoption. Abbreviated breast MRI is gaining acceptance by way of reducing cost and increasing efficiency while maintaining diagnostic performance. Innovative techniques such as ultrafast imaging helps further enhance sensitivity and specificity of the MRI exam. In this session, we will discuss the clinical role and outcomes of abbreviated breast MRI, and explore potential advantages and limitations of ultrafast imaging as a part of the abbreviated protocol.

15:15 Break & Meet the Teachers

Weekend Course

Unveiling the Invisible: MRI's Potential Role in Assessing Child Abuse

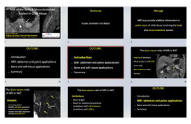
Organizers: Jonathan Dillman, Dan Wu

Summit 1 | Sunday 13:15 - 15:20 | *Moderators:* Taylor Chung & Mary-Louise Greer

13:15 Mechanisms, Medicolegal Issues & Reporting of Child Abuse
Harvey Teo

13:40 MRI of the Brain, Spinal Cord & Spine in Child Abuse
Rupa Radhakrishnan

14:05 MRI of the Body & Musculoskeletal System in Child Abuse
Jesse Courtier



Keywords: Body: Urogenital, Cross-organ: Pediatric, Musculoskeletal: Skeletal

Abuse-related trauma in children involving the abdomino-pelvic and musculoskeletal systems is unfortunately common, and MRI is uncommonly utilized as a primary modality in this setting. There are, however, specialized indications in which MRI can provide additional clinically-relevant information can that impact management. These indications include assessment of pancreatic / pancreatic duct injury, sequela of pelvic inflammatory disease, and genital trauma. Musculoskeletal and soft tissue injuries and their extent can also be well documented using MRI. MRI can provide a complementary role in these types of indications.

14:30 Role of Whole-Body & Post-Mortem MRI in Child Abuse
Teresa Victoria

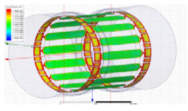
14:55 Break & Meet the Teachers

Weekend Course

MR Engineering II: RF Engineering

Organizers: Maria Engel, Shaoying Huang, Özlem Ipek, Xiaoliang Zhang

Summit 2 | Sunday 13:15 - 17:10 | *Moderators:* Gregor Adriany & Lena Nohava

13:15 

Volume & Surface Coils for Low- & High-Field MR
Ed Boskamp

Keywords: Physics & Engineering: Hardware

Motivation: This course is intended for engineers and physicists who want to design RF coils

Goal(s): After this course you will be able to make simple transmit and receive coils for low and high field

Approach: We will review design requirements for low and high field Tx and Rx coils, SNR, SAR, EM field-tissue interaction, decoupling

Results: High field and low field require very different designs

Impact: Coil designers will appreciate the differences in low and high field RF coil designs and will understand the difference in design requirements

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13:45 Multi-Transmit RF Coils
Xiao-Yong Zhang

14:15 

Preclinical MR Coil Design
Ernest WH Wong

Keywords: Physics & Engineering: Hardware, Physics & Engineering: Preclinical MRI

The objective of this course is to give the audience a basic understanding of vary technologies used in preclinical MR RF coil design so that they are able to pick the right tools for their researches.
In this course, four common sensitivity enhancement approaches in coil design will be mentioned. The basic principle, the advantages and the limitations within the preclinical MR domain will be discussed. Typical coil types using these approaches will be listed. Also two measurement-speed enhancement approaches and multiple-nuclei RF coil design will be discussed.

14:45 Break & Meet the Teachers

15:15 Receive Coil Arrays & SNR
Ye Li

Keywords: Physics & Engineering: Hardware

The receive coil array plays a crucial role in MRI systems, allowing for the reception of MR signals detected from objects. The receive coil array consists of multiple decoupled coil elements that acquire MR signals simultaneously. The performance of receive coil arrays is critical for signal-to-noise ratio, coverage and parallel imaging capability. This presentation aims to introduce element optimization, decoupling methodologies and integration of RF components such as T/R switches, detuning circuits, baluns, etc..

15:45 Multi-Nuclei Coil Design
Nikolai Avdievich

Keywords: Physics & Engineering: Hardware

Motivation: X-nuclei (^{13}C, ^{31}P, ^{19}F etc) MRI and spectroscopy are of great interest since these methods provide a non-invasive technique to study in-vivo metabolite changes due to various diseases.

Goal(s): To provide anatomical landmarks for interpretation of X-nuclei spectroscopic data, ^{1}H anatomical images are required.

Approach: To eliminate uncertainties associated with repositioning the patient, the RF coil must also resonate at the ^{1}H frequency. This technique is called double-tuning (DT) of the RF coils.

Results: The choice of DT design is determined by the requirements of a specific application. Various methods of constructing DT RF surface coils, volume coils, and phased arrays are discussed.

Impact: RF engineers, scientists and students interested in development, construction and usage of double-tuned RF MRI coils for X-nuclei spectroscopic studies can benefit from this presentation.

16:15 Hands-On Workshop on RF Coils
Joe Li

Member-Initiated Session
Recent Progress on Open-Source Low-Field Portable MRI

Room 325-326 Sunday 13:15 - 15:15

(no CME credit)

13:15	Opening
13:25	Recent Research & Development in Open-Source (Very-)Low-field MRI
13:40	Open Source for Magnet Designs
13:55	Open-Source RF Coil Designs
14:10	MaRCoS: An Open-Source Console
14:25	Open-Source Tools for Designing MRI Gradient Coils
14:40	Panel Discussion and Q&A
15:10	Closing

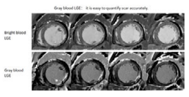
ISMRT Oral

President's Abstract Winner & JAK Award Presentations

Hall 406D Sunday 14:00 - 14:15

(no CME credit)

14:00 Gray blood late gadolinium enhancement based on phase-sensitive inversion recovery for improved detection of myocardial scar and cardiac mass



Jie Zhao

Motivation: During magnetic resonance imaging for myocardial viability, the bright blood within the heart chambers can significantly diminish the apparent volume of myocardial scars or obscure the visualization of cardiac masses.

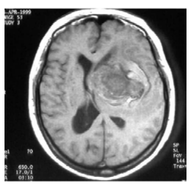
Goal(s): An imaging technique that can reduce the signal from the blood pool and highlight the signal of the scar tissue or cardiac masses is needed to increase diagnostic accuracy.

Approach: Subjects are randomized to undergo gray blood and bright blood late gadolinium enhancement (LGE) imaging using phase-sensitive inversion recovery technique to compare the diagnostic differences for scar tissue or cardiac masses.

Results: Gray blood LGE reveals more myocardial scars or cardiac masses.

Impact: Gray blood LGE enhances the detection of myocardial scars and intracavitary cardiac masses, especially those showing enhancement after contrast injection, facilitating clinical decisions and improving patient outcomes. Additionally, the PSIR-based gray blood approach offers greater adaptability and ease of use.

14:07 The role of magnetic resonance in the diagnosis of intracranial berry aneurysm: A case report



KARIM Abdul RASHID

Keywords:

Motivation: Headaches associated with intracranial aneurysms are often misdiagnosed and poorly understood in the Ghanaian population.

Goal(s): Our goal was to use gadolinium-enhanced MR angiography to radiologically describe features of intracranial berry aneurysm (IBA) in a clinically asymptomatic patient presenting with right-sided headaches.

Approach: Axial, sagittal and coronal brain MR angiography was conducted with 50 mg/ml gadolinium contrast and radiologically evaluated.

Results: A right posterior communicating artery aneurysm was found, suggesting compression of the oculomotor nerve which is characteristic of IBA.

Impact: The imaging findings could help physicians to better understand, diagnose and treat the underlining causes of constant right-sided headaches which may otherwise be poorly managed by patients themselves through self-medication as is the current practice in the Ghanaian setting.

Member-Initiated Session

MRI Standards & Metrology: From Pulse Sequence to Measurement to Interpretation

Room 325-326 Sunday 15:15 - 17:15

(no CME credit)

15:15	The Current State of Standardization & Metrology in MRI I
15:32	The Current State of Standardization & Metrology in MRI II
15:49	An Overview of Clinical Quantitative Biomarkers
16:06	Deep Dive: Diffusion
16:23	Deep Dive: Quantitative MRI in Radiation Oncology & MR-Guided Radiotherapy
16:40	Reference Pulse Sequences
16:57	The Need for MRI Standards & Quantification from a Radiologist Perspective

Weekend Course

From Cradle to "Gray": Imaging of Trauma Across a Lifespan

Organizers: Dan Ma, Khin Tha

Summit 1 | Sunday 15:20 - 17:00 | *Moderators:* Elizabeth George & Tomiyasu Moyoko

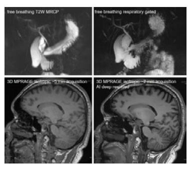
15:20 Imaging Protocols for Very Young Children: From Neonates to Toddlers

Susan Palasis

Keywords: Neuro: Brain, Cross-organ: Pediatric

This talk will address the importance of understanding brain maturation to devise diagnostic protocols in neonates and infants. We will discuss basic brain maturational processes seen on neuroimaging from birth to 2 years of age, alongside the risks and limitations of MR. The technique used to minimize motion and avoid sedation during MR examinations will be presented. Brain imaging protocols in this age group need to be targeted to reveal pathology within the immature brain while being mindful of scanner time. Examples of how the specific sequences allow us to detect abnormalities, especially in the trauma setting, will be shown.

15:45 Minimizing Patient Motion



Suraj Serai

Keywords: Image acquisition: Motion correction, Image acquisition: Fast imaging

Emerging MRI motion reduction techniques have promising potential to substantially improve image quality and reduce scan time as well as allow free-breathing acquisition. Motion-reducing free-breathing MRI protocols allow the imaging of pediatrics and geriatrics while they are awake or distracted using movie goggles or other audio-video options. These emerging imaging techniques are suitable for use with certain MR pulse sequences, acquisition planes, age groups, and for specific situations. They also have the potential to decrease exposure to sedation and to paralytics used during intubation and ventilation for patients requiring anesthesia by reducing the scan time and minimizing the motion artifacts.

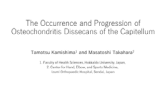
16:10 Imaging the Evolution of Brain Tissue Properties & Neuroplasticity Across the Human Lifespan

Weili Lin

Keywords: Neuro: Brain, Neuro: Brain function, Neuro: Brain Connectivity

Extensive efforts have recently focused on creating comprehensive brain charts spanning the human lifespan. These endeavors are driven by the significance of this line of research, the availability of several comprehensive large-scale biomedical databases, and the development of novel tools capable of harmonizing images acquired from various MRI scanners across multiple vendors and imaging parameters. In this presentation, we will explore critical aspects of lifespan imaging studies, covering study designs, data analysis tools, and recent key findings. Since the approaches for adult studies have been well-established, we will focus on essential considerations when imaging non-sedated pediatric subjects.

16:35 The Occurrence and Progression of Osteochondritis Dissecans of the Capitellum



Tamotsu Kamishima

Keywords: Musculoskeletal: Joints

We defined early-onset osteochondritis dissecans (OCD) as occurring at age < 12 years, with skeletal maturity < 15 points, and onset within < 1 month. For five cases meeting these criteria, we aim to chronologically observe imaging changes in early-onset OCD and discuss its early pathologies based on MRI findings. Early-onset OCD is presumed to involve loading pressure on the chondral tissue, leading eventually to the influx of synovial fluid/cells into the subchondral bone marrow, deterioration of the subchondral trabeculae, and progression to subchondral bone cysts or sclerosis. The presence of intraarticular ossification complicates the interpretation of findings.

Plenary Session
Opening Plenary

Plenary Hall (Hall 603-604) | Sunday 17:20 - 18:30

17:20 Welcome
Derek Jones

17:45 Lauterbur Lecture Accessible MRI: No Surrender
Andrew Webb

Monday, 06 May 2024

Go to top

Sunrise Course
Cardiology for Physicists: Measure What Matters

Organizers: Michael Atalay, Teresa Correia, Tarique Hussain, Christopher Nguyen, Hajime Sakuma, Andrew Scott, Tobias Wech

Hall 606 | Monday 7:00 - 8:00 | *Moderators:* Tevfik Ismail & Mayil Krishnam

7:00 Outcomes: A Discussion for Ischemic Heart Disease
Marcus Chen

7:30 Outcomes: A Discussion for Non-Ischemic Heart Disease
Jeremy Collins

Sunrise Course
Absolute Beginner's Guide to Diffusion Imaging

Organizers: Sune Jespersen, Sila Kurugol, Shaihan Malik, Henrik Odéen, Yasuhiko Tachibana, Cristian Tejos, Richard Thompson

Nicoll 2 | Monday 7:00 - 8:00 | *Moderators:* Cemre Ariyurek & J-Donald Tournier

7:00 Diffusion: Fundamentals
Onur Afacan

7:30 Diffusion: Clinical Applications
Hong-Hsi Lee

Sunrise Course
AI for Improved Patient Care: Game or Game-Changer?

Organizers: Nandita DeSouza, Takeshi Yokoo

Nicoll 3 | Monday 7:00 - 8:00 | *Moderators:* Martin Graves & Steven Shea

7:00 AI for Image Reconstruction
Marcel Nickel

7:20 Language Models: Help or Hindrance?
Ito Rintaro

7:40 AI for Data Acquisition & Image Segmentation
Indrani Bhattacharya

Sunrise Course
Unlocking Productivity & Impact in Teaching & Publishing I

Organizers: Agah Karakuzu, Shin-Lei Peng

Room 325-326 | Monday 7:00 - 8:00 | *Moderators:* Jun Hua & Feng Xu

7:00 Tips for Preparing & Delivering a PowerPoint Presentation Effectively
Zixuan Lin

7:30 Online Teaching: How To Effectively Capture Students' Attention
Chia-Feng Lu

Sunrise Course
All About Head & Neck: Hemorrhage, Stroke & Beyond I: Imaging of Non-Hemorrhagic Stroke
Organizers: Wei-Tang Chang, Seena Dehkharghani, Xiao-Qi (Juliana) Huang

Room 331-332 | Monday 7:00 - 8:00 | *Moderators:* Susie Huang & Jae Song

7:00 Clinical Indications & MRI Markers of Acute Ischemic Stroke
Binbin Sui

7:30 MRI Characterization of In Vitro Clots at 3T & 7T
Su Lui

Sunrise Course
Quantification & Analysis: Relaxation
Organizers: HyungJoon Cho, Rita Nunes, Khin Tha, Mingming Wu

Room 334-336 | Monday 7:00 - 8:00 | *Moderators:* Mariya Doneva & Ji Eun Park

7:00 Relaxometry: Technical Considerations
Martina Callaghan

7:30 Relaxometry: Application to Brain Disorders
Akifumi Hagiwara

Sunrise Course
Inside the Backbone: Exploring Spine & Spinal Cord Trauma with MRI
Organizers: Alissa Burge, Iman Khodarahmi

Summit 1 | Monday 7:00 - 8:00 | *Moderators:* Young Han Lee & Marta Switlyk

7:00 MRI in Spinal Cord & Nerve Root Injuries
In Sook Lee

7:20 MRI in Osseous & Ligamentous Spine Injuries
Asako Yamamoto

7:40 Advanced MRI Techniques in Spine Trauma
Ann Choe

Sunrise Course
Surprising Aspects of MRI Physics: What Would MacGyver Do To Detect Motion & Frequency Shifts?
Organizers: Brian Hargreaves, Shaoying Huang, Rita Schmidt, Rolf Schulte, Ramesh Venkatesan, Andrew Webb

Summit 2 | Monday 7:00 - 8:00 | *Moderators:* Barbara Dymerska & Brian Rutt

7:00 RF Coils as Respiratory & Motion Sensor: Pilot Tone
Peter Speier

7:30 Mapping B0 Fluctuations from Inconsistencies in the Coils Sensitivities
Klaas Pruessmann

Study Group Business Meeting
Electro-Magnetic Tissue Properties Business Meeting

Room 303-304 | Monday 8:15 - 9:15

(no CME credit)

Study Group Business Meeting

Reproducible Research Business Meeting

Room 324 | Monday 8:15 - 9:15

(no CME credit)

Other

Democratising MRI: Maximising Impact in Low-Resource Settings

Room 325-326 | Monday 8:15 - 10:15 | *Moderators:* Ernesta Meintjes & Godwin Ogbole

(no CME credit)

8:15 Establishing Radiology Residency in Malawi

Karen Chetcuti[1], Katrina McGinty[2]

1, 2

8:40 Training Future Leaders in Radiography

Sekinat Aderibigbe[1], Cowles Chilungulo[2], Shawna Farquharson[3], Karabo Mokay[4], Jackline Thairu[5]

1, 2, 3, 4, 5

9:05 Enhancing Radiology Readiness

Joe Weygand

9:30 Lessons Learned from the Democratization of Ultrasound

Kristen de Stigter

9:55 Panel Discussion / Q&A

10:05 Meet the Speakers

Weekday Course

ISMRM-ISMRT Joint Forum: Navigating MRI Safety After Trauma

Organizers: Kate Negus

Summit 1 | Monday 8:15 - 9:55 | *Moderators:* Sony Boiteaux & Ji Eun Park

8:15 Safety Aspects of Trauma Patients Undergoing Neuroimaging

Sumeet Kumar[1]

[1]*National Neuroscience Institute, Singapore*

8:35 Safe Imaging in Patients from the Intensive Care Unit

Weiling Lee[1]

[1]*Singapore General Hospital*

8:55 The never-ending quest for faster MRI: common methods to reduce scan time and what to expect

Emre Kopanoglu[1]

[1]*CUBRIC, Psychology, Cardiff University, Cardiff, United Kingdom*

Keywords: Image acquisition: Fast imaging, Transferable skills: Safety

We will discuss various ways to accelerate MRI scans in clinical settings such as partial Fourier, parallel imaging, and compressive sensing. We will elaborate on the main advantages and disadvantages of each approach. Then, we will explore some of the safety concerns in MRI that impact scan duration, in order to uncover indirect ways to reduce scan time further. We will expand the safety discussion towards the presence of implants, discussing implant safety definitions and their implications for scanning. We will also examine the effect of metallic implants on image quality and describe some techniques to reduce such effects.

9:15 Safety Aspects of Trauma Patients Undergoing Musculoskeletal Imaging

TBD

9:35 MRI Safety with External Fixation Device: A Case Study

Kate Negus[1]

[1]*Barwon Medical Imaging, University Hospital Geelong, Geelong, Australia*

I will present a case study of the safety procedure conducted to assess if a patient with an external fixation device was safe to scan in MRI

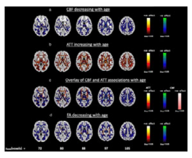
9:55 Q&A

Oral

Young Investigator Awards: Oral Presentations

Summit 2 | Monday 8:15 - 10:15 | *Moderators:* Pablo Irarrazaval

0001 8:15 MRI Assessment of Cerebral White Matter Microvascular Hemodynamics Across the Adult Lifespan



Nikou L. Damestani[1,2], John Jacoby[1], Christa B. Michel[1], Barnaly Rashid[1,3], David H. Salat[1,2,4], and Meher R. Juttukonda[1,2]

[1]*Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States,* [2]*Department of Radiology, Harvard Medical School, Boston, MA, United States,* [3]*Department of Neurology, Harvard Medical School, Boston, MA, United States,* [4]*Neuroimaging Research for Veterans Center, VA Boston Healthcare System, Boston, MA, United States*

Keywords: YIA, White Matter

Motivation: The mechanisms underlying age-related structural neurodegeneration are not well understood, limiting our knowledge of atypical versus typical aging.

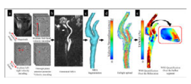
Goal(s): Our goal was to use data involving advanced hemodynamic and structural MRI techniques tailored to white matter to characterize the aging process.

Approach: We used data from a large cohort of the Human Connectome Project in Aging to investigate the relationship between brain blood flow and white matter tract microstructural integrity.

Results: We found strong relationships between white matter hemodynamics and tract integrity that were affected by both age and sex.

Impact: These findings could reveal potential underlying physiological mechanisms behind structural changes during typical aging. This could help us understand healthy brain aging and encourage future research to target hemodynamic biomarkers to understand neurodegeneration.

0002 8:30 Assessment of Complex Flow Patterns in Patients with Carotid Webs, Patients with Carotid Atherosclerosis, and Healthy Subjects Using 4D Flow MRI



Retta El Sayed[1], Charlie C Park[2], Zahraw Shah[1], Fadi B Nahab[3], Diogo C. Haussen[3], Jason Allen[3], and John N Oshinski[1]

[1]*Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, United States,* [2]*Department of Radiology & Imaging Sciences, Emory University, Atlanta, GA, United States,* [3]*Department of Neurology, Emory University, Atlanta, GA, United States*

Keywords: Flow, Blood vessels, 4D Flow MRI

Motivation: The motivation of this work is to understand the hemodynamics parameters in subjects with carotid web (CaW), atherosclerosis subjects with similar luminal narrowing, and normal subjects using 4D Flow MRI.

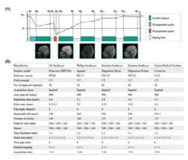
Goal(s): The main goal of this work is to quantify parameters related to vascular dysfunction including wall shear stress (WSS) and oscillatory shear index (OSI).

Approach: 4D Flow MRI was utilized to prospectively scan subjects with CaW and hemodynamic parameters were compared to subjects with mild atherosclerosis and healthy volunteers.

Results: The results show that subjects with CaW have larger regions of complex blood flow represented by low WSS and high OSI.

Impact: This study improves our understanding of disturbed hemodynamics caused by CaWs in comparison to atherosclerosis, which may explain the mechanism of thrombus formation and lay the groundwork for stroke risk assessment in patients with CaW.

0003 8:45



[Cross-Vendor Multiparametric Mapping of the Human Brain Using 3D-QALAS: A Multicenter & Multivendor Study]

Shohei Fujita[1,2,3,4], Borjan Gagoski[4,5], Ken-Pin Hwang[6], Akifumi Hagiwara[1], Marcel Warntjes[7,8], Issei Fukunaga[1], Wataru Uchida[1], Yuya Saito[1], Towa Sekine[1], Rina Tachibana[1], Tomoya Muroi[1], Toshiya Akatsu[1], Akihiro Kasahara[2], Ryo Sato[2], Tsuyoshi Ueyama[2], Christina Andica[1,9], Koji Kamagata[1], Shiori Amemiya[2], Hidemasa Takao[2], Yasunobu Hoshino[10], Yuji Tomizawa[10], Kazumasa Yokoyama[10], Berkin Bilgic[3,4,11], Nobutaka Hattori[10], Osamu Abe[2], and Shigeki Aoki[1]

[1]Department of Radiology, Juntendo University, Tokyo, Japan, [2]Department of Radiology, The University of Tokyo, Tokyo, Japan, [3]Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [4]Department of Radiology, Harvard Medical School, Boston, MA, United States, [5]Fetal Neonatal Neuroimaging and Developmental Science Center, Boston Children's Hospital, Boston, MA, United States, [6]Department of Imaging Physics,, MD Anderson Cancer Center, Houston, TX, United States, [7]SyntheticMR, Linköping, Sweden, [8]Center for Medical Imaging Science and Visualization (CMIV), Linköping University, Linköping, Sweden, [9]Faculty of Health Data Science, Juntendo University, Chiba, Japan, [10]Department of Neurology, Juntendo University, Tokyo, Japan, [11]Harvard/MIT Health Sciences and Technology, Cambridge, MA, United States

Keywords: YIA, Neuro

Motivation: To address the unmet need for a cross-vendor, multiparametric technique to facilitate data pooling across sites.

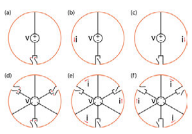
Goal(s): To evaluate a vendor-standardized multiparametric mapping scheme based on 3D-QALAS for whole-brain T1, T2, and proton density (PD) mapping.

Approach: Intra-scanner repeatability and inter-vendor reproducibility were evaluated in vivo on five different 3T systems from four vendors (GE, Philips, Siemens, and Canon). Patients with multiple sclerosis were scanned on systems from different vendors to assess the feasibility of the scheme in real-world clinical settings.

Results: 3D-QALAS provided T1, T2, and PD with coefficient of variations <4.0% using 3T scanners from different manufacturers.

Impact: The four major vendors used in this study constitute a considerable portion of the global installation base, demonstrating the value of cross-vendor quantitative technique 3D-QALAS for imaging in clinical sites with multiple vendors, as well as in multicenter research settings.

0004 9:00



[Any-nucleus Distributed Active Programmable Transmit Coil]

Victor Han[1], Charlie P. Reeder[1], Miriam Hernández-Morales[1], and Chunlei Liu[1]

[1]University of California, Berkeley, Berkeley, CA, United States

Keywords: Non-Array RF Coils, Antennas & Waveguides, Non-Proton, Multinuclear, RF coil, X-nuclei

Motivation: There are 118 elements. Nearly all elements have NMR active isotopes and 39 different nuclei have been shown to have biological relevance. Despite this, most of today's MRI is based on only one nucleus – ^{1}H.

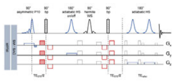
Goal(s): To significantly reduce the cost and complexity of imaging all potential nuclei.

Approach: We present the Any-nucleus Distributed Active Programmable Transmit Coil (ADAPT Coil), with fast switches integrated into the coil itself which allows it to selectively excite any nucleus using digital controls.

Results: Using the ADAPT Coil, we acquired ^{1}H, ^{23}Na, ^{2}H, and ^{13}C phantom images and ^{1}H and ^{23}Na ex vivo images at 3T.

Impact: The ADAPT Coil enables arbitrary nucleus excitation in high field MRI, significantly reducing the cost and technological barriers of clinical translation of X-nuclei research. X-nuclei benefits include improved early diagnosis and treatment evaluation for cancer, osteoarthritis, Alzheimer's, and many more.

0005 9:15



Diffusion-Weighted SPECIAL Improves the Detection of J-Coupled Metabolites at Ultrahigh Magnetic Field

Jessie Mosso[1,2,3], Dunja Simicic[2,3], Bernard Lanz[2,3], Rolf Gruetter[1], and Cristina Cudalbu[2,3]

[1]LIFMET, EPFL, Lausanne, Switzerland, [2]CIBM Center for Biomedical Imaging, Lausanne, Switzerland, [3]Animal Imaging and Technology, EPFL, Lausanne, Switzerland

Keywords: YIA, Diffusion/other diffusion imaging techniques, Diffusion-weighted MR spectroscopy, rodent brain, high field, SPECIAL, glutamine, J-coupled metabolites

Motivation: Diffusion-weighted MR spectroscopy (dMRS) uniquely probes cell-specific tissue microstructure in vivo but most sequences suffer from long TE leading to signal loss by J-evolution and T_2 relaxation.

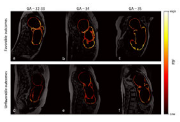
Goal(s): To propose an alternative dMRS sequence (DW-SPECIAL) with a shorter TE while preserving the benefits of the current gold-standard rodent sequence at high field (STE-LASER).

Approach: DW-SPECIAL was tested *in vivo* in the rat brain and compared to STE-LASER.

Results: DW-SPECIAL halved the minimum TE while reducing specific absorption rate compared to STE-LASER, thereby 1) improving the J-coupled metabolites' diffusion properties estimation and 2) offering a new candidate sequence for human dMRS.

Impact: With its shorter TE, our newly proposed DW-SPECIAL can serve as an alternative to STE-LASER when strongly J-coupled metabolites like glutamine are investigated, thereby extending the range of accessible metabolites in the context of diffusion-weighted MRS acquisitions at high field.

0006 9:30



Fetal MRI-based body and adiposity quantification for small for gestational age perinatal risk stratification

Aviad Rabinowich[1,2,3], Netanell Avisdris[1,4], Bossmat Yehuda[1,5], Ayala Zilberman[3,6], Tamir Graziani[2,3], Bar Neeman[2,3], Bella Specktor-Fadida[4], Dafna Link-Sourani[1], Yair Wexler[7], Jacky Herzlich[3,8], Karina Krajden Haratz[3,6], Leo Joskowicz[4,9], Liat Ben Sira[2,3], Liran Hiersch[3,6], and Dafna Ben Bashat[1,3,5]

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Keywords: YIA, Fetus

Motivation: Small for gestational age (SGA) fetuses are undernourished and at higher risk for adverse outcomes; however, conventional assessment methods exhibit limited sensitivity.

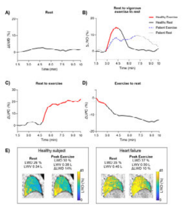
Goal(s): To stratify perinatal risk using MRI-based body composition metrics.

Approach: TruFISP and 2-points Dixon images were used to compute the total fetal volume (TFV), fat-to-body volume ratio (FBVR) and adipose tissue fat signal fraction (FSF) using deep-learning segmentation.

Results: SGA fetuses (N=40) with lower FBVR were more likely to require obstetric interventions because of non-reassuring status, while those with reduced TFV were prone to adverse neonatal outcomes. The model's sensitivity/specificity rates are 85.7%/87.5% and 82.35%/86.4%, respectively.

Impact: Quantifying fetal body composition through MRI can offer additional insights into the severity of small for gestational age complicated pregnancies and may help in stratifying perinatal risk.

0007 9:45 [Dynamic lung water magnetic resonance imaging during exercise stress]



Felicia Seemann[1], Ahsan Javed[1], Jaffar M Khan[1], Christopher G Bruce[1], Rachel Chae[1], Korel Yildirim[1], Amanda Potersnak[1], Haiyan Wang[1], Scott Baute[1], Rajiv Ramasawmy[1], Robert J Lederman[1], and Adrienne E Campbell-Washburn[1]

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Keywords: YIA, Data Acquisition, Acquisition & Analysis, Body, Lung, Lung water, Heart failure, Translational Studies

Motivation: Quantification of lung water during exercise is of interest for early diagnosis of heart failure.

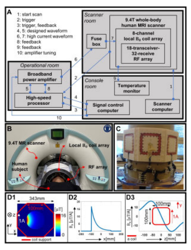
Goal(s): To develop a time-resolved 3D MRI method to quantify lung water in transitions between rest and exercise.

Approach: We derive quantitative time-resolved lung water density (LWD) maps using a motion corrected sliding-window image reconstruction. We included 12 healthy controls and 2 patients with heart failure, and a porcine model of mitral regurgitation (n=5).

Results: We measured a peak exercise ΔLWD=16±6.8% in controls, but detected no changes during rest (ΔLWD=-1.4±3.5%, p=0.18). Accumulation rates were slower in patients (2.0±0.1%/min) vs controls (2.6±0.9%/min). Animals developed ΔLWD=3.3±1.5%.

Impact: Exercise-induced changes in lung water can be dynamically quantified using a continuous 3D MRI acquisition with a sliding-window and motion corrected image reconstruction, which may have clinical utility in unmasking latent heart failure at early stages of disease.

0008 10:00 [Accelerated 2D Cartesian MRI with an 8-channel local B0 coil array combined with parallel imaging]



Rui Tian[1], Martin Uecker[2,3,4,5], Mathias Davids[6,7], Axel Thielscher[8,9], Kai Buckenmaier[1], Oliver Holder[1], Theodor Steffen[1], and Klaus Scheffler[1,10]

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Keywords: YIA, Hybrid & Novel Systems Technology, Physics & Engineering, Acquisition & Reconstruction, New Trajectories & Spatial Encoding Methods, Acquisition Methods, nonlinear gradient

Motivation: The inherently slow MRI scans can be accelerated through rapid modulation of nonlinear gradient fields; however, its fundamental mechanisms and limits remain incompletely understood and validated.

Goal(s): We investigate accelerated MRI with flexible modulations of nonlinear B_0 fields using a custom-built local B_0 array.

Approach: The sampling theory is extended to rigorously compare nonlinear field modulation schemes in a quantitative k-space. A novel field calibration technique is proposed to enhance reconstruction. With safety evaluations, we perform in-vivo accelerated scans.

Results: Our in-vivo 2D FLASH scans make significant steps to speed up MRI with local B_0 array, achieving eight-fold joint acceleration with parallel imaging.

Impact: For the first time, the sampling efficiency of nonlinear gradients in the entire k-space is quantitatively visualized, allowing rigorous comparison of distinct B_0 modulations. Furthermore, the field estimation technique enables fast and robust in-vivo scans accelerated by flexible nonlinear fields.

Oral
AI/ML-Driven Reconstruction Techniques for Dynamic MRI

Hall 606 | Monday 8:15 - 10:15 | *Moderators:* Thomas Küstner & Chen Qin

8:15 Introduction

Thomas Küstner
University Hospital Tuebingen, Germany

0009 8:27

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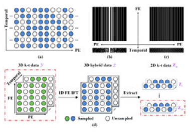


[Cardiac Cine MRI with Dimension-Reduced Deep Separable Spatiotemporal Learning]

Zi Wang[1], Yirong Zhou[1], Chengyan Wang[2], Di Guo[3], and Xiaobo Qu[4]

[1]Xiamen University, Xiamen, China, [2]Fudan University, Shanghai, China, [3]Xiamen University of Technology, Xiamen, China, [4]Department of Electronic Science, Xiamen University, Xiamen, China

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, Cardiovascular MRI

Motivation: Cardiac cine MRI reconstruction is a natural high-dimensional problem that poses great challenges to deep learning.

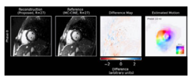
Goal(s): To develop a new deep learning method that can work efficiently in cardiac cine MRI, even with limited training data.

Approach: In this work, the proposed method DeepSSL significantly alleviates training and generalization challenges of deep learning in cardiac cine MRI through efficient dimension-reduced separable learning and spatiotemporal modeling.

Results: Extensive results show that DeepSSL can work efficiently even with highly limited training data (5~10 cases), and provides state-of-the-art reconstructions while reduces data demand by up to 75%. It further shows robustness in prospective real-time MRI.

Impact: The proposed deep separable spatiotemporal learning (DeepSSL) significantly alleviates the training and generalization challenges of deep learning in high-dimensional cardiac cine MRI through efficient dimension-reduced separable learning and spatiotemporal modeling.

0010 8:39



[Rapid Motion Estimation and Motion-Corrected End-to-End Deep Learning Reconstruction for 1 Heartbeat CINE]

Thomas James Fletcher[1], Lina Felsner[1], Andrew Phair[1], Gastão Cruz[2], Haikun Qi[3], René Botnar[1,4,5,6,7], and Claudia Prieto[1,5,6]

[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Department of Radiology, University of Michigan, Ann Arbor, MI, United States, [3]School of Biomedical Engineering, ShanghaiTech University, Shanghai, China, [4]Instituto de Ingeniería Biológica y Médica, Pontificia Universidad Católica de Chile, Santiago, Chile, [5]Escuela de Ingeniería, Pontificia Universidad Católica de Chile, Santiago, Chile, [6]Millenium Institute for Intelligent Healthcare Engineering iHEALTH, Santiago, Chile, [7]Institute of Advanced Study, Technical University of Munich, Munich, Germany

Keywords: AI/ML Image Reconstruction, Cardiovascular

Motivation: Cardiac CINE provides dynamic images of the heart for morphology and function assessment. Single-heartbeat CINE enables faster acquisition times and the study of heart rate variations, but conventional reconstruction methods incur significant computational cost.

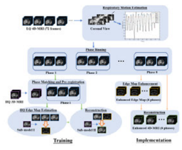
Goal(s): This study aims to speed up single-heartbeat CINE reconstruction by using deep learning reconstruction.

Approach: We propose a novel, rapid, end-to-end deep learning pipeline for motion estimation and motion-corrected single-heartbeat CINE reconstruction with golden-angle radial acquisition.

Results: The network reconstructs each CINE slice in ~40 seconds (400 times faster than state-of-the-art), with comparable image quality, achieving SSIM values ranging from 0.75 to 0.84 across cardiac phases and slices.

Impact: The proposed approach enables reconstruction of single-heartbeat golden-angle radial CINE acquisition in ~40 seconds, making it clinically feasible. Single-heartbeat CINE could reduce scan times, achieve acquisitions of multiple slices in a single breath-hold and be robust to heart rate variations.

0011 8:51



A Temporal-compensated Structure-preserving Enhancement Network (Tco-SEN) for Abdominal Four-dimensional Magnetic Resonance Imaging

Yinghui Wang[1], Haonan Xiao[2], Wen Li[1], Tian Li[1], and Jing Cai[1]

[1]Department of Health Technology and Informatics, The Hong Kong Polytechnic University, Hung Hom, Hong Kong, [2]Department of Radiation Oncology and Physics, Shandong Cancer Hospital and Institute, Shandong First Medical University and Shandong Academy of Medical Sciences, Jinan, China

Keywords: AI/ML Image Reconstruction, Cancer, 4D-MRI\Enhancement\Temporal-compensation

Motivation: Four-dimensional Magnetic Resonance Imaging (4D-MRI) shows promise for motion management in abdominal radiotherapy. However, the prevalent undersampling often hampers its image quality.

Goal(s): To enhance the image quality of 4D-MRI, we propose Tco-SEN, a deep-learning model to exploit its properties.

Approach: Tco-SEN employs a two-stage architecture and a customized loss penalty, enabling effective restoration of detailed features and preservation of anatomical structures.

Results: Compared to state-of-the-art algorithms, Tco-SEN significantly enhances image quality by improving spatial resolution, reducing motion artifacts and noise, and preserving delicate structures. Furthermore, our method enhances the accuracy of subsequent motion modeling in 4D-MRI, highlighting its potential for clinical applications.

Impact: Tco-SEN effectively improves the image quality of 4D-MRI, benefiting more accurate tumor delineation and motion estimation. This advancement promotes the application of 4D-MRI in cancer radiotherapy, ultimately enhancing the accuracy of abdominal cancer radiation treatment.

0012 9:03

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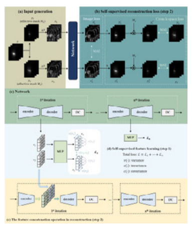


A self-supervised feature learning strategy for training reconstruction networks on undersampled data in cardiac Cine MRI

Siying Xu[1], Kerstin Hammernik[2], Daniel Rueckert[2,3,4], Sergios Gatidis[1,5], and Thomas Kuestner[1]

[1]Medical Image and Data Analysis (MIDAS.lab), Department of Diagnostic and Interventional Radiology, University of Tuebingen, Tuebingen, Germany, [2]School of computation, Information and Technology, Technical University of Munich, Munich, Germany, [3]Department of Computing, Imperial College London, London, United Kingdom, [4]Klinikum Rechts der Isar, Technical University of Munich, Munich, Germany, [5]Department of Radiology, Stanford University, Stanford, CA, United States

Keywords: AI/ML Image Reconstruction, Cardiovascular, Self-Supervised learning, Feature learning

Motivation: Most existing deep learning-based MR image reconstruction methods are supervised learning, relying on fully-sampled images, which is challenging to acquire in practice.

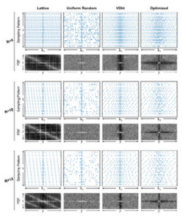
Goal(s): We aim to leverage undersampled data in a self-supervised reconstruction framework to enhance expressibility and model performance.

Approach: We use information maximization methods to learn sampling-invariant features from undersampled images and incorporate them in a self-supervised reconstruction network.

Results: The proposed method can learn sampling-invariant features from undersampled data, which enhance the reconstruction performance, enabling self-supervised MR image reconstruction for up to 16× undersampling.

Impact: The proposed self-supervised feature learning strategy can extract sampling-invariant features from undersampled images, effectively assisting the reconstruction of undersampled cardiac cine MR imaging without requiring fully-sampled images. This feature learning strategy may also be advantageous for other downstream tasks.

0013 9:15



Joint Optimization of Data Sampling and Reconstruction for Dynamic MRI

Cagan Alkan[1], Julio Oscanoa[1], Andy Dimnaku[2], Ali Syed[1], Shreyas Vasanawala[1], and John Pauly[1]

[1]Stanford University, Stanford, CA, United States, [2]California Institute of Technology, Pasadena, CA, United States

Keywords: AI/ML Image Reconstruction, New Trajectories & Spatial Encoding Methods

Motivation: Sampling patterns in deep learning (DL) or compressed sensing (CS) based accelerated dynamic MRI reconstructions are typically chosen heuristically. k-t sampling patterns can be optimized to capture the spatio-temporal characteristics of dynamic MRI data more efficiently.

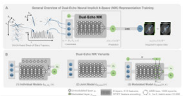
Goal(s): Our objective is to develop a method for optimizing k-t sampling patterns for dynamic MRI.

Approach: We extend the recently developed AutoSamp framework to dynamic MRI setting to jointly optimize k-t sampling and reconstruction. We test our method on a cardiac cine dataset.

Results: DL reconstruction with optimized k-t patterns using the proposed method produces higher quality results with reduced spatial and temporal artifacts.

Impact: Dynamic MRI reconstructions with learned sampling patterns improves reconstruction quality. The learned patterns can also provide insights about designing general k-t MRI sampling patterns.

0014 9:27



DE-NIK: Leveraging Dual-Echo Data for Respiratory-Resolved Abdominal MR Reconstructions Using Neural Implicit k-Space Representations

Veronika Spieker[1,2,3], Jonathan Stelter[4], Wenqi Huang[2], Hannah Eichhorn[1,2], Kilian Weiss[5], Rickmer Braren[4], Veronika A Zimmer[2], Kerstin Hammernik[2], Claudia Prieto[3,6,7], Dimitrios C Karampinos[4], and Julia A Schnabel[1,2,6]

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Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence

Motivation:
Neural implicit k-space representations (NIK) enable binning-free respiratory-resolved MR reconstructions in a data-driven manner. The multi-dimensionality of MR, i.e., provided in dual-echo acquisitions, is expected to improve reconstruction performance and allows for further echo-processing.

Goal(s): A Dual-Echo-NIK that takes advantage of the redundant data present in two echoes and enables subsequent water-fat-separation.

Approach: We propose three Dual-Echo-NIK variants trained (1) individually, (2) jointly and (3) in an echo-modulated way. Motion-resolved echo and water-fat reconstructions are evaluated on a free-breathing phantom simulation and in-vivo.

Results: Quantitative simulations demonstrate improved performance for the modulated Dual-Echo-NIK. In-vivo reconstructions reveal sharper reconstructions when both echoes are utilized.

Impact: The Dual-Echo Neural Implicit k-space Representations indicate how echo information can lead to improved motion-resolved reconstructions, including subsequent water-fat separations. Echo-modulation can further enhance reconstruction performance and offers the potential to reduce acquisition times for training data.

0015 9:39

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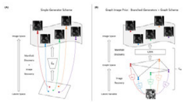


Graph Image Prior for Unsupervised Dynamic MRI Reconstruction

Zhongsen Li[1], Wenxuan Chen[1], Chuyu Liu[1], Puguang Xie[2], Haozhong Sun[1], Haining Wei[1], Jiachen Ji[1], Jing Zou[1], and Rui Li[1]

[1]Tsinghua University, Beijing, China, [2]School of Medicine, Chongqing University, Chongqing, China

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, Unsupervised Learning, Image Reconstruction, Dynamic MRI

Motivation: Current unsupervised dynamic-MRI reconstruction algorithms based on DIP uses very low-dimensional latent variables and a single generator for direct non-linear mapping, which may limit the performance.

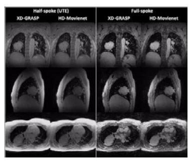
Goal(s): To propose a new model and algorithm for unsupervised dynamic MRI reconstruction.

Approach: We propose a novel Graph-Image-Prior(GIP) model, which uses branched CNN generators to recover the image structure, and use a Graph-Neural-Network(GNN) to discover the best spatio-temporal manifold. Besides, we devise an ADMM algorithm to alternately optimize the dynamic image and network.

Results: The proposed method achieves the state-of-art performance even compared with supervised deep-learning methods, without the need for any fully-sampled data.

Impact: The proposed Graph-Image-Prior(GIP) scheme is a new unsupervised image reconstruction model, which has a significant value for further research. Besides, GIP is promising to be used in other multi-frame MRI reconstruction applications where fully-sampled data is scarce or unavailable.

0016 9:51



HD-Movienet: High-definition 4D MRI using 3D radial kooshball acquisition and deep learning reconstruction

Victor Murray[1], Can Wu[1], and Ricardo Otazo[1,2]

[1]Department of Medical Physics, Memorial Sloan Kettering Cancer Center, New York City, NY, United States, [2]Department of Radiology, Memorial Sloan Kettering Cancer Center, New York City, NY, United States

Keywords: AI/ML Image Reconstruction, Image Reconstruction

Motivation: State-of-the-art motion-resolved 4D MRI techniques lack sufficient spatial resolution and efficient acquisition and reconstruction for application in clinical practice.

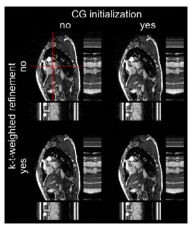
Goal(s): To develop HD-Movienet, a deep learning-based method to efficiently acquire and reconstruct 4D MRI with approximately 1mm isotropic resolution using 3D radial acquisitions.

Approach: HD-Movienet uses accelerated half-spoke (UTE) and full-spoke (T1-weighted) 3D radial kooshball acquisition and image-time-coil deep learning 4D reconstruction without k-space data consistency.

Results: HD-Movienet can enable 4D MRI with isotropic 1.1mm resolution, 4 minutes of scan time, and reconstruction of less than 7 seconds to image patients with lung tumors.

Impact: Deep learning-based HD-Movienet reconstruction enables motion-resolved 4D MRI technique with isotropic 1.1mm resolution, 4 minutes of scan time, and reconstruction of less than 7 seconds for robust radiation-free imaging of patients with mobile tumors.

0017 10:03



Low-Latency Reconstruction of Real-Time Cine MRI Using an Unrolled Network

Marc Vornehm[1,2], Jens Wetzl[2], Florian Fürnrohr[1], Daniel Giese[2,3], Rizwan Ahmad[4], and Florian Knoll[1]

[1]Computational Imaging Lab, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [2]Magnetic Resonance, Siemens Healthcare GmbH, Erlangen, Germany, [3]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [4]Biomedical Engineering, The Ohio State University, Columbus, OH, United States

Keywords: Machine Learning/Artificial Intelligence, Image Reconstruction

Motivation: Interactive real-time MRI requires low reconstruction latencies. Deep learning-based methods are promising, but unrolled networks like the Variational Network have longer inference times than purely image-based methods.

Goal(s): Design and train a Variational Network with high reconstruction quality and inference times suitable for interactive real-time applications.

Approach: Modify the Variational Network architecture such that few unrolling steps are sufficient for high reconstruction quality with short inference times.

Results: The proposed architectural modifications allowed to halve the number of unrolling steps without compromising image quality, therefore enabling considerably shortened reconstruction times.

Impact: Two modifications to an unrolled Variational Network architecture for MRI reconstruction are proposed. These enable reconstructing interactive real-time cardiac cine MRI with high reconstruction quality while maintaining minimal reconstruction latency.

Oral

Radiomics & Imaging Biomarkers in Brain Tumors

Nicoll 1 | Monday 8:15 - 10:15 | *Moderators:* Antonella Castellano & Manabu Kinoshita

0018 8:15

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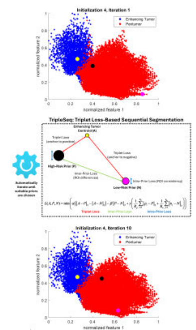


Automatic Infiltration Risk Prior Generation with Modified Triplet Loss for Pre-Operative Glioblastoma Infiltration Prediction

Walter Zhao[1], Sree Gongala[2], Eunate Alzaga Goñi[1], Xiaofeng Wang[3], Shengwen Deng[2], Charit Tippareddy[2], Hamed Akbari[4], Anahita Fathi Kazerooni[5], Christos Davatzikos[6], Marta Couce[7], Andrew E. Sloan[8], Chaitra Badve[2], and Dan Ma[1]

[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Radiology, University Hospitals Cleveland Medical Center, Cleveland, OH, United States, [3]Department of Quantitative Health Sciences, Cleveland Clinic, Cleveland, OH, United States, [4]Department of Bioengineering, Santa Clara University, Santa Clara, OH, United States, [5]Center for Data Driven Discovery in Biomedicine, Children's Hospital of Pennsylvania, Philadelphia, OH, United States, [6]Center for Biomedical Image Computing and Analytics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, OH, United States, [7]Department of Pathology, University Hospitals Cleveland Medical Center, Cleveland, OH, United States, [8]Piedmont Physicians Neurosurgery Atlanta, Piedmont Healthcare, Atlanta, GA, United States

Keywords: Tumors (Pre-Treatment), Tumor, Glioblastoma

Motivation: Pre-operative glioblastoma (GBM) infiltration prediction models rely on manual infiltration risk (IR) prior segmentation which is tedious, requires expert input, and is highly variable.

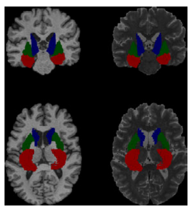
Goal(s): Automation is needed for fast segmentation. A data-driven method would account for GBM heterogeneity and be independent of specific MRI input for applicability to clinical protocols.

Approach: IR priors are grown using modified triplet loss with inter-prior and intra-prior terms to ensure priors are distinct from each other and maintain similarity within individual priors.

Results: TripleSeq generated more consistent IR priors compared to manual segmentation. TripleSeq-trained models showed good classification (> 85% mean accuracy) of ground truth infiltration.

Impact: Glioblastoma (GBM) infiltration inevitably leads to tumor recurrence and progression. We introduce an automatic method to generate infiltration risk priors for improved GBM infiltration machine learning prediction, which applied pre-operatively can identify at-risk peritumoral regions for targeted neurosurgery and radiotherapy.

0019 8:27 [Predicting Brain Age of Healthy Adults Based on Morphological MRI Parcellation Using Radiomics]



Eros Montin[1,2], Marco Muccio[1,2], Chenyang Li[1,2,3], Zhe Sun[1,2,3], Yulin Ge[1,2], and Riccardo Lattanzi[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology,, New York University Grossman School of Medicine, New York, New York, USA, new york, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, New York, USA, new york, NY, United States, [3]Vilcek Institute of Graduate Biomedical Sciences, New York University Grossman School of Medicine, New York, New York, USA, new york, NY, United States

Keywords: Aging, Aging, aging, structural imaging, radiomics, neuro

Motivation: A machine learning model capable of accurately estimating brain age could have a large clinical impact.

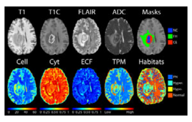
Goal(s): To apply radiomics analysis to morphological MR images and train a machine learning model capable of accurately estimating subjects' age from radiomics features.

Approach: T1- and T2-weighted brain images of 725 healthy adults were used to extract 18324 radiomics features from bilateral caudate, putamen, and hippocampus, and used to train a stacking regressor machine learning model.

Results: Our machine learning model accurately estimated the subjects' age with a mean absolute error of 4.77±0.35 years using radiomics features from T1-(45%) and T2-weighted(55%).

Impact: Investigating advanced machine learning methods to accurately estimate brain aging based on commonly used clinical MR images provides vital insights to further improve our understanding of brain changes in both healthy aging and neurodegeneration.

0020 8:39 [Radio-pathomic signatures within and beyond FLAIR hyperintensity predict prognosis in glioblastoma following gross total resection]



Savannah Duenweg[1], Michael Flatley[2], Aleksandra Winiarz[2], Samuel Bobholz[2], Allison Lowman[2], Biprojit Nath[2], Fitzgerald Kyereme[2], Jennifer Connelly[2], Dylan Coss[2], Max Krucoff[2], Anjishnu Banerjee[2], and Peter LaViolette[2]

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Keywords: Tumors (Pre-Treatment), Tumor, glioma, neuro-oncology

Motivation: Glioblastoma (GBM), a highly lethal brain tumor, poses a significant threat to patient survival, even after gross total resection (GTR).

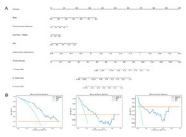
Goal(s): This study explored whether radio-pathomic features from autopsy-trained models could predict survival in GTR-treated GBM patients.

Approach: The relationship between cell density and tumor probability (TPM) beyond the FLAIR hyperintense (FH) region, as well as a habitat-based labeling within FH was investigated. Cox regressions evaluated the impact of habitat volume and radio-pathomic characteristics within FH on survival.

Results: The study revealed that radio-pathomic features of FH predicted overall survival, suggesting the ability to identify infiltrative tumor ultimately missed by surgery.

Impact: In GTR-treated GBM patients, the presence of infiltrative tumor cells within and beyond FLAIR hyperintensity may predict patient prognosis and could be used for optimizing treatment.

0021 8:51



Integrated MRI radiomics, tumor microenvironment, and clinical risk factors improving survival prediction in patients with glioblastoma

Qing Zhou[1] and Junlin Zhou[1]

[1]Lanzhou University Second Hospital, Lanzhou, China

Keywords: Tumors (Post-Treatment), Neuro

Motivation: The patients with glioblastoma (Gb) with poor prognosis and quality of life.

Goal(s): To construct a comprehensive model for predicting the prognosis of patients with Gb using a radiomics method and integrating tumor microenvironment .

Approach: In total, 149 patients with isocitrate dehydrogenase wild-type Gb were enrolled retrospectively. Selected the best feature combination related to Gb overall survival. Clinical-radiomics-TME models were established.

Results: Lasso-Cox analyses were used to screen the factors related to OS in patients with Gb, including age, peritumoral edema, tumor purity, tumor-associated macrophages, and the 21 radiomics features. The clinical-radiomics-TME model had the best survival prediction ability, the C-indices was 0.727.

Impact: Considering the poor prognosis of IDH wild-type Gb, we explored additional prognostic risk factors and established a survival prediction model. The clinical-radiomics-TME comprehensive model showed a significant improvement compared to other models and was most effective in predicting patient survival.

0022 9:03

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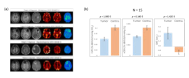


CO2 and O2 reactivity in brain gliomas

Oluwateniola Sophia Akinwale[1], Yang Li[1,2], Peiying Liu[1], Xirui Hou[1], Shanshan Jiang[1], Doris Lin[1,3], Jay J. Pillai[1,3], and Hanzhang Lu[1]

[1]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Graduate School of Biomedical Sciences, UT Southwestern Medical Center, Dallas, TX, United States, [3]Department of Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States

Keywords: Tumors (Pre-Treatment), Tumor, Cerebrovascular reactivity; venous cerebral blood volume; bolus arrival time; hypercapnia; hyperoxia

Motivation: Current clinical practice assesses baseline vascular features and cerebrovascular reactivity with multiple techniques that involve the use of injected contrast and radioactive tracers. Obtaining this information requires numerous tests and visits, which increases patient stress and healthcare costs.

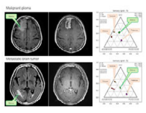
Goal(s): Our goal was to determine whether a multiparametric scan could conveniently and economically assess glioma hemodynamics with no exogenous contrast.

Approach: The technique involves sequential manipulation of CO_2 and O_2 in inspired gas while collecting BOLD MRI images to obtain CVR, vCBV, and BAT maps.

Results: Multiparametric maps correctly differentiated tumor and normal tissue with characteristics that may inform tumor classification.

Impact: We showed that an efficient multiparametric scan can map different vascular properties. These maps allow for tumor and healthy tissue differentiation and show qualitative traits that potentially informs tumor characteristics which could aid in the diagnostic evaluation of glioma patients.

0023 9:15



[Is edema of malignant glioma different from edema of other tumors? Analysis of time dependent diffusion image using ternary plot method]

Toshiaki Taoka[1], Rintaro Ito[1], Rei Nakamichi[2], Toshiki Nakane[2], Kazushige Ichikawa[3], Takaya Mori[4], Ozaki Masanori[4], Nobuyasu Ichinose[4], Yoshiki Tanaka[5], and Shinji Naganawa[2]

[1]Department of Innovative Biomedical Visualization (iBMV), Nagoya University, Nagoya, Japan, [2]Department of Radiology, Nagoya University, Nagoya, Japan, [3]Department of Radiological Technology, Nagoya University, Nagoya, Japan, [4]Canon Medical Systems Corporation, Otawara, Japan, [5]SORD Corporation, Tokyo, Japan

Keywords: Tumors (Pre-Treatment), Diffusion/other diffusion imaging techniques

Motivation: The edema around a malignant glioma contains infiltrating tumor cells. The motivation for this study was to determine the characteristics of the edema of malignant glioma.

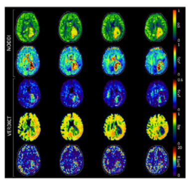
Goal(s): The goal is to evaluate the characteristics of edema around malignant gliomas using a combination of the oscillating gradient spin echo and pulsed gradient spin echo.

Approach: The ternary plot method is used to evaluate the characteristics of edema by using a plot of existing tissue as an internal reference.

Results: Edema of malignant gliomas showed a different distribution in relation to the internal reference in the ternary plot method compared to edema of other tumors.

Impact: Ternary plot method was used to present pixel values obtained from oscillating gradient spin echo and pulsed gradient spin echo, and existing tissues were evaluated as internal references, which was thought to enable evaluation of the histological properties of edema.

0024 9:27



[Combined DW-MRI and DW-MRS sensitivity to glioma tumour microenvironment: a preliminary study]

Marco Palombo[1,2], Samuel Rot[3,4], Matteo Figini[5], Elizabeth Powell[6], Bhavana Solanky[3,7], Chloe Najac[8], Bernard Siow[9,10], Jeremy Rees[11], Ciaran Hill[11], Eleftheria Panagiotaki[5], Itamar Ronen[12], and Harpreet Hyare[13]

[1]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]School of Computer Science, Cardiff University, Cardiff, United Kingdom, [3]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [4]Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [5]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom, [6]Centre for Medical Image Computing, Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [7]Centre for Medical Image Computing, Medical Physics & Biomedical Engineering, University College London, London, United Kingdom, [8]Department of Radiology, C.J. Gorter MRI Center, Leiden University Medical Center, Leiden, Netherlands, [9]In Vivo Imaging, The Francis Crick Institute, London, United Kingdom, [10]Centre for Medical Image Computing, University College London, London, United Kingdom, [11]NMR UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [12]Clinical Imaging Sciences Centre, Brighton and Sussex Medical School, University of Sussex, Brighton, United Kingdom, [13]NMR Research Unit, Queen Square UCL Queen Square Institute of Neurology, University College London, London, United Kingdom

Keywords: Tumors (Pre-Treatment), Cancer, Microstructure, Diffusion, Spectroscopy

Motivation: Understanding the complexity of the tumour microenvironment is critical for understanding glioma progression and developing effective therapies.

Goal(s): To develop a non-invasive imaging pipeline for characterization of the glioma tumor microenvironment.

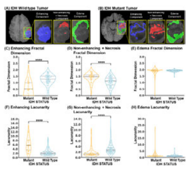
Approach: Combining DW-MRI and DW-MRS to enhance the characterization of a spectrum of gliomas as a feasibility study.

Results: Changes in neuronal (tNAA) and glial (tCho) metabolites apparent diffusion coefficients suggest neuronal atrophy and glial activation/reaction in tumor core, respectively. Changes in intracellular and extracellular volume fractions and extracellular diffusivity quantified by DW-MRI support and complement metabolite DW-MRS result and further suggest a more infiltrative marging in IDH mutant tumors.

Impact: Combination DW-MRI and DW-MRS has potential to characterize the glioma microenvironment for improved understanding of radio-resistance and developing more effective therapies.

0025 9:39

Advanced Imaging investigations of Fractal Dimension and Lacunarity measures of Glioma Subcomponents as Discriminator of IDH Status



Neha Yadav[1], Ankit Mohanty[1], and Vivek Tiwari[1]

[1]Department of Biological Sciences, Indian Institute of Science Education and Research Berhampur, Berhampur, India

Keywords: Tumors (Pre-Treatment), Machine Learning/Artificial Intelligence, Fractal Dimension, Radiogenomic, Lacunarity, Glioma

Motivation: The presence of structural and geometric variations within gliomas, even among those with similar histologic grades, potentially reflect the phenotypic heterogeneity because of the distinct genetic and epigenetic landscape.

Goal(s): To develop a non-invasive radiogenomic platform to identify IDH and MGMT status using the geometry of glioma subcomponent.

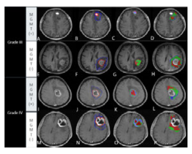
Approach: Fractal dimension and Lacunarity, non-Euclidean geometric measures of glioma subcomponents, were estimated using MR images and wrapped in artificial intelligence-based models to discriminate IDH status and MGMT status.

Results: The combination of fractal dimension or lacunarity of enhancing and nonenhancing glioma subcomponent is the definitive discriminator of IDH status as wildtype or mutant.

Impact: Fractal Dimension and Lacunarity of Glioma subcomponents are unique for IDH-Mutant and IDH-Wildtype gliomas. Fractal-geometry analysis can serve as an effective non-invasive tool for identifying IDH-status prior to biopsy and surgical interventions, thereby improving the clinical management of glioma patients.

0026 9:51

Preoperative prediction of MGMT methylation status in high-grade glioma based on MRI radiomics signature of habitat analysis



Binju Yang[1], Yueluan Jiang[2], Song Yang[3], Miao Chang[1], and Guoguang Fan[1]

[1]The First Affiliated Hospital of China Medical University, Shenyang, Liaoning Province, China, [2]MR Research Collaboration, Siemens Healthineers, Beijing, China, [3]MR Research Collaboration, Siemens Healthineers, Shanghai, China

Keywords: Radiomics, Neuro, MGMT， habitat analysis， radiomics

Motivation: To predict the oxygen 6-methylguanine-DNA methyltransferase (MGMT) methylation status in high-grade gliomas (HGG) before surgery by using conventional MRI radiomics features within tumor habitat.

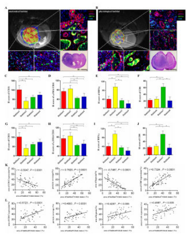
Goal(s): To better understand the molecular characteristics of HGG.

Approach: In 105 HGG patients, the whole tumor was segmented into 3subregions by Kmeans clusters on T2 and T1 contrast-enhanced images. Radiomic features were extracted from each subregion and the predictive performance of radiomics signature was compared with clinical data.

Results: The efficiency of 3 subregions segmentation using Kmeans clustering with habitats analysis was the highest. The AUC of the model validation set was as high as 0.878.

Impact: We developed a radiomic signature model that can be used to predict MGMT methylation status in HGG patients. This can be used as a tool to help clinicians assess MGMT methylation status in HGG patients and guide individualized treatment.

0027 10:03



MRI-based habitats to quantify tumor microenvironment normalization in glioblastoma: validation with histology and transcriptomics

Junfeng Zhang[1] and Hao Wu[2]

[1]Radiology, General Hospital of Western Theater Command of PLA, Chengdu, China, [2]Radiology, The First Affiliated Hospital of Chongqing Medical University, Chongqing Medical University, Chongqing, China

Keywords: Tumors (Post-Treatment), Quantitative Imaging, Habitat imaging

Motivation: The lack of *in vivo* and noninvasive biomarkers to quantify tumor microenvironment (TME) normalization hinders the evaluation of bevacizumab (BEV) therapy response in glioblastoma (GBM).

Goal(s): To quantify TME normalization during BEV therapy in GBM by conventional and multiparametric MRI (mpMRI).

Approach: The MRI-based habitats were generated by Gaussian mixture model in patient-derived GBM models. Spatial-paired analyses of MRI, histology, and single-cell RNA sequencing were performed to validate the effetiveness of habitats.

Results: A total of eight habitats were generated to quantify TME normalization spatiotemporally. Habitat7 was strongly correlated with TME normalization-associated phenotypes including pericyte coverage, hypoxia and immune cell infiltration.

Impact: We developed and validated a quantitative mpMRI-based biomarker to characterize TME normalization in GBM. This may provide a new *in vivo* approach for precise evaluation of BEV therapy response in GBM noninvasively.

Oral

All About Choroid Plexus

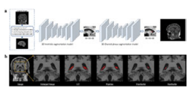
Nicoll 2 | Monday 8:15 - 10:15 | *Moderators:* Junko Kikuta & Hongyu An

8:15 Introduction

Junko Kikuta

Juntendo University, Bunkyo-ku, Japan

0028 8:27



The Correlation between Choroid Plexus and Protein Biomarkers in the Alzheimer's Disease

Jiaxin Li[1], Yueqin Hu[2], Xue Feng[3], Craig H. Meyer [3], and Li Zhao[1]

[1]College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [2]Psychology, Beijing Normal University, Beijing, China, [3]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States

Keywords: Alzheimer's Disease, Alzheimer's Disease, choroid plexus

Motivation: Dysfunction of the glymphatic system is one of the possible causes of Alzheimer's disease (AD). We hypothesize that the choroid plexus (CP), the major site of CSF secretion, is associated with the hallmarks of AD, Aβ and tau protein deposition.

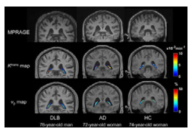
Goal(s): to investigate the association between CP and hallmark proteins in the AD.

Approach: Based on the proposed CP segmentation pipeline, univariate regression and stepwise regression models were employed to analyse correlations between CP and AD.

Results: Our work shows that the ratio between CP and parenchyma is correlated with Aβ42 and p-tau (p<0.001) and the CP volume is correlated with t-tau (p<0.001).

Impact: The proposed CP segmentation pipeline provided improved sensitivity to detect the correlations between CP/parenchyma ratio and Aβ42 and p-tau. This work may indicate the choroid plexus a possbile biomarker for AD.

0029 8:39



Choroid Plexus Area and Permeability in Dementia with Lewy Bodies

Ziming Xu[1], Xize Gao[1], Jinghuan Gan[2], Zhichao Chen[2], Yong Ji[3], and Huijun Chen[1]

[1]Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, Beijing, China, [2]Department of Neurology, Beijing Friendship Hospital, Capital Medical University, Beijing, China, Beijing, China, [3]Department of Neurology, Tianjin Huanhu Hospital, Tianjin, China, Tianjin, China

Keywords: Other Neurodegeneration, DSC & DCE Perfusion, choroid plexus; dementia with Lewy bodies

Motivation: The choroid plexus has been demonstrated to play a significant role in the pathophysiology of dementia with Lewy bodies (DLB), however the imaging characteristics are not yet explored.

Goal(s): Our goal was to assess choroid plexus area and permeability based on MRI in DLB patients.

Approach: DLB patients were imaged to acquire choroid plexus area and permeability and compared with patients with Alzheimer’s disease and healthy controls.

Results: DLB patients exhibited larger area and lower fractional plasma volume in choroid plexus than healthy controls. Additionally, they were found to be significantly associated with the mini-mental state examination score.

Impact: The larger choroid plexus area and lower fractional plasma volume detected by T1-weighted MRI and DCE-MRI in dementia with Lewy bodies provide a non-invasive and quantitative metric for advancing the diagnosis and treatment of dementia with Lewy bodies.

0030 8:51

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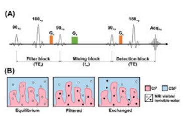


Relaxation-exchange imaging (REXI) for the measurement of trans-barrier water exchange in choroid plexus

Xuetao Wu[1,2], Zejun Wang[3], Yu Yin[4], Qingping He[5], Yi-Cheng Hsu[6], Rong Xue[1,2], and Ruiliang Bai[7]

[1]State Key Laboratory of Brain and Cognitive Science, Beijing MRI Center for Brain Research, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Key Laboratory of Biomedical Engineering of Ministry of Education, College of Biomedical Engineering and Instrument Science, Zhejiang University, Hangzhou, China, [4]Department of Chemistry, Zhejiang University, Hangzhou, China, [5]School of Brain Science and Brain Medicine, Zhejiang University, Hangzhou, China, [6]MR Collaboration, Siemens Healthcare, Shanghai, China, [7]Interdisciplinary Institute of Neuroscience and Technology, Zhejiang University School of Medicine, Hangzhou, China

Keywords: Neurofluids, Neurofluids, choroid plexus, Blood-CSF barrier, relaxation exchange

Motivation: Scarcity of non-invasive imaging techniques of choroid plexus function hindered our knowledge of the blood-cerebrospinal fluid barrier (BCSFB).

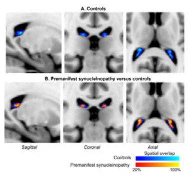
Goal(s): We aimed to measure the trans-barrier water exchange rate in choroid plexus.

Approach: We developed a new imaging method and contrast mechanism, named relaxation-exchange imaging (REXI), and validated its feasibility on both phantoms and rats.

Results: REXI successfully captured the changes in proton exchange rate of urea-water phantoms at varying pH. In-vivo experiments on rats showed the potential of REXI to measure the trans-barrier water exchange in choroid plexus.

Impact: Given the emerging importance of neurofluids and choroid plexus, our novel MRI method REXI provides a way to measure the trans-barrier water exchange in CP and a potential imaging tool to evaluate CP function in future studies.

0031 9:03 **Choroid plexus atrophy in premanifest synucleinopathy using 7 Tesla MRI: an underlooked mechanism for α-synuclein accumulation?**



Firdaus Fabrice Hannanu[1], Stephan Grimaldi[1,2], Kavita Singh[1,3], Subhranil Koley[1], Ambra Stefani[1,4], Aleksandar Videnovic[5,6], Guadalupe Garcia-Gomar[1,7], and Marta Bianciardi[1,6]

[1]Brainstem Imaging Laboratory, Department of Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States, [2]Department of Neurology and Movement Disorders, APHM, Hôpital Universitaire Timone, Marseilles, France, [3]Multiscale Imaging and Integrative Biophysics Unit, LBN, National Institute on Aging, NIH, Baltimore, MD, United States, [4]Department of Neurology, Medical University of Innsbruck, Innsbruck, Austria, [5]Department of Neurology, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States, [6]Division of Sleep Medicine, Harvard University, Boston, MA, United States, [7]Escuela Nacional de Estudios Superiores Unidad Juriquilla, Universidad Nacional Autónoma de México, Querétaro, Mexico

Keywords: Parkinson's Disease, High-Field MRI, Choroid Plexus, Synucleinopathy, RBD

Motivation: As opposed to Alzheimer's disease, the mechanism linking neurotoxic protein accumulation to alterations in neurofluid turnover and in neuroimmunity due to choroid plexus (ChP) changes is understudied in premanifest synucleinopathy.

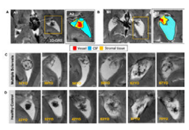
Goal(s): To determine changes in the structure of ChP in premanifest synucleinopathy and to generate a ChP probabilistic atlas.

Approach: ChP in multi-contrast 7 Tesla images of 12 premanifest synucleinopathy and 12 sex-and-age-matched controls were evaluated in terms of volume and signal intensity.

Results: Reduced ChP volume in premanifest synucleinopathy suggested ChP atrophy that may result in neurofluid dynamics and neuroimmune function impairment; a probabilistic atlas of ChP was generated.

Impact: ChP atrophy observed in premanifest synucleinopathy using high-resolution multi-contrast 7-Tesla MRI suggests a potential role of ChP in pathophysiology of synucleinopathies, urging further investigation. Probabilistic ChP atlas may aid precise MRI localization in future studies of ChP in living humans.

0032 9:15 **Unveiling Choroid Plexus Changes in Multiple Sclerosis using 7T MRI**



Zhe Sun[1,2,3] and Yulin Ge[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [3]Vilcek Institute of Graduate Biomedical Sciences, NYU Grossman School of Medicine, New York, NY, United States

Keywords: Multiple Sclerosis, Multiple Sclerosis, choroid plexus, neurodegeneration, neuroinflammation

Motivation: Conventional imaging limits the assessment of choroid plexus (ChP) inflammatory activity in multiple sclerosis (MS).

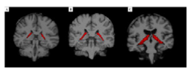
Goal(s): Use high-resolution MRI with 0.25mm^2 matrix at 7T to assess ChP changes in MS patients compared to controls and explore correlations with lesion volumes.

Approach: In 14 MS patients and 9 controls, ChPs were categorized into vascular and stromal compartments using 7T T2* imaging, and vessel-to-stroma ration was compared between the two groups.

Results: The ChP's vessel-to-stroma ratio quantified by 7T T2*w MRI was lower in MS patients, correlating negatively with lesion volume. Furthermore, the age-related decline was more rapid in MS patients compared to controls.

Impact: This pilot study suggests that the vessel-to-stroma ratio of ChP, as revealed by high-resolution 2D-GRE 7T T2* imaging, could potentially serve as an imaging marker for inflammatory and degenerative changes of ChP in MS patients.

0033 9:27



MRI study of enlarged choroid plexus in patients with spinocerebellar ataxia type 3.

Zhiming Zhen[1,2], Yonghua Huang[1], Chenghao Cao[1], Yanqiu Hua[1], Peiling Ou[1], Wei Chen[3], Wei Chen[1], Zhentao Zuo[4], and Chen Liu[1,2]

[1]Department of Radiology, Southwest Hospital, Army Medical University (Third Military Medical University), Chongqing 400038, China., Chongqing, China, [2]7T Magnetic Resonance Imaging Translational Medical Center, Southwest Hospital, Army Medical University (Third Military Medical University), Chongqing 400038, China., Chongqing, China, [3]MR Research Collaboration Team, Siemens Healthineers Ltd., Wuhan 430000, China, Wuhan, China, [4]State Key Laboratory of Brain and Cognitive Science, Beijing MR Center for Brain Research, Institute of Biophysics, Chinese Academy of Sciences, Beijing 100000, China, Beijing, China

Keywords: Other Neurodegeneration, Brain, spinocerebellar ataxia type 3

Motivation: The role of cerebral immune and homeostatic structures of choroid plexus (CP) in SCA3 patients remains elusive.

Goal(s): The objective of this study is to investigate the volumetric changes in the choroid plexus.

Approach: Whole brain of SCA3 patients was imaged using a 3T MRI scanner and the volume of CP was analyzed.

Results: The findings revealed that CP volume was significantly larger in the SCA3 group compared to normal control group, exhibiting a positive correlation with both the number of ATXN3 repeats and scores of motor function abnormalities.

Impact: The abnormal change of CP volume may serve as a new marker for distinguishing SCA3 patients

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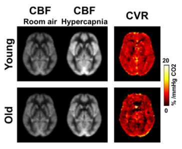


Cerebrovascular reactivity in choroid plexus

YUECEN JIN[1], Monroe Turner[2], Kaisha Hazel[3], Yuguang Zhao[2], Beini Hu[1], Dema Abdelkarim[2], Binu Thomas[4], Bart Rypma[2], Hanzhang Lu[3], and Peiying Liu[1]

[1]University of Maryland, Baltimore, Baltimore, MD, United States, [2]University of Texas at Dallas, Richardson, TX, United States, [3]Johns Hopkins University, Baltimore, MD, United States, [4]University of Texas Southwestern Medical center, Dallas, TX, United States

Keywords: Neurofluids, Arterial spin labelling, Aging, Blood vessels, Neuro, Neurofluids, Perfusion, Vascular

Motivation: Choroid plexus (CP) plays an important role in the production of CSF and the formation of the blood-CSF barrier, but its vascular function is unclear.

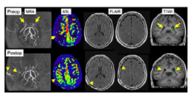
Goal(s): We aim to quantify cerebrovascular reactivity (CVR) of CP in normal controls.

Approach: We applied PCASL with 5%CO2 inhalation in 92 subjects and compared CVR in gray matter, white matter and CP between young and old subjects.

Results: CVR of CP was significantly lower than that of gray and white matter, but showed no age-related difference.

Impact: This work provides a reference for future studies on CVR changes of CP in pathological conditions.

0035 9:51



How chronic cortical hypoperfusion affects choroid plexus in patients with moyamoya disease?

Shoko Hara[1,2], Junko Kikuta[2], Kaito Takabayashi[2], Hongkai Chen[2], Koji Kamagata[2], Yoji Tanaka[1], Masaaki Hori[2,3], Tadashi Nariai[1], Shigeki Aoki[2], and Taketoshi Maehara[1]

[1]Department of Neurosurgery, Tokyo Medical and Dental University, Tokyo, Japan, [2]Department of Radiology, Juntendo University Graduate School of Medicine, Tokyo, Japan, [3]Department of Radiology, Toho University Omori Medical Center, Tokyo, Japan

Keywords: Neurofluids, Ischemia, moyamoya disease

Motivation: How chronic cortical hypoperfusion affects choroid plexus, an important structure to maintain neurofluid dynamics, has rarely reported.

Goal(s): To investigate changes of choroid plexus after revascularization surgery to improve chronic hypoperfusion in patients with moyamoya disease.

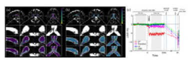
Approach: Eighteen adult patients with moyamoya disease were evaluated with T1WI and ASL before and one year after surgery. Choroid plexus volume and cortical perfusion were compared before and one year after the surgery.

Results: After the surgery, choroid plexus volume decreased (1.65 (0.55) ml vs. 1.52 (0.51) ml; P=0.014), while cortical perfusion improved (P=0.001).

Impact: Choroid plexus may be hyperactivated and proliferated when cortical hypoperfusion and decreased glymphatic system function exist. After the revascularization surgery and restoration of cortical perfusion and glymphatic system function, choroid plexus may shrink to the normal function.

0036 10:03

MERIT AWARD
MAGNA CUM LAUDE



Fast imaging of intravenous Gadolinium-based contrast agents entrance into ventricular CSF via choroid plexus in healthy subjects

Yuanqi Sun[1,2,3], Di Cao[1,2,3], Yinghao Li[1,2,3], Jay J. Pillai[4,5], Adrian Paez[1], Jacob M. Pogson[6], Linda Knutsson[1,7], Peter B. Barker[1,2], Peter C.M. Van Zijl[1,2,3], Arnold Bakker[7,8], Bryan K Ward[6], and Jun Hua[1,2]

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Keywords: Neurofluids, DSC & DCE Perfusion, lymphatic; CSF; ISF; GBCA

Motivation: Intravenously administered gadolinium-based-contrast-agents (GBCAs) can enter the lateral-ventricle (LV) via choroid-plexus (CP). However, systematic investigation of GBCA accumulation in ventricular CSF via CP in ***healthy*** subjects is limited.

Goal(s): To measure GBCA-induced signal changes in the LV and CSF around CP immediately and 4 hours after intravenous GBCA administration.

Approach: Dynamic-susceptibility-contrast-in-the-CSF (cDSC) MRI was performed in 25 healthy subjects.

Results: At ~20s post-GBCA, GBCA-induced signal changes were detected in the CSF around CP but not in the rest of LV. After 4 hours, GBCA-induced signal changes also became significant in the entire LV. GBCA-amount in the LV showed an age correlation.

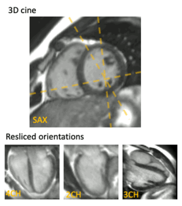
Impact: These results provided direct imaging evidence that intravenous GBCA can pass the BCSFB in the CP and enter ventricular CSF in healthy subjects.

Oral

Image Reconstruction

Nicoll 3 Monday 8:15 - 10:15 *Moderators:* Mark Chiew & Mariya Doneva

0037 8:15



Four-dimensional iterative motion correction (iMoCO) for isotropic stack-of-spirals cine imaging at 0.55T

Rajiv Ramasawmy[1], Ahsan Javed[1], Daniel Herzka[2], Prakash Kumar[3], Krishna Nayak[3], Robert Lederman[1], and Adrienne Campbell-Washburn[1]

[1]National Heart, Lung and Blood Institute, Bethesda, MD, United States, [2]Case Western Reserve University and University Hospitals, Cleveland, OH, United States, [3]University of Southern California, Los Angeles, CA, United States

Keywords: Image Reconstruction, Cardiovascular, Image Reconstruction, Low-Field MRI, Data Acquisition

Motivation: Three-dimensional (3D) isotropic cine imaging can be resliced and resampled for clinical diagnosis and planning for structural interventions. Currently, these 3D cine approaches are hampered by long scan times.

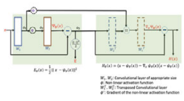
Goal(s): To demonstrate cardiac-resolved iterative motion compensation (iMoCo) for a free-breathing stack-of-spirals 3D cine with optimized acquisition ordering at 0.55T

Approach: The 3D cine was acquired in five healthy volunteers and one patient, reconstructed with cardiac-resolved iMoCo, and compared to a reference 2D cine.

Results: The proposed method yielded high quality 3D cines. Volumetric measurements had good agreement with reference data (-2.3 ± 2.8% and 3.9 ± 10.4% in diastole and systole respectively).

Impact: A gaussian-distributed stack-of-spirals sampling scheme paired with an iMoCo reconstruction improves image quality and sharpness for isotropic three-dimensional cines. This technique can be a useful tool for interventional planning and assessment or as a one-stop shop for diagnostic cardiovascular MRI.

0038 8:27



Multi-scale plug-and-play energy framework for inverse problems

Jyothi Rikhab Chand[1] and Mathews Jacob[1]

[1]University of Iowa, Iowa city, IA, United States

Keywords: Image Reconstruction, Data Processing

Motivation: Unrolled algorithms provide high quality image reconstruction. However, their training is memory-intensive and is sensitive to forward model mismatches.

Goal(s): To develop a memory-efficient plug-and-play algorithm, whose performance is comparable to unrolled algorithms and can be used with arbitrary forward models.

Approach: We propose a memory-efficient energy-based multi-scale framework. We model the negative log prior with different smoothnesses using Convolutional Neural Networks (CNN). This approach enables us to relax the constraints on the CNN, while the multi-scale strategy improves the convergence to the global minimum.

Results: The enhancements improves performance, making it comparable to end-to-end methods, while being robust to model mismatch.

Impact: The proposed framework is memory-efficient compared to unrolled algorithms, paving the way for its usage in large-dimensional inverse problems. Its flexibility enables recovery of images with arbitrary forward operators.

0039 8:39

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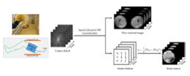

[Time-Resolved Biomechanics using Spectro-Dynamic MRI: Proof of Principle in the Muscles of the Thigh]

Max H.C. van Riel[1], David G.J. Heesterbeek[1], Martijn Froeling[1], Tristan van Leeuwen[2], Cornelis A.T. van den Berg[1], and Alessandro Sbrizzi[1]

[1]Department of Radiotherapy, Computational Imaging Group for MR Diagnostics and Therapy, UMC Utrecht, Utrecht, Netherlands, [2]Mathematical Institute, Utrecht University, Utrecht, Netherlands

Keywords: Image Reconstruction, Muscle, Time-Resolved, Motion, Strain

Motivation: Measurements of biomechanical tissue properties require time-resolved reconstructions from dynamic experiments. The Spectro-Dynamic MRI framework achieves this by working directly from k-space data.

Goal(s): To develop an experimental setup and reconstruction method with which time-resolved biomechanical information can be measured in vivo.

Approach: An inflatable pressure cuff deformed the thigh muscles of a volunteer. Time-resolved images and strain maps were reconstructed directly from k-space data using the Spectro-Dynamic MRI framework.

Results: Principal strains were obtained for different muscles in the thigh at a temporal resolution of 352 ms. The first principal strain direction could differentiate between muscle structures, indicating different underlying biomechanical properties.

Impact: The reconstruction of time-resolved images and strains using Spectro-Dynamic MRI allows for time-resolved measurements of biomechanical parameters during dynamic loads with a straightforward experimental setup. This information is useful for studying the mechanical behavior of tissues.

0040 8:51

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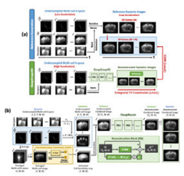

[DeepGrasp4D: A General Framework for Highly-Accelerated Real-Time 4D Golden-Angle Radial MRI Using Deep Learning]

Haoyang Pei[1,2,3], Hersh Chandarana[1,2], Daniel K Sodickson[1,2], and Li Feng[1,2]

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Keywords: Image Reconstruction, Image Reconstruction

Motivation: Time-resolved real-time 4D MRI demands high imaging speed to achieve high spatial and temporal resolution. While conventional iterative reconstruction methods can accomplish this, they require substantial temporal correlations and impose a significant computational burden.

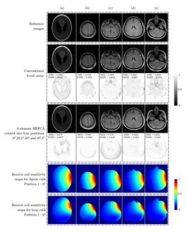
Goal(s): This study proposes DeepGrasp4D, a deep learning technique tailored to efficiently reconstruct real-time 4D MR images with reduced temporal correlations and shortened scan times.

Approach: DeepGrasp4D was developed based on an unrolled network that incorporates an explicit low-rank constraint and a temporal total variation constraint, enabling efficient reconstruction of 4D images from continuously acquired golden-angle radial k-space.

Results: DeepGrasp4D enables accurate 4D MRI reconstruction at high acceleration rates.

Impact: The proposed DeepGrasp4D technique enables efficient and reliable 4D MRI reconstruction from golden-angle radial data acquired with shortened scan times and reduced temporal correlations. This can be useful in various applications such as DCE-MRI or MRI-guided radiotherapy.

0041 9:03



[Image reconstruction for an 8-element loop-dipole rotating RF coil array (RRFCA) using a novel calibration-free GRAPPA-based method]

Lachlan West[1], Andrew Phair[2,3], Mingyan Li[1], Michael Brideson[3], Andrew P Bassom[3], and Feng Liu[1]

[1]University of Queensland, Brisbane, Australia, [2]King's College London, London, United Kingdom, [3]University of Tasmania, Hobart, Australia

Keywords: Image Reconstruction, Image Reconstruction

Motivation: SENSE-based reconstruction is challenging for clinical imaging when rotating the RRFCA into multiple positions; therefore, a novel calibration-free GRAPPA-based method was developed.

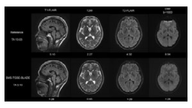
Goal(s): To effectively reconstruct k-space data acquired from the RRFCA, enhancing image quality compared to a conventional stationary array without a scan time penalty.

Approach: Conventional GRAPPA was extended by uncovering a subset of the radial grid to cope with the rotation of the RRFCA. Numerical and human brain images were used for validation.

Results: Image quality was improved using the proposed method. Up to 58% reduction in RMSE and 2.5% increase in SSIM was achieved while maintaining scan time.

Impact: The RRFCA utilising our novel calibration-free, GRAPPA-based, radial image reconstruction method provides a clinically relevant parallel imaging technique. In the future, our approach may incorporate compressed sensing to further reduce motion artifacts, particularly in applications like cardiac and dynamic MRI.

0042 9:15



[Fast and motion robust brain examination using simultaneous multi-slice turbo gradient spin echo BLADE Sequence]

Kun Zhou[1], Li Yang[1], and Nan Xiao[1]

[1]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China

Keywords: Motion Correction, Motion Correction

Motivation: PROPELLER/BLADE is robust to motion in brain imaging but comes at the cost of longer acquisition time.

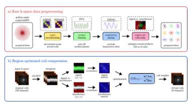
Goal(s): Our goal was to reduce the acquisition time of commercial sequences (BLADE and EPI) based brain motion-insensitive workflow by a factor of 2.

Approach: The SMS-TGSE-BLADE sequence was developed with acceleration techniques, including in-plane GRAPPA, SMS, and EPI readout.

Results: Comparable image quality was obtained with the SMS-TGSE-BLADE sequence with more than 2-fold decrease in acquisition time.

Impact: The improvement in acquisition speed in the motion-insensitive brain examination (including T1-FLAIR, T2W, T2-FLAIR and DWI) through SMS-TGSE-BLADE sequence may increase patient comfort. It can also increase patient throughput and cost efficiency of healthcare providers.

0043 9:27



[Deep Learning Reconstruction for Free-Breathing Radial Cine Imaging]

Mahmut Yurt[1], Kanghyun Ryu[2], Zhitao Li[3], Xucheng Zhu[4], Xianglun Mao[4], Kawin Setsompop[5], Martin Janich[4], John Pauly[1], Ali Syed[5], and Shreyas Vasanawala[5,6]

[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Korea Institute of Science and Technology, Seoul, Korea, Republic of, [3]Department of Radiology, Northwestern University, Chicago, IL, United States, [4]GE Healthcare, Stanford, CA, United States, [5]Department of Radiology, Stanford University, Stanford, CA, United States, [6]Stanford Cardiovascular Institute, Stanford University, Stanford, CA, United States

Keywords: Image Reconstruction, Cardiovascular

Motivation: We aim to introduce a cardiac cine imaging protocol to address the issues of motion susceptibility and robustness in the previous techniques.

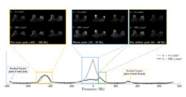
Goal(s): Our objective is to demonstrate an accelerated acquisition and high-quality reconstruction framework based on free-breathing radial cardiac cine imaging that shows enhanced patient comfort and robustness against respiratory motion.

Approach: We synergistically leverage a raw k-space preprocessing module, region optimized coil compression, and deep learning reconstruction based on memory efficient unrolled neural networks.

Results: Our experiments indicate that the proposed framework achieves high reconstruction quality at large acceleration factors (e.g., 8x), in terms of spatial and temporal accuracy.

Impact: Conventional cardiac protocols use Cartesian k-space sampling and are susceptible to motion artifacts. We provide an acquisition and reconstruction framework based on a free-breathing protocol and deep learning reconstruction for enhanced patient comfort and robustness against motion artifacts.

0044 9:39



[Distortion-Free Fat/Water Separated Body Diffusion-Weighted Imaging using Spatio-Temporal Joint Reconstruction]

Xuetong Zhou[1,2], Brian A. Hargreaves[1,2,3], and Philip K. Lee[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Bioengineering, Stanford University, Stanford, CA, United States, [3]Department of Electrical Engineering, Stanford University, Stanford, CA, United States

Keywords: Pulse Sequence Design, Data Acquisition

Motivation: DWI is effective for cancer imaging, but conventional EPI suffers from geometric distortion and chemical shift artifacts. Conventional fat suppression techniques are sensitive to the large B_0 and B_1^+ inhomogeneities in the body. Residual fat causes artifacts and is a confounding factor in using DWI for cancer diagnosis.

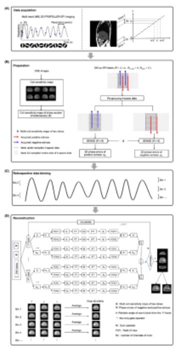
Goal(s): Perform robust fat/water separation in distortion-free DWI.

Approach: A diffusion-weighted EPTI acquisition and joint reconstruction method is used. Separation is performed using chemical shift encoding along the temporal dimension. A distortion-less FSE-based phase navigator is used to resolve shot-to-shot phase.

Results: The proposed method is validated in vivo in the brain, head&neck, and breast.

Impact: Using the proposed navigated EPTI sequence, we demonstrated fat/water separated DWI that is robust to B_0 variation in the body. This will enable more reliable use of DWI to assess cancer and other abnormalities, complementing or replacing contrast-enhanced imaging.

0045 9:51



High-fidelity Four-dimensional Abdominal Diffusion-Weighted Imaging Enabled by SCOPER and Multi-Band acceleration (4D-DW-MB-SCOPER)

Lu Wang[1], Tian Li[1], Jing Cai[1], and Hing Chiu Chang[2]

[1]The Hong Kong Polytechnic University, Hong Kong, China, [2]The Chinese University of Hong Kong, Hong Kong, China

Keywords: Image Reconstruction, Radiotherapy

Motivation: 4D-DWI can benefit the treatment planning in radiotherapy (RT) because of its high tumor-to-tissue contrast. Both 4D-DW-PROPELLER-EPI and 4D-DW-SCOPER have been proposed but suffer from long acquisition time, thereby limiting clinical applications

Goal(s): This study aims to develop a new technique to achieve distortion-free 4D-DWI with a practical acquisition time.

Approach: 4D-DW-SCOPER and multiband (MB) techniques were combined, termed 4D-DW-MB-SCOPER. In vivo experiments were performed.

Results: Results indicate that 4D-DW-MB-SCOPER is feasible for achieving distortion-free 4D-DWI within 7 mins for a coverage of 176 mm in the Superior-Inferior (SI) direction, and has the potential to benefit treatment planning in clinical RT.

Impact: The results might offer a new way for clinicians to perform 4D RT planning as well as for patients to have a better treatment outcome. However, the reconstruction time is long for the technique and need to be further investigated.

0046 10:03

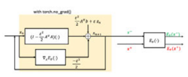


Image recovery using deep end-to-end posterior networks

Jyothi Rikhab Chand[1] and Mathews Jacob[1]

[1]University of Iowa, Iowa city, IA, United States

Keywords: Image Reconstruction, Data Processing

Motivation: End-to-End (E2E) trained unrolled algorithms recover MR images with high quality. However, they have large memory demands during training. In addition, these maximum a posteriori methods cannot provide uncertainty estimates.

Goal(s): To develop a memory-efficient framework for E2E learning of the posterior probability distribution.

Approach: We model the posterior distribution as a combination of the data-consistent-determined likelihood term and the prior, represented using a Convolutional Neural Network whose weights are learned in an E2E fashion using maximum likelihood optimization.

Results: The proposed E2E training strategy requires significantly less memory than unrolling. In addition, the model facilitates sampling and provides uncertainty estimates.

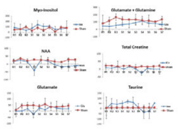
Impact: The higher memory efficiency of the proposed E2E scheme makes it an attractive option for image reconstruction problems of large dimensions. The learned posterior model provides a minimum mean square estimate and uncertainty maps, which unrolled approaches cannot offer.

Oral

Metabolism & Mechanics in Animal Models

Room 331-332 Monday 8:15 - 10:15 *Moderators:* Grace McIlvain & Kavindra Nath

0047 8:15



Metabolic characterization of the rat motor cortex with fMRS upon chemogenetic excitation

Nathalie Just[1]

[1]*DRCMR, Copenhagen University Hospital - Amager and Hvidovre, Hvidovre, Denmark, Denmark*

Keywords: Biology, Models, Methods, Metabolism, Chemogenetics, fMRS

Motivation: To complement previous fMRI studies of interhemispheric pathways, we propose to characterize the interhemispheric metabolism using functional magnetic resonance spectroscopy (^{1}H-fMRS).

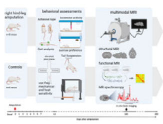
Goal(s): To demonstrate the feasibility of chemogenetic ^{1}H-fMRS in the rat brain at 7T.

Approach: DREADDs and Sham viruses were injected in the right motor cortex of rat. Neural activation was induced by a 1mg/kg IP bolus of Clozapine-N Oxide (CNO). Spectra were acquired continuously prior and following CNO injection and quantified with a temporal resolution of 5 minutes.

Results: Relative concentration changes were found for myo-Inositol, Taurine, Glutamate and NAA in the motor cortex of chemo-induced rats following CNO injection.

Impact: Functional metabolic findings will greatly complement our knowledge of interhemispheric pathway allowing a better understanding of long-distance circuits known to initiate both excitation and inhibition.

0048 8:27



Establishment, behavioral, structural and functional characterization of a hindlimb amputation model in mice with multimodal MRI and MRS

Claudia Falfán-Melgoza[1], Carmen La Porta[2], Anke Tappe-Theodor[2], and Wolfgang Weber-Fahr[1]

[1]*RG Translational Imaging, Central Institute of Mental Health, Medical Faculty Mannheim, University of Heidelberg, Mannheim, Germany,* [2]*Pharmacology institute, Medical Faculty, University of Heidelberg, Heidelberg, Germany*

Keywords: Small Animals, Spectroscopy

Motivation: Limb amputation frequently leads to pain in residual limb and phantom sensations, but there is no comprehensively described mouse model for translational research.

Goal(s): To extensively phenotype a mouse model of limb amputation to investigate contributing factors of pain.

Approach: Behavioral characterization and multimodal in vivo brain imaging (Voxel-based Morphometry, resting-state functional Magnetic Resonance Imaging and MR-spectroscopy).

Results: VBM showed reduction in primary somatosensory and visual areas (ipsilateral-hemisphere). Functional analysis showed potential neurocompensatory mechanisms and reorganization (left hemisphere). Metabolic data indicated reduced glutamate in the left somatosensory area, and increased N-acetylaspartate in the right somatosensory area.

Impact: We phenotyped a mouse model of limb amputation and showed that sensory and motor areas are involved in the manifestation of pain, which strengthens previous evidence and guides future research.

0049

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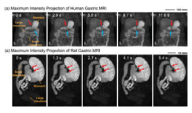
8:39



Cross-species comparison: imaging and mapping gastric motor functions in humans and rats using contrast-enhanced rapid MRI

Xiaokai Wang[1], Fatimah Alkaabi[1], Ulrich Scheven[2], Minkyu Choi[3], Douglas Noll[1], and Zhongming Liu[4]

[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Mechanical Engineering, University of Michigan, Ann Arbor, MI, United States, [3]Electrical and Computer Engineering, University of Michigan, Ann Arbor, MI, United States, [4]Biomedical Engineering, Electrical and Computer Engineering, University of Michigan, Ann Arbor, MI, United States

Keywords: Digestive, Digestive, Gastrointestinal, Stomach

Motivation: Direct and granular cross-species comparisons of gastric motor functions remain scarce in the literature.

Goal(s): This study aims to establish functional similarities and distinctions of the stomach between humans and rats, and lay the foundation for integrating preclinical findings into clinical gastrointestinal studies.

Approach: Using comparable MRI protocols, we examined the interspecies parallels and distinctions in their functions as pressure and peristaltic pumps.

Results: Similarities were confirmed with high-resolution spatial maps, including intragastric pressure gradient and spatial distribution of peristaltic amplitude and frequency, despite their differences in scale. We highlighted the pronounced variance in initialization and spatial coordination of peristaltic contractions across species.

Impact: This work serves as the first one to map and compare gastric motor events with comparable MRI protocols, laying the foundation for preclinical rat research to clinical translation using contrast-enhanced gastrointestinal MRI.

0050

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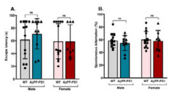
8:51



Impact of Gender on Alzheimer's disease: a Behavioral and Metabolic Analysis in AβPP-PS1 Mouse Model

Akila Ramesh[1,2] and Anant Bahadur Patel[1,2]

[1]NMR Microimaging and Spectroscopy, Centre for Cellular and Molecular Biology, Hyderabad, India, [2]Academy of Scientific and Innovative Research, Ghaziabad, India

Keywords: Alzheimer's Disease, Metabolism, Neurodegeneration, Alzheimer's disease

Motivation: Sex specific status of neurometabolic activity in Alzheimer's disease is poorly understood.

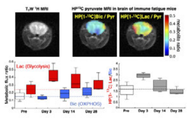
Goal(s): To assess glutamatergic and GABAergic neurometabolism in different brain regions of male and female AβPP-PS1 mouse model of AD.

Approach: Tracer approach involving infusion of [1,6-$^{13}C_2$]glucose in AβPP-PS1 mouse model of AD together with ^{1}H-[^{13}C]-NMR spectroscopy was used to estimate rate of neuronal Glucose oxidation ($CMR_{Glc(Ox)}$) in AD mice.

Results: The neuronal metabolic activity reduced in the cerebral cortex, hippocampus and cerebellum of female AβPP-PS1 mice. However, only hippocampal neurometabolic activity was reduced in the male mice. This suggests a differential progression of AD in male and female AβPP-PS1 mice.

Impact: The findings of the study suggest differential progression of AD in male and female AβPP-PS1 mice. These factors require attention for future interventions for AD treatment.

0051 9:03



[Brain metabolic alteration at a late phase of immune fatigue model mice using parahydrogen-polarized [1-13C] pyruvate MRI.]

Shingo Matsumoto[1], Hayate Tomiyama[1], and Hiroshi Hirata[1]

[1]*Information Science and Technology, Hokkaido University, Sapporo, Japan*

Keywords: Biomarkers, Hyperpolarized MR (Non-Gas)

Motivation: Long-lasting brain issues including cognitive impairments after infections have become a worldwide problem after COVID-19.

Goal(s): Our goal was to detect brain metabolic alteration at a late phase of immune fatigue.

Approach: Parahydrogen-polarized ^{13}C MRI of pyruvate metabolism was applied in the brain of 3 days poly I:C treated mice.

Results: Alteration of brain pyruvate metabolism toward glycolysis was observed in both acute phase at day 3 and late phase at day 14 of immune fatigue model mice, which was correlated with diminished dopamine signal marker and nighttime moving distance in open-field test.

Impact: Our demonstration of a detectable alteration of brain pyruvate metabolism by parahydrogen-polarized ^{13}C MRI at a late phase of immune fatigue mice can be a useful biomarker of cognitive impairments after infections such as brain fog of long-COVID.

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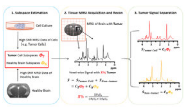


[Cell-Specific Mapping of MR Spectroscopic Signatures: A Pilot Study in a Murine Glioma Model]

Yizun Wang[1,2], Urbi Saha[3], Marina Milad[4], Edward J Roy[3,5], Andrew M Smith[1,5], and Fan Lam[1,2,5,6]

[1]*Department of Bioengineering, 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]*Neuroscience Program, University of Illinois at Urbana-Champaign, Urbana, IL, United States,* [4]*Department of Biochemistry, University of Illinois at Urbana-Champaign, Urbana, IL, United States,* [5]*Cancer Center at Illinois, University of Illinois at Urbana-Champaign, Urbana, IL, United States,* [6]*Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States*

Keywords: Spectroscopy, Spectroscopy

Motivation: Effective monitoring of tumor progression and therapeutic efficacy should benefit from new in vivo imaging capability to resolve cell-specific contributions at tissue level.

Goal(s): To develop a new MRSI-based approach to resolve tumor cell-specific components at individual imaging voxels leveraging the spectral dimensions.

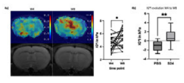
Approach: We proposed a multiscale experimental and computational MRSI framework that learns cell-specific spectroscopic signatures from glioma cell lines and resolves intravoxel nontumor and tumor-specific components in vivo using the learned signatures.

Results: Results from cellular mixtures and glioma-bearing mice demonstrated the potential of our method. Time-dependent, spatially-resolved tumor cell maps can be obtained, showing tumor growth in vivo.

Impact: The proposed approach marks a potential new paradigm to map cellular complexity at tissue level leveraging additional imaging dimensions and machine learning. It holds the promise to provide new tools for tumor grading, progression monitoring and treatment assessment.

0053 9:27

MERIT AWARD MAGNA CUM LAUDE



[Magnetic Resonance Elastography captures tumor invasiveness and therapy response in the invasive S24-glioma model]

Hannah Elisabeth Fels-Palesandro[1,2], Sophie Heuer[3,4], Berin Boztepe[1,5], Yannik Streibel[1], Chenchen Pan[3,4], Ina Maria Weidenfeld[1,2], Manuel Fischer[1], Volker Sturm[1], Daniel Dominguez-Azorin[3,4], Ralph Sinkus[6,7], Amir Abdollahi[2,8], Sabine Heiland[1], Frank Winkler[3,4], Martin Bendszus[1], Michael Breckwoldt[1,5], and Katharina Schregel[1,4]

[1]Neuroradiology, Heidelberg University Hospital, Heidelberg, Germany, [2]Clinical Cooperation Unit Translational Radiation Oncology, Deutsches Krebsforschungszentrum, Heidelberg, Germany, [3]Neurology, Heidelberg University Hospital, Heidelberg, Germany, [4]Clinical Cooperation Unit Neurooncology, Deutsches Krebsforschungszentrum, Heidelberg, Germany, [5]Clinical Cooperation Unit Neuroimmunology and Brain Tumor Immunology, Deutsches Krebsforschungszentrum, Heidelberg, Germany, [6]School of Biomechanical Engineering and Imaging Science, King's College London, London, United Kingdom, [7]INSERM UMRS1148 - Laboratory for Vascular Translational Science, University of Paris, Paris, France, [8]Radiation Oncology, Heidelberg University Hospital, Heidelberg, Germany

Keywords: Elastography, Elastography, Cancer, Neuro

Motivation: In a neurooncological setting clinically established MRI-sequences have shortcomings with regards to tumor invasion and therapy-associated parenchyma changes.

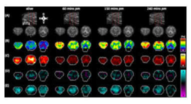
Goal(s): Our goal was to determine if MRE and the ADC could improve detection of tumor cell invasion and radiotherapy effects.

Approach: 23 tumor-bearing mice and 9 sham injected mice underwent MRE- and MRI-scans for up to 16 weeks, a subgroup of animals underwent additional radiotherapy.

Results: MRE was sensitive to early tumor invasion and MRE and ADC captured radiotherapy effects so far not detectable with established MRI-sequences.

Impact: In a preclinical setting the ADC and especially MRE allow for a better characterization of therapeutic effects and tumor cell invasion and should thus also be evaluated in a clinical setting.

0054 9:39



[Post-Mortem Changes of Anisotropic Mechanical Properties in the Porcine Brain Assessed by MR Elastography]

Shuaihu Wang[1], Kevin N Eckstein[1], Charlotte A Guertler[1], Curtis L Johnson[2], Ruth J Okamoto[1], Matthew DJ McGarry[3], and Philip V Bayly[1]

[1]Washington University in St. Louis, St. Louis, MO, United States, [2]University of Delaware, Newark, DE, United States, [3]Dartmouth College, Hanover, NH, United States

Keywords: Elastography, Elastography

Motivation: Anisotropic mechanical properties of brain tissue define the mechanobiology of injury and disease, but most measurements of direction-dependent properties have been performed post-mortem.

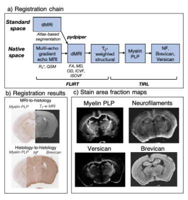
Goal(s): To characterize the post-mortem changes

Approach: We use magnetic resonance elastography and diffusion tensor imaging with a transversely-isotropic nonlinear inversion algorithm to estimate anisotropic mechanical properties of minipig brain, both *in vivo* and at specific times after death.

Results: White matter is stiffer, more dissipative, and more anisotropic than gray matter when the minipig is alive, but except for tensile anisotropy, these differences largely disappear post-mortem. Overall, brain tissue becomes stiffer, less dissipative, and less mechanically anisotropic after death.

Impact: Our demonstration of significantly different mechanical properties in living versus post-mortem minipig brains is critical to improving computational models of TBI and correctly interpreting their predictions, which have relied on post-mortem measurements of brain material properties for several decades.

0055 9:51



[An optimised framework for relating microstructural MRI to multi-stain histology metrics in the mouse brain]

Cristiana Tisca[1], Mohamed Tachrount[1], Adele Smart[1], Frederik J Lange[1], Amy FD Howard[1], Chaoyue Wang[1,2], Benjamin Tendler[1], Lily Qiu[1], Claire Bratley[1], Daniel Z L Kor[1], Istvan N Huszar[1,3], Javier Ballarobre-Barreiro[4], Manuel Mayr[4], Jason Lerch[1,5], Aurea B Martins-Bach[1], and Karla L Miller[1]

[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]SJTU-Ruijin-UIH Institute for Medical Imaging Technology, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Athinoula A. Martinos Centre for Biomedical Imaging, Harvard University, Cambridge, MA, United States, [4]British Heart Foundation Centre of Research Excellence, King's College London, London, UK, London, United Kingdom, [5]Mouse Imaging Centre, Hospital for Sick Children, Toronto, ON, Canada

Keywords: Biology, Models, Methods, Microstructure, Validation

Motivation: Voxel-wise MRI-histology comparisons routinely rely on manual segmentations of ROIs and subjective quantitative histological metrics, an error-prone and labour-intensive process.

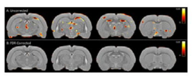
Goal(s): We developed an automated framework for investigating relationships between multiple MRI metrics and immunostains.

Approach: We used MRI and histology protocols optimised for *ex-vivo* mouse brains. We co-registered this data and derived quantitative histological metrics. We conducted voxel-wise correlations in grey and white matter between MRI (diffusion, R_2* and susceptibility) and immunohistochemistry (myelin, neurofilament and extracellular matrix proteins).

Results: Our framework successfully recapitulated known relationships for myelin and neurofilaments and, interestingly, demonstrated new relationships between MRI metrics and extracellular matrix protein stains.

Impact: Our optimised framework combines openly-shared software and MRI-histology protocols, addressing current challenges, such as obtaining high-quality histology data, MRI-to-histology registration and automatic extraction of quantitative histological metrics. This can benefit future MRI-histology studies in mouse brains prepared for ex-vivo MRI.

0056 10:03



[Atlas-based Analysis and Deformation-Based Morphometry of Structural MRI to Study Effects of Hypertension on Rat Brain Structure]

Haley Elizabeth Wiskoski[1,2], Loi Do[1], Marc Zempare[3], Natalie Carey[3], Amy Delmendray[3], Kimberly Young[3], Kimberly Bohne[3], Monica Chawla[3], Pradyumna Bharadwaj[4], Kenneth Mitchell[5], Gene Alexander[3,4,6], Carol Barnes[3,4], and Theodore Trouard[1,3,7]

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Keywords: Preclinical Image Analysis, Hypertension

Motivation: Hypertension (HTN) is a known risk factor for cardiovascular disease and cognitive decline, with a need to understand its effects on brain function and structure using animal models.

Goal(s): We aim to investigate impact of HTN on the brain of transgenic Cyp1a1-Ren2 rats through atlas-based and deformation-based analysis of high-resolution structural MRI.

Approach: Rats were divided into control and hypertensive groups. Structural MRI was carried out, upon which atlas-based analysis and deformation-based morphometry were performed.

Results: Induced HTN significantly affected peripheral organs but showed no significant brain volume changes or cognitive differences. This suggests potential brain protection mechanisms against HTN, warranting further investigation.

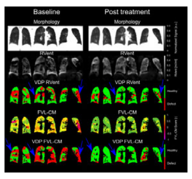
Impact: This research explores effects of hypertension on the brain using a rat model and structural MRI. Results show the brain appears resilient to induced hypertension compared to peripheral organs, highlighting need for investigation into protective mechanisms and their potential degradation.

Oral

A Breath of Fresh Air: What’s New in Lung MRI

Room 334-336 Monday 8:15 - 10:15 *Moderators:* Mark Schiebler

0057 8:15



Regional ventilation measured by 3D phase-resolved functional lung MRI improves after dual bronchodilator treatment in patients with COPD

Filip Klimeš[1,2], Andreas Voskrebenzev[1,2], Marcel Gutberlet[1,2], Till Frederik Kaireit[1,2], Robert Grimm[3], Frank Wacker[1,2], Jens Hohlfeld[4,5], and Jens Vogel-Claussen[1,2]

[1]Institute of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Biomedical Research in Endstage and Obstructive Lung Disease Hannover (BREATH), German Center for Lung Research (DZL), Hannover, Germany, [3]MR Application Predevelopment, Siemens Healthineers AG, Erlangen, Germany, [4]Department of Clinical Airway Research, Franhofer Institute for Toxicology and Experimental Medicine, Hannover, Germany, [5]Department of Respiratory Medicine, Hannover Medical School, Hannover, Germany

Keywords: Lung, Lung, COPD, Dual bronchodilator, treatment

Motivation: Bronchodilators relieve the symptoms of respiratory conditions, such as chronic obstructive lung disease (COPD). 3D PREFUL MRI offers a non-invasive assessment of pulmonary ventilation. It is unclear whether 3D PREFUL parameters are sensitive to ventilation changes induced by bronchodilators.

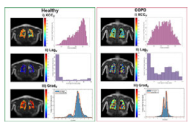
Goal(s): To determine whether 3D PREFUL parameters enable to measure response to dual bronchodilator therapy in COPD.

Approach: 3D PREFUL MRI and spirometry at baseline and 2 weeks after initiation of therapy.

Results: Ventilation assessed by 3D PREFUL parameters significantly improved by bronchodilator therapy. Relative changes of 3D PREFUL ventilation defect percentage parameters were similar to relative change differences of FEV1.

Impact: 3D PREFUL MRI derived ventilation maps show significantly reduced ventilation defects in COPD patients after bronchodilator therapy. This positions 3D PREFUL MRI as a promising candidate for non-invasive monitoring of regional ventilation changes in future clinical studies.

0058 8:27



Application of Voxel-wise Lung Ventilation (VOLVE) Assessment Utilising Cross-Correlation in Chronic Obstructive Pulmonary Disease (COPD)

Zachary Peggs[1,2], Jonathan Brooke[2], Jan Paul[1,2], Christopher Bradley[1,2], Andrew Cooper[1,2], Charlotte E Bolton[2], Ian Hall[2], Susan Francis[1], and Penny Gowland[1]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Nottingham Biomedical Research Centre (BRC), Respiratory Medicine, School of Medicine, University of Nottingham, Nottingham, United Kingdom

Keywords: Lung, Quantitative Imaging, COPD

Motivation: To develop dynamic ventilation metrics that are robust to breathing behaviour and can identify nonlinear responses of MR signal to lung expansion.

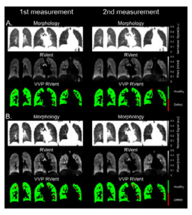
Goal(s): To extend Voxel-wise Lung Ventilation (VOLVE) analysis by incorporating cross-correlation metrics to account for phase shifts between the navigator (global) and lung parenchyma (local) respiratory signal representing delays in ventilation.

Approach: Prospective pilot study using VOLVE analysis incorporating cross-correlation of navigator and lung parenchyma signals.

Results: Significant differences between healthy and COPD groups in the cross-correlation metrics, with both a reduction in amplitude indicating reduced signal linearity and increase in phase shift (lag) indicating delayed ventilation.

Impact: Voxel-wise Lung Ventilation (VOLVE) analysis incorporating cross-correlation and lag enables the distinction between lung regions with delayed ventilation from regions where ventilation signal is static. This additional insight into nonlinear ventilation dynamics will improve understanding of changes in lung function.

0059 8:39



[Dual-center repeatability and comparison of 3D phase-resolved functional lung (PREFUL) ventilation MRI at 3T]

Filip Klimeš[1,2], Chuan Tai Foo[3,4], Marcel Gutberlet[1,2], Andreas Voskrebenzev[1,2], Richard McIntyre[5,6], Marius Malte Wernz[1,2], Robin Aaron Müller[1,2], Robert Grimm[7], Frank Wacker[1,2], Frank Thien[3,4], and Jens Vogel-Claussen[1,2]

[1]Institute of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Biomedical Research in Endstage and Obstructive Lung Disease Hannover (BREATH), German Center for Lung Research (DZL), Hannover, Germany, [3]Department of Respiratory Medicine, Eastern Health, Melbourne, Australia, [4]Faculty of Medicine, Nursing and Health Sciences, Monash University, Melbourne, Australia, [5]Monash Biomedical Imaging, Monash University, Melbourne, Australia, [6]Monash Imaging Department, Monash Health, Melbourne, Australia, [7]MR Application Predevelopment, Siemens Healthineers AG, Erlangen, Germany

Keywords: Lung, Lung, Repeatability

Motivation: 3D phase-resolved functional lung (PREFUL) MRI provides evaluation of ventilation during free-breathing without contrast agents. The repeatability of 3D PREFUL at 3T is unknown.

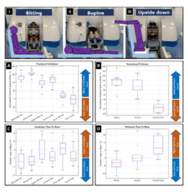
Goal(s): To assess the performance of 3D PREFUL in dual-center setting and to compare 3T measurement to 1.5T.

Approach: Dual-center 3D PREFUL MRI in healthy volunteers

Results: 3D PREFUL was feasible at 3T scanners at both centers. The repeatability assessments showed a bias only for one parameter, where it was negligibly small. Significant differences of 3D PREFUL ventilation parameters were observed between 1.5T and 3T, suggesting for pronounced susceptibility effects at 3T.

Impact: Despite the pronounced differences in ventilation parameters across the field strengths, consistently reproducible surrogates of ventilation markers were derived from 3D PREFUL MRI using a patient-friendly acquisition without the need for contrast agents and during free tidal breathing.

0060 8:51



[Investigating Gravitational Influence on Normal Lung Function Using PREFUL MRI on an Open Scanner]

Arthur Harrison[1,2], Galina E Pavlovskaya[1,2], Penny Gowland[1,2], Thomas Meersmann[1,2], Jan A Paul[1,2], Rashed Sobhan[1,2], Amanda Goodwin[2], and Olivier Mougin[1,2]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Nottingham NIHR Biomedical Research Centre, University of Nottingham, Nottingham, United Kingdom

Keywords: Lung, Lung

Motivation: Insights into the factors contributing to local ventilation and perfusion variation within the lungs are of crucial importance to improving patient care.

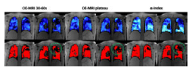
Goal(s): To investigate the gravity dependent contributions to regional heterogeneity of normal lung function including ventilation and perfusion.

Approach: With use of an open MRI system, participants were scanned in three positions to vary the direction of gravity experienced by the lungs. PREFUL analysis was employed to attain fractional ventilation, normalised perfusion, and associated Time-To-Peak markers.

Results: Contributions from both gravity and physiological factors were observed in ventilation and perfusion distribution for each of the three positions.

Impact: Enhanced understanding of the causes of functional variations in healthy lungs will allow physicians to make more informed decisions regarding patient care. Additionally, posture dependent lung function could serve as a marker for lung disease and support stratified treatment approaches.

0061 9:03



[Simultaneous extraction of Oxygen enhanced MRI indices and α-mapping in Cystic Fibrosis]

Marta Tibiletti[1], Christopher Short[2,3], Jo Naish[1,4], John Charles Waterton[1,5], Mary Abkir[2,3], Thomas Semple[2,6], Simon Padley[2,3], Jane C Davies[2,3], and Geoff JM Parker[1,7]

[1]Bioxydyn Ltd, Manchester, United Kingdom, [2]National Heart & Lung Institute, Imperial College London, London, United Kingdom, [3]Royal Brompton Hospital, Guy's & St Thomas' Trust, London, United Kingdom, [4]MCMR, Manchester University NHS Foundation Trust, Manchester, United Kingdom, [5]Centre for Imaging Sciences, University of Manchester, Manchester, United Kingdom, [6]Centre for Paediatric and Child Health, Imperial College London, London, United Kingdom, [7]Centre for Medical Image Computing, Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom

Keywords: Lung, Oxygenation

Motivation: Functional lung MRI methods based on different physical principles are available, but their relationship is not well understood in disease

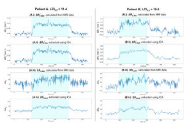
Goal(s): Compare dynamic oxygen-enhanced MRI and 'α-mapping' extracted from the same acquisition with lung clearance index (LCI) in a cystic fibrosis (CF) population

Approach: Oxygen enhancement at 30s to 60s after oxygen start and at plateau are compared with α-mapping in 45 CF patients.

Results: α-mapping and OE-MRI correlate strongly with LCI, confirming their validity. Dynamic OE-MRI identifies areas of fast and slow enhancement, which may be areas of collateral ventilation. α-mapping cannot separate non-ventilated areas from areas of slow gas arrival.

Impact: Dynamic OE-MRI and α-mapping are extracted from a single acquisition and compared in a cystic fibrosis population. Dynamic OE-MRI identifies areas of fast and slow enhancement, possible collateral ventilation. α-Index cannot separate non-ventilated areas from areas of slow gas arrival.

0062 9:15



[ICA-enabled oxygen-enhanced MRI (OE-MRI) correlates with pulmonary function tests in cystic fibrosis]

Sarah H. Needleman[1], Mina Kim[1], Jamie R. McClelland[1], Marta Tibiletti[2], Christopher Short[3,4,5], Thomas Semple[3,4], Jane C. Davies[3,4,5], and Geoff J. M. Parker[1,2]

[1]Centre for Medical Image Computing (CMIC), Department of Medical Physics & Biomedical Engineering, University College London, London, United Kingdom, [2]Bioxydyn Limited, Manchester, United Kingdom, [3]National Heart & Lung Institute, Imperial College London, London, United Kingdom, [4]Royal Brompton Hospital, Guy's & St Thomas' Trust, London, United Kingdom, [5]European CF Society Lung Clearance Index Core Facility, London, United Kingdom

Keywords: Lung, Data Processing

Motivation: There is a clinical need for non-ionising methods to assess heterogeneous lung function in cystic fibrosis (CF). Dynamic oxygen-enhanced MRI (OE-MRI) can assess regional lung function, however OE-MRI analysis is impaired by confounding signals and poor SNR.

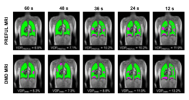
Goal(s): To evaluate the sensitivity of OE-MRI measures to the lung clearance index (LCI) in CF, with and without independent component analysis (ICA) to reduce noise.

Approach: We used ICA to reduce noise in the OE-MRI measures. We evaluated the correlation between OE-MRI measures, LCI, and pulmonary function tests.

Results: OE-MRI measures demonstrated significant correlation with LCI. OE-MRI measures extracted using ICA displayed clear oxygen-enhancement responses.

Impact: Dynamic lung OE-MRI measures extracted using independent component analysis (ICA) exhibited significant correlation with lung clearance index ($LCI_{2.5}$) in cystic fibrosis (CF) patients, suggesting a potential application of ICA-extracted OE-MRI measures to assess regional disease severity in CF.

0063 9:27



Acceleration of Ventilation-Weighted Free-Breathing Functional 1H MRI in Pediatric Cystic Fibrosis Lung Disease

Samal Munidasa[1,2,3], Brandon Zanette[3], Marie-Pier Dumas[4], Wallace Wee[4], Sharon Braganza[3], Daniel Li[3], Jason Woods[1], Felix Ratjen[4], and Giles Santyr[3]

[1]Pulmonary Medicine, Cincinnati Children's Hospital, Cincinnati, OH, United States, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Translational Medicine, The Hospital for Sick Children, Toronto, ON, Canada, [4]Division of Respiratory Medicine, The Hospital for Sick Children, Toronto, ON, Canada

Keywords: Lung, Lung, hyperpolarized 129-Xenon, functional lung MRI

Motivation: Free-breathing pulmonary MRI acquisitions can be lengthy (i.e. 1-minute per slice) which can prove challenging for imaging pediatric lung diseases.

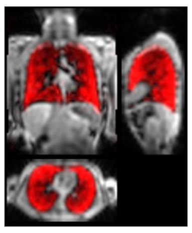
Goal(s): The purpose of this work is to determine if reducing the free-breathing MRI scan time will produce stable ventilation defect measures that agree with hyperpolarized ^{129}Xenon-MRI (Xe-MRI).

Approach: Free-breathing MRI data acquired in cystic fibrosis patients were retrospectively truncated to compare measured Xe-MRI ventilation defects at shorter acquisition times.

Results: Free-breathing MRI ventilation defects showed minimal variability and similar correlation strength to Xe-MRI following approximately 40% reductions in scan time.

Impact: Free-breathing MRI can evaluate pulmonary ventilation in pediatric cystic fibrosis lung disease in agreement with 129Xenon-MRI but is lengthy. Accelerated free-breathing MRI allows for decreased scan durations, without compromising ventilation maps. This can potentially improve clinical translation, especially in pediatrics.

0064 9:39



Preliminary Investigation of Feasibility, Tolerability, and Image Quality of Perfluoropropane Ventilation MRI in Pediatric Participants

Brandon Zanette[1], Faiyza S Alam[1,2], Mary A Neal[3,4], Peter E Thelwall[3,4], Felix Ratjen[1,5], and Giles Santyr[1,2]

[1]Translational Medicine, The Hospital for Sick Children, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Translational and Clinical Research Institute, Newcastle University, Newcastle upon Tyne, United Kingdom, [4]Newcastle Magnetic Resonance Centre, Newcastle University, Newcastle upon Tyne, United Kingdom, [5]Division of Respiratory Medicine, The Hospital for Sick Children, Toronto, ON, Canada

Keywords: Lung, Lung, 19F, Fluorine-19, Ventilation, Perfluoropropane, Gas

Motivation: Inert fluorinated gas MRI has potential as a lower cost alternative to hyperpolarized noble gas MRI for lung ventilation imaging. However, this technology has not yet been evaluated for use in pediatrics.

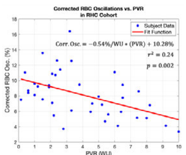
Goal(s): To investigate the feasibility, tolerability, and image quality of inert fluorinated gas MRI with perfluoropropane (PFP) in pediatric participants.

Approach: PFP MRI was performed in pediatric participants. Image quality, SNR, and ventilation defect percent (VDP) were evaluated.

Results: PFP MRI was well-tolerated and successfully performed in all pediatric recruits. Image quality was good and permitted quantification of ventilation defect percent (VDP).

Impact: PFP MRI was determined to be feasible in pediatrics, yielding ventilation images and image quality similar to hyperpolarized gas MRI. This may permit more widespread adoption for the study of pediatric lung disease in the future.

0065 9:51



[Combining Hyperpolarized 129Xe MR Imaging and Spectroscopy to Estimate Pulmonary Vascular Resistance]

Anna Costelle[1], David Mummy[2], Junlan Lu[1], Suphachart Leewiwatwong[3], Sudarshan Rajagopal[4], and Bastiaan Driehuys[1,2,3]

[1]Medical Physics, Duke University, Durham, NC, United States, [2]Radiology, Duke University, Durham, NC, United States, [3]Biomedical Engineering, Duke University, Durham, NC, United States, [4]Cardiology, Duke University, Durham, NC, United States

Keywords: Lung, Lung, Pulmonary Hypertension

Motivation: Pulmonary hypertension (PH) and reduced capillary blood volume, V_C', have competing effects on oscillations of the hyperpolarized ^{129}Xe red blood cell (RBC) resonance, rendering it difficult to distinguish PH.

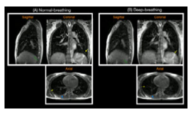
Goal(s): Our goal was to correct RBC oscillations for reduced V_C', then use corrected oscillations to estimate pulmonary vascular resistance (PVR).

Approach: We developed a model of RBC oscillations as a function of V_C' in a cohort without known PH and used this model to derive a correction factor. Corrected oscillations were regressed against known PVR in a cohort with suspected PH.

Results: Corrected oscillations improved PH sensitivity and were significantly correlated to PVR.

Impact: Correcting oscillations in the hyperpolarized ^{129}Xe red blood cell resonance for reduced pulmonary capillary blood volume improves sensitivity to pulmonary hypertension and permits estimation of pulmonary vascular resistance, thereby offering a non-invasive diagnostic alternative to right heart catheterization.

0066 10:03



[High resolution free-breathing respiratory-resolved volumetric lung imaging at 0.55T using stack-of-spiral out-in bSSFP]

Ziwei Zhao[1], Bilal Tasdelen[1], Nam G. Lee[2], and Krishna S. Nayak[1,2]

[1]Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States, [2]Biomedical Engineering, University of Southern California, Los Angeles, CA, United States

Keywords: Lung, Lung, Low-Field MRI, Data Sampling and Reconstruction, Non-Cartesian Trajectory

Motivation: High resolution free-breathing structural lung imaging at 0.55T has been demonstrated using bSSFP half-radial dual-echo imaging with constrained reconstruction within ~10-min scan time.

Goal(s): To develop faster high-resolution free-breathing lung imaging using spiral sampling.

Approach: We employ a stack-of-spirals out-in trajectory with constrained reconstruction along with pilot-tone based respiratory navigation.

Results: Structural lung imaging is demonstrated with 2mm isotropic resolution, 5-7 respiratory states, and 5-7 min scan time. 3D ventilation maps are demonstrated, showing -3.1% ~ 70.2% lung capacity during normal and deep breathing.

Impact: Free-breathing SoSOi can provide simultaneous structural and functional lung imaging at 0.55T within a 5-min scan, with improved sampling efficiency and lower undersampling factor compared to bSTAR. This has implications for the evaluation of lung function and chronic lung diseases.

Power Pitch

Pitch: Stroke

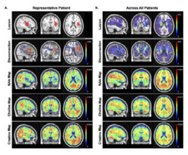
Power Pitch Theatre 1

Monday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Ona Wu

(no CME credit)

0067 Pitch: 8:15 Poster: 9:15 Screen 1



[Combining Cortical Neurometabolic Changes and Structural Disconnection Improves Stroke Severity Prediction: A High-Resolution 1H-MRSI Study]

Ziyu Meng[1], Tianyao Wang[2], Hong Zhou[3], Chang Xu[1], Bin Bo[1], Yibo Zhao[4,5], Rong Guo[4,6], Yudu Li[4,7], Wen Jin[4,5], Xin Yu[8], Zhi-Pei Liang[4,5], and Yao Li[1]

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Keywords: Stroke, Stroke

Motivation: Understanding distant metabolic changes resulting from stroke injuries can offer valuable prognostic biomarkers for patient recovery but remains underexplored.

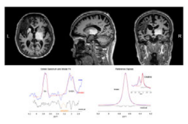
Goal(s): Our goal was to investigate the relationship between lesional and cortical neurometabolic changes, structural disconnections, and their collective impact on stroke severity using high-resolution 3D ^{1}H-MRSI.

Approach: 3D ^{1}H-MRSI scanning using SPICE technology (scan time: 8 minutes, resolution: 2×3×3 mm^{3}, FOV: 240×240×72 mm^{3}) was performed on 105 acute ischemic stroke patients.

Results: Cortical neurometabolic changes were associated with lesional metabolic levels and structural disconnections, which can be used jointly to improve symptom severity prediction in stroke patients.

Impact: The demonstrated predictive value of combining structural disconnections with distant cortical metabolic disruptions may offer prognostic biomarkers useful for treatment and management of stroke patients.

0068 Pitch: 8:15 Poster: 9:15 Screen 2



[Reduced GABA level in ipsilateral thalamus correlates with cognitive impairment in stroke patients]

Zhenxiong Wang[1,2], Peng Wu[3], Yongzhou Xu[4], and Xinhua Wei[1,2]

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Keywords: Stroke, Stroke, GABA, Glx

Motivation: Neurotransmitters are involved in diseases associated with cognitive impairment.

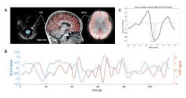
Goal(s): Investigate the changes of the main inhibitory (gamma-aminobutyric acid, GABA) and excitatory neurotransmitters (glutamate and glutamine, Glx) for stroke patients and their correlation with cognitive impairment.

Approach: GABA and Glx were measured using Meshcher-Garwood point-resolved spectroscopy (MEGA-PRESS) sequence in 20 ischemic stroke patients.

Results: GABA to total creatine ratio (GABA/Cr) were reduced in the ipsilateral thalamus compared to the contralateral thalamus, and reduced GABA/Cr in ipsilateral thalamus was strong correlated with cognitive impairment. Thalamic GABA level could serve as a potential target for the evaluation and treatment of patients with post-stroke cognitive impairment.

Impact: The levels of GABA, glutamate and glutamine (Glx) in thalamus can be noninvasively quantified using MRS based on MEGA-PRESS technique in ischemic stroke patients. Reduced GABA level in ipsilateral thalamus was associated with cognitive impairment in ischemic patients.

0069 Pitch: 8:15 Poster: 9:15 Screen 3



Reduced coupling between cerebrospinal fluid flow and global brain activity in post-stroke dementia with subcortical lesion

Nan Zhang[1], Huaying Cai[2], Linhui Ni[2], Guocan Han[3], Dan Wu[1], Zhiyong Zhao[1], and Zixuan Lin[1]

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Keywords: Stroke, Dementia, Neurovascular , glymphatic system

Motivation: Post-stroke dementia (PSD) affects up to one third of stroke survivors but the underlying mechanism remains unclear.

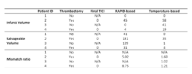
Goal(s): We hypothesized that dysfunction in glymphatic system may play a role in the pathogenesis in PSD and aim to investigate it with non-contrast imaging method.

Approach: Coupling between BOLD and cerebrospinal fluid (CSF) signal was compared between PSD, post-stroke non-dementia (PSND) and normal controls.

Results: Significant reduction in the BOLD-CSF coupling was found in PSD patients, which is negatively associated with cognitive test scores.

Impact: The present work revealed a reduced BOLD-CSF coupling in PSD patients, indicating a potential abnormality in the glymphatic function.

0070 Pitch: 8:15 Poster: 9:15 Screen 4



Improved stratification for thrombectomy after acute ischemic stroke using personalized brain thermal modeling

Dongsuk Sung[1], Peter Kottke[2], Jason W. Allen[3,4], Fadi Nahab[5], Andrei G. Fedorov[2,6], and Candace C. Fleischer[1,4,6]

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Keywords: Stroke, Stroke, Computational Model

Motivation: Prior research has demonstrated the benefits of thrombectomy after acute ischemic stroke (AIS). Despite improvements in surgical techniques, failed reperfusion after thrombectomy is problematic.

Goal(s): Our goal was to evaluate brain temperature-based identification of infarcted and salvageable tissue for improved stratification after AIS.

Approach: A patient-specific computational model using imaging data was used to predict local brain temperatures after AIS to identify infarcted and salvageable tissue and compared to existing clinical methods (RAPID).

Results: Temperature-based stratification identified infarct regions not observed with RAPID and predicted lower mismatch ratios more consistent with final clinical outcomes.

Impact: We demonstrate the potential for model-predicted brain temperatures to quantify infarcted and salvageable tissue after acute ischemic stroke for patient selection for thrombectomy. Local brain temperature may complement existing metrics, particularly for patients without sufficient salvageable tissue.

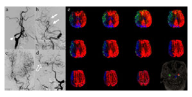
0071 Pitch: 8:15 Poster: 9:15 Screen 5

WITHDRAWN

0072 Pitch: 8:15

Poster: 9:15

Screen 6



Assessment of collateral flow in patients with carotid stenosis using random vessel-encoded arterial spin labeling

Shanshan Lu[1], Chunqiu Su[2], Yuezhou Cao[3], Yining He[4], and Lirong Yan[4]

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Keywords: Stroke, Perfusion

Motivation: The ability to characterize collateral flows is crucial for evaluating patients with steno-occlusive internal carotid artery disease (ICAD). A random vessel-encoded ASL (rVE-ASL) has been introduced as a non-invasive approach for mapping vascular territories.

Goal(s): In this study, we evaluated the feasibility of using a planning-free rVE-ASL to assess collateral flows in patients with ICAD by taking DSA as the golden standard.

Approach: Prospective, case-control study.

Results: rVE-ASL provides comparable information with DSA in determining the presence and the extent of collateral flows. The presence of flow alterations in the territory of middle cerebral artery may be attributed to symptomatic ICAD.

Impact: Our study emphasized the clinical utility of a planning-free random vessel-encoded ASL (rVE-ASL) as a non-invasive tool for characterizing individual collateral pathways and its potential role in predicting and managing symptomatic patients with ICAD.

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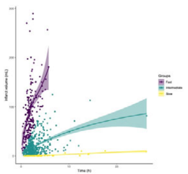
Screen 7



Dynamic evolution of infarct volumes at MRI in ischemic stroke due to large vessel occlusion

Fanny Munsch[1], David Planes[2], Hikaru Fukutomi[3], Thomas Courret[2], Emilien Micard[4], Bailiang Chen[4], Pierre Seners[5], Gaultier Marnat[2], Vincent Planche[6], Pierrick Coupé[7], Vincent Dousset[1,2,8], Bertrand Lapergue[9], Jean-Marc Olivot[10], Igor Sibon[11], Michel Thiebault de Schotten[12], and Thomas Tourdias[1,2,8]

[1]Institute of Bioimaging, University of Bordeaux, Bordeaux, France, [2]Neuroimagerie diagnostique et thérapeutique, CHU de Bordeaux, Bordeaux, France, [3]Neuroimaging department, Kyoto University Hospital, Kyoto, Japan, [4]INSERM CIC-IT U1433, University of Nancy, Nancy, France, [5]INSERM U1266, Institut de Psychiatrie et Neurosciences de Paris, Paris, France, [6]CNRS, UMR 5293, Institut des Maladies Neurodégénératives, University of Bordeaux, Bordeaux, France, [7]Bordeaux INP, LABRI, CNRS, UMR5800, University of Bordeaux, Talence, France, [8]INSERM, Neurocentre Magendie, University of Bordeaux, Bordeaux, France, [9]Service de Neurologie et Unité de Neuro Vasculaire, Hôpital FOCH, Suresnes, France, [10]Unité neurovasculaire, CHU de Toulouse, Toulouse, France, [11]Unité neurovasculaire, CHU de Bordeaux, Bordeaux, France, [12]CNRS, UMR-5293, University of Bordeaux, Bordeaux, France

Keywords: Stroke, Stroke, Image analysis; Prognosis

Motivation: The typical infarct volume courses of stroke patients are still unknown.

Goal(s): We aimed to reveal the spatiotemporal evolutions of infarct volumes and show that such charts help anticipate clinical outcomes.

Approach: On a dataset of large vessel occlusion stroke patients, we performed unsupervised clustering approach to identify groups and then extrapolated pseudo-longitudinal core volume models across time for each group before assessing the growth phenotypes influence on outcome.

Results: We identified three groups with different infarct growth profiles: slow: 11%, intermediate: 62% and fast: 27%, which translated into archetype brain locations. This growth phenotypes significantly predicted the 3-month handicap in two datasets.

Impact: Infarct volumes show stereotypical spatiotemporal courses according to the patient phenotype of resistance to ischemia referred to as slow, intermediate, or fast progressors, which help to anticipate the clinical outcome for new patients.

0074

MERIT AWARD
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Pitch: 8:15

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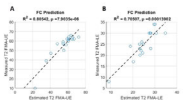
Screen 8



Prediction of Long-term Motor Function Based on Functional Connectivity in Ischemic Stroke after Intra-arterial Thrombectomy

Wei Yang[1], Bing-Fong Lin[1], Yen-Jun Lai[2], Chih-Wei Tang[3], and Chia-Feng Lu[1]

[1]Department of Biomedical Imaging and Radiological Sciences, National Yang Ming Chiao Tung University, Taipei, Taiwan, [2]Department of Radiology, Far Eastern Memorial Hospital, New Taipei City, Taiwan, [3]Department of Neurology, Far Eastern Memorial Hospital, New Taipei City, Taiwan

Keywords: Stroke, Brain Connectivity

Motivation: Intra-arterial thrombectomy (IAT) can remove the thrombus to restore cerebral blood flow. However, even if the thrombus is removed, the experienced hypoxia may still damage the brain, resulting in motor deficits.

Goal(s): This study demonstrated that early brain network changes after IAT treatment can predict long-term recovery in ischemic stroke patients.

Approach: Functional connectivity was correlated with motor recovery after IAT treatment, identifying key functional connectivity features that influence stroke prognosis to unravel the involved mechanisms.

Results: Long-term motor functions can be predicted based on the two-week functional connectivity and Fugl-Meyer Assessment scores.

Impact: The current clinical challenge is that nearly half of stroke patients who undergo IAT still cannot fully recover after treatment and rehabilitation. Early prediction of post-IAT motor recovery in stroke patients can provide appropriate rehabilitation plans in clinics.

0075

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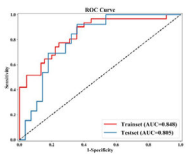
Screen 9



Nomogram to predict hemorrhagic transformation using arterial spin labeling MRI in acute ischemic stroke with mechanical endovascular therapy

jianbin huang[1], yikai xu[2], kan deng[3], peng hao[2], and zhiping zhong[1]

[1]Guangdong Provincial Hospital of Traditional Chinese Medicine, guangzhou, China, [2]nanfang hospital, guangzhou, China, [3]Philips Healthcare, guangzhou, China

Keywords: Stroke, Arterial spin labelling

Motivation: Hemorrhagic transformation (HT) is the most severe complication of acute ischemic stroke.

Goal(s): The present study was to construct and internally validate a nomogram model based on pre-treatment arterial spin labeling (ASL) MRI to predict HT in AIS patients

Approach: This retrospective study enrolled 117 AIS patients with anterior circulation large vessel occlusion. Multivariate logistic regression analysis identified that baseline NIHSS, ADC value and pre-treatment ASL hyperperfusion were independent factors affecting HT. Those independent predictors were then incorporated to develop a predictive nomogram model.

Results: The nomogram model, could reliably calculated the probability of HT in AIS patients with mechanical endovascular therapy.

Impact: The prediction model has significant clinical implications, which could guide clinical screening of high-risk patients and develop more targeted prevention strategies.

0076 Pitch: 8:15

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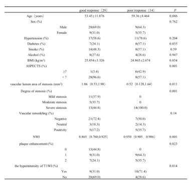
Screen 10



Prediction value of DWI-ASPECTS and HR-VWI to evaluate the response of patients with acute ischemic stroke

Min Lv[1], Jiali Sun[1], Wei Wang[1], and Jianxiu Lian [2]

[1]*First Affiliated Hospital of Harbin Medical University, Harbin, China,* [2]*Philips Healthcare, Beijing, China*

Keywords: Stroke, Atherosclerosis, ASPECTS, HR-VWI, RESPONSE, STROKE

Motivation: The predicted ability of High-resolution vessel wall imaging (HR-VWI) combined with diffusion-weighted imaging (DWI) in acute ischemic stroke (AIS) patients based on the simplified modified Rankin Scale questionnaire （smRSq） remains unknown.

Goal(s): The purpose is to analyze AIS patients by obtaining HR-VWI and DWI information for further providing the information for endovascular therapy.

Approach: Patients are grouped by smRSq including the good response group and the poor. The characteristics of plaque and DWI are analysed for comparing between the two groups.

Results: Severe stenosis, high normalized wall index, plaque enhancement, T1WI high signal and low ASPECTS were risk factors of poor response (all $P<0.05$).

Impact: The combination of HR-VWI and ASPECTS can assist clinical in adopting different rehabilitation management methods for patients.

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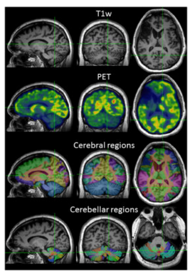
Poster: 9:15

Screen 11



PET and MRI identification of metabolically injured brain and associated resting state networks to predict outcome of DBS chronic stroke therapy

Jacqueline Chen[1], Xuemei Huang[1], Ajay Nemani[1], Frank DiFilippo[1], Stephen Jones[1], Mark Lowe[1], Kenneth Baker[1], and Andre Machado[1]

[1]*Cleveland Clinic, Cleveland, OH, United States*

Keywords: Stroke, Stroke

Motivation: Determine which chronic post-stroke patients with hand motor deficits will benefit from cerebellar deep brain stimulation (DBS).

Goal(s): Test the hypothesis that patients with metabolic injury to fewer rsfMRI networks experienced greater motor improvement after DBS.

Approach: Analysis of baseline 18F-fluorodeoxyglucose PET identified the most metabolically injured brain region (*"PET-max-imbalance-region"*) for 12 patients. The total number of rsfMRI networks and volume of functionally connected brain associated with the *"PET-max-imbalance-region"* were calculated.

Results: : Lower numbers of rsfMRI networks intersecting the *"PET-max-imbalance-region"* and total volumes of brain contained within networks and functionally connected to the *"PET-max-imbalance-region"* were associated with greater arm function improvement after DBS.

Impact: Metrics quantifying the extent of resting-state functional MRI networks associated with the most metabolically injured brain region could be considered as inclusion/exclusion criteria when evaluating candidates for cerebellar deep brain stimulation treatment for chronic post-stroke hand motor deficits.

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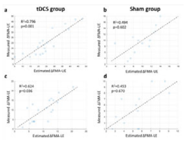
Screen 12



[Bilateral corticospinal tract asymmetry predicts motor recovery after transcranial direct current stimulation in subacute stroke patients]

Bing-Fong Lin[1], Wei Yang[1], Shih-Pin Hsu[2,3], I-Hui Lee[2,3], and Chia-Feng Lu[1]

[1]National Yang Ming Chiao Tung University, Taipei, Taiwan, [2]Division of Cerebrovascular Diseases, Neurological Institute, Taipei Veterans General Hospital, Taipei, Taiwan, [3]Institute of Brain Science, National Yang Ming Chiao Tung University, Taipei, Taiwan

Keywords: Stroke, Diffusion Tensor Imaging

Motivation: A reliable neuroimaging biomarker to predict motor improvement after neuromodulation is lacking.

Goal(s): We compared the integrity of bilateral corticospinal tracts and evaluated the asymmetry before tDCS. The association between the motor improvement and pretreatment integrity of the CST was identified to predict motor recovery in subacute stroke patients.

Approach: We calculated the asymmetry and fractional anisotropy between bilateral CST.
The linear regression analysis was conducted to predict the motor recovery.

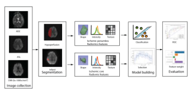
Results: The patients with more severe motor impairment have higher asymmetry in CST. The tDCS regression models achieved an R^2=0.796 and 0.624 for predicting FMA at three months after stroke onset.

Impact: The ischemic stroke patients with higher degree of right white matter integrity have better response to neural modulation effects of tDCS treatment. The identi□fied DTI predictors could be the basis for optimizing the treatment protocols of tDCS in stroke patient.

0079 Pitch: 8:15

Poster: 9:15

Screen 13



[Prognosis prediction based on penumbra and infarct core radiomics features in patients with acute ischemic stroke]

Xiaoling Wu[1], Jing Zhang[2], Fei Wang[1], Xiao Zhang[3], Mengzhou Sun[4], Pinjia Cai[5], Zihan Li[5], Shuixing Zhang[1], and Xiaoyun Liang[2]

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Keywords: Stroke, Radiomics

Motivation: The identification and assessment of the penumbra are crucial for making the right treatment decisions and improving clinical outcomes in acute ischemic stroke (AIS) patients.

Goal(s): To develop a radiomics model based ASL and DWI to predict outcomes of AIS patients with clinical factors.

Approach: Radiomics features were extracted from penumbra and infarct core in 151 patients with clinical parameters. Five-fold cross-validation was performed on 70% data sets, and the model performance was evaluated by an independent test cohort.

Results: The joint model with 4 radiomics features from infarct core and NHISS score yielded highest AUC of 0.802.

Impact: The combined model incorporating clinical factors and radiomics features based on infarct core and penumbra has achieved satisfactory performance in predicting the outcomes of AIS patients, which provides a non-invasive approach to optimize individualized treatment for AIS patients.

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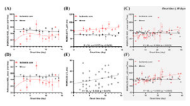
Screen 14



[Predicting the onset of ischemic stroke with multi-parametric mapping based on multiple overlapping-echo detachment (MQMOLED) technique]

Ming Ye[1], Junbo Zeng[1], Qizhi Yang[1], Ying Lin[1], Jianfeng Bao[2], Jianhui Zhong[3], Zhigang Wu[4], Zhong Chen[1], Congbo Cai[1], and Shuhui Cai[1]

[1]*Xiamen University, Xiamen, China,* [2]*Department of Magnetic Resonance Imaging, the First Affiliated Hospital of Zhengzhou University, Zhengzhou, China,* [3]*Department of Imaging Sciences, University of Rochester, Rochester, NY, United States,* [4]*Clinical & Technical Support, Philips Healthcare, Shenzhen, China*

Keywords: Stroke, Stroke, T2 mapping, ADC mapping

Motivation: Multi-parametric quantitative magnetic resonance imaging can characterize tissue properties of ischemic stroke patients noninvasively, but it is generally time consuming and susceptible to motions.

Goal(s): Investigate the value of single-shot multi-parametric mapping based on multiple overlapping-echo detachment (MQMOLED) method in distinguishing acute (≤7 days) and non-acute (>7 days) ischemic stroke patients.

Approach: MQMOLED was applied on ischemic stroke patients (N = 94) to obtain their T_2 and ADC maps, based on which histogram analysis was performed.

Results: The combination of histogram parameters of T_2 and ADC maps effectively discriminated between acute and non-acute ischemic stroke patients (AUC = 0.928).

Impact: The MQMOLED approach shows improvement in predicting acute and non-acute stroke patients. Ultrafast and motion-robust MQMOLED can be included in routine clinical MRI protocols to help patient stratification management for a timely beneficial therapy.

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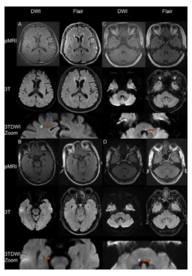
Poster: 9:15

Screen 15



[Detection of Acute Infarction Using 0.23T Mobile Magnetic Resonance Imaging in Patients with Minor Ischemic Stroke or Transient Ischemic Attack]

Yue Suo[1,2], Zhe Zhang[1], Yuyuan Xu[1,2], Ning Wei[1], Wanlin Zhu[1], Nan Qi[1], Xinyao Liu[1], Xiping Gong[2], Kehui Dong[2], Zixiao Li[2], Xia Meng[2,3], Yongjun Wang[1,2,3], and Jing Jing[1,2]

[1]*Tiantan Neuroimaging Center of Excellence, Beijing Tiantan Hospital, Capital Medical University, Beijing, China,* [2]*Department of Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China,* [3]*China National Clinical Research Center for Neurological Diseases, Beijing Tiantan Hospital, Capital Medical University, Beijing, China*

Keywords: Stroke, Stroke

Motivation: Low-field mobile MRI (0.064T) enables early identification of acute infarction(s) for patients with minor ischemic stroke (MIS) or transient ischemic attack (TIA). Improving the spatial resolution and shortening the scanning time are needed.

Goal(s): This study sought to compare the performance of low-field mobile MRI (0.23T) and 3T MRI in detecting acute infarction(s) in MIS or TIA patients within 14 days since onset.

Approach: The accuracy was calculated. The ground truth was defined as the closest 3T fixed MRI examination.

Results: The accuracy of mobile low-field MRI in detecting acute infarction(s) was 96.1%. Overall scan time was shortend compared to the 0.064T system.

Impact: The performance of 0.23T low-field mobile MRI in detecting acute ischemic infarctions was comparable with 3T MRI in our study.

0082

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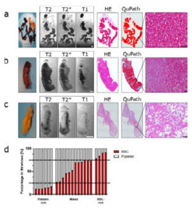
Screen 16



MR microscopy to assess clot composition following mechanical thrombectomy predicts recanalization and clinical outcome

Kianush Karimian-Jazi[1], Dominik Vollherbst[1], Daniel Schwarz[1], Manuel Fischer[1], Katharina Schregel[1], Gregor Bauer[2], Anna Kocharyan[3], Volker Sturm[1], Ulf Neuberger[1], Jessica Jesser[1], Christian Herweh[1], Christian Ulfert[1], Tim Hilgenfeld[1], Fatih Seker[1], Fabian Preisner[1], Niclas Schmitt[1], Tobias Charlet[1], Stefan Hamelmann[4], Felix Sahm[4], Sabine Heiland[1], Wolfgang Wick[1], Peter Ringleb[2], Lucas Schirmer[3], Martin Bendszus[1], Markus Möhlenbruch[1], and Michael Breckwoldt[1]

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Keywords: Stroke, Stroke

Motivation: Mechanical thrombectomy (MT) is the standard for ischemic stroke with large vessel occlusion (LVO). Clot composition is underexplored in clinical practice, leading to standardized MT regardless of clot type.

Goal(s): This single-center study examined clot composition in 60 LVO stroke patients using high-field MRI at 9.4T ("MR-microscopy").

Approach: MR microscopy correlated with histopathology, and quantifying the hyperdense artery sign (HAS) on pre-interventional CT further stratified clot composition.

Results: MR microscopy successfully identified clot types—red (23%), white (28%), or mixed (48%)—with 95.4% accuracy. White clots required more passes during MT, had worse clinical outcomes, while red clots showed better first-pass recanalization rates.

Impact: This study suggests clot imaging can personalize MT for improved outcomes in LVO stroke patients.

0083

MERIT AWARD

MAGNA CUM LAUDE

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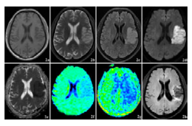
Poster: 9:15

Screen 17



Amido-proton transfer imaging combines DWI to evaluate ischemic penumbra in wake-up stroke patients: A Feasibility study

yanting wang[1], Xiuzheng Yue[2], Zhanguo Sun[3], Yueqin Chen[3], and Hao Yu[3]

[1]Clinical Medical College of Jining Medical University, Jining, Shandong, China, [2]Philips Healthcare (Beijing), Beijing, China, [3]Affiliated Hospital of Jining Medical University, Jining, Shandong, China

Keywords: Stroke, Stroke, ischemic penumbra， wake-up stroke， Amido-proton transfer， Arterial spin labeling， Diffusion weighted imaging

Motivation: Ischemic Penumbra (IP) is an Ischemic tissue that is "basically reversible" during effective treatment. amide proton transfer-weighted (APT) imaging based on the PH value of biological tissues may have certain application value in evaluating the range of ischemic penumbra

Goal(s): This study aimed to explore if APTw imaging has the clinical potential to predict Ischemic Penumbra

Approach: This study intends to apply APTw imaging technology to wake-up stroke patients to explore whether this technology can more accurately evaluate the range of IP compared with ASL technology

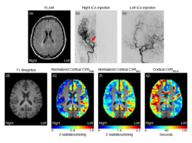
Results: The APTw-DWI mismatch model has the potential to evaluate the ischemic penumbra in wake-up stroke patients

Impact: APTw combined with DWI provides a new method to distinguish ischemic penumbra in patients with wake-up stroke accurately.

0084 Pitch: 8:15

Poster: 9:15

Screen 18



[Cerebrovascular reactivity response delays from time regression analysis are uniquely correlated to recent stroke symptomatology in moyamoya]

Caleb Jeonghyun Han[1], Wesley T. Richerson[1], Maria Garza[1], Murli Mishra[1], Taylor Davis[1,2], Matthew Fusco[3], Rohan Chitale[3], Colin D. McKnight[2], Lori C. Jordan[1,4], and Manus Donahue[1,5,6]

[1]Neurology, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Neurosurgery, Vanderbilt University Medical Center, Nashville, TN, United States, [4]Pediatrics, Vanderbilt University Medical Center, Nashville, TN, United States, [5]Psychiatry and Behavioral Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [6]Electrical and Computer Engineering, Vanderbilt University, Nashville, TN, United States

Keywords: Stroke, Stroke, Cerebrovascular Reactivity, Moyamoya

Motivation: Moyamoya impairment is commonly assessed by anatomical MRI and angiography, yet these methods lack information on compensatory parenchymal behaviors.

Goal(s): To evaluate whether cerebrovascular compliance measures reflect recent ischemic symptomology and may have relevance as biomarkers of stroke risk or as endpoints in interventional trials.

Approach: We applied logistic regression analysis in 73 moyamoya participants to evaluate whether BOLD hypercapnia-induced reactivity or reactivity delays related to recent ischemic symptoms.

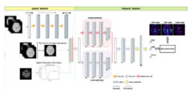
Results: Reactivity delays in the flow territory of ischemic symptoms were found to be significantly lengthened compared to the asymptomatic territories. Maximum vasodilatory responses were less closely associated with symptoms.

Impact: The sensitivity of the cerebrovascular reactivity timing profiles to recent ischemic symptomology suggests that the dynamics of vascular compliance may have clinical relevance as a diagnostic measurement of impairment or treatment response in moyamoya.

0085 Pitch: 8:15

Poster: 9:15

Screen 19



[PERFUSION MAPS QUANTIFICATION USING A NOVELTY SPATIOTEMPORAL CONVOLUTIONAL NEURAL NETWORK]

Anbo Cao[1], Pin-Yu Lee[2], Yan Kang[1], and Jia Guo[3]

[1]College of Health Science and Environmental Engineering, Shenzhen Technology University, Shenzhen, China, guangdong, China, [2]Department of Biomedical Engineering, Columbia University, New York, NY, United States, [3]Department of Psychiatry, Columbia University, New York, NY, USA, New York, NY, United States

Keywords: Stroke, Stroke

Motivation: Traditional methods employing deconvolution techniques to estimate perfusion parameters, like singular value decomposition, are known to be vulnerable to noise, potentially distorting the derived perfusion parameters.

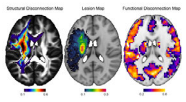
Goal(s): We try to use deep learning methods to achieve accurate perfusion parameter estimation and we also identified the clinical utility of these parameters.

Approach: Data and preprocessing: The gold standard perfusion parameter maps and hypo-perfused masks were generated using commercial software RAPID. 52/86 for the training and validation/testing.
Network architecture: Spatio network and Temporal network.
Loss function: the supervised and unsupervised loss function.

Results: All metrics showed a high degree of consistency with the ground truth.

Impact: Based on this study, we can achieve AI-based automation of imaging, quantification, and analysis in the future, which will significantly change the current landscape of clinical treatment, reducing costs while minimizing harm to the human body.

0086 Pitch: 8:15 Poster: 9:15 Screen 20



Predicting Ischemic Stroke Prognosis based on Lesion Structural and Functional Disconnections

Ning Wu[1]

[1]*Department of Medical Imaging Technology, Yanjing Medical College, Capital Medical University, Beijing, China*

Keywords: Data Processing, Stroke

Motivation: Assessing stroke patients' prognosis is challenging due to complex neurophysiological mechanisms involved, with only lesion location accessible from DWI sequence.

Goal(s): This study aims to use patients' lesion information, alongside its structural and functional disconnections, to predict their recovery.

Approach: We designed a retrospective study using lesion information at admission along with its strctural and funcitonal disconnetion, combined with machine learning to predict the prognosis of 148 stroke patients six months post-stroke.

Results: Our results suggested that the structural and functional disruptions of the lesion could explain and predict National Institutes of Health Stroke Scale score and prognosis of stroke.

Impact: The results not only help us understand the neurophysiological mechanisms underpinning stroke prognosis from the perspective of brain structural and functional connections, but also reveal potential targets for intervention treatments aimed at stroke recovery.

Power Pitch

Pitch: Flow & Angiography in the Heart & Great Vessels

Power Pitch Theatre 2

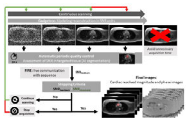
Monday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Bernd Wintersperger & Jennifer Steeden

(no CME credit)

0087 MERIT AWARD SUMMA CUM LAUDE

Pitch: 8:15 Poster: 9:15 Screen 21



Inline automatic quality control of 2D phase-contrast flow MR imaging for subject-specific scan time adaptation

Pierre Daudé[1], Rajiv Ramasawmy[1], Ahsan Javed[1], Robert J Lederman[2], Kelvin Chow[3], and Adrienne Campbell-Washburn[1]

[1]*Laboratory of Imaging Technology, National Heart, Lung & Blood Institute, NIH, Bethesda, MD, United States,* [2]*Cardiovascular Branch, National Heart, Lung & Blood Institute, NIH, Bethesda, MD, United States,* [3]*Siemens Healthcare Ltd., Calgary, AB, Canada*

Keywords: Data Acquisition, Low-Field MRI, MR value

Motivation: Conventional fixed duration acquisitions can result in patient-dependent image quality, leading to either unnecessarily long scan times or insufficient quality across patients.

Goal(s): We propose an inline automatic quality control based on signal-to-noise ratio (SNR) to achieve consistent diagnostic image quality and apply it to 2D phase-contrast flow MRI.

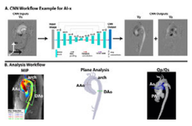
Approach: We designed a closed-loop feedback framework between image reconstruction and data acquisition to automatically stop the acquisition when a target SNR is achieved. Ten healthy volunteers and one patient were imaged at 0.55T.

Results: Deployed inline, the SNR stop threshold saved 53% of the scan duration, with a variation of ±1min across subjects.

Impact: The inline automatic quality control enables a subject-specific optimized scan time while ensuring consistent diagnostic image quality. The distribution of automated stopping times across the population revealed the value of a subject-specific scan time.

0088 Pitch: 8:15 Poster: 9:15 Screen 22

MERIT AWARD SUMMA CUM LAUDE



Fluid-Physics Informed Deep-Learning Enabled 2-point Velocity Encoded 4D flow MRI

Haben Berhane[1], Anthony Maroun[1], Justin Baraboo[1], Bradley Allen[1], and Michael Markl[1]

[1]*Northwestern University, Chicago, IL, United States*

Keywords: Flow, Velocity & Flow, Deep-Learning

Motivation: 4D Flow MRI enables comprehensive hemodynamic assessments, but its clinical usage is hindered by long scan times.

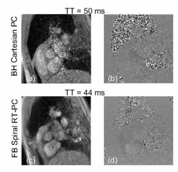
Goal(s): To enable a 2-point velocity encoded 4D flow MRI by using deep-learning to estimate the missing two velocity vector-components, reducing scan time by 50%.

Approach: Convolutional neural networks (CNNs) were trained with a single velocity vector-component as input data to generate a 3D velocity vector field (complete 4D flow dataset). CNN performance was evaluated in peak velocity, net and peak flow, and Qp/Qs compared to standard 4D flow MRI.

Results: AI-derived 4D flow MRI showed strong-to-excellent agreement to standard 4D flow MRI across all comparisons.

Impact: This technique enables reduction of 4D flow MRI scan time and data acquired by 50%. Future work will focus on coupling our method with conventional imaging acceleration techniques to achieve greater scan time reductions and/or improvements in temporal resolution.

0089 Pitch: 8:15 Poster: 9:15 Screen 23



Spiral Real-time Phase Contrast MR on a 0.55T MRI System

Ning Jin[1], Chong Chen[2], Juliet Varghese[2], Katherine Binzel[3,4], Yingmin Liu[3], Rizwan Ahmad[2], and Orlando P. Simonetti[2,3,4,5,6]

[1]*Siemens Medical Solutions USA, Inc, Solon, OH, United States,* [2]*Department of Biomedical Engineering, The Ohio State University, Columbus, OH, United States,* [3]*Dorothy M. Davis Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States,* [4]*Department of Radiology, The Ohio State University, Columbus, OH, United States,* [5]*Division of Cardiovascular Medicine, The Ohio State University, Columbus, OH, United States,* [6]*Department of Internal Medicine, Columbus, OH, United States*

Keywords: Flow, Low-Field MRI

Motivation: Free-breathing (FB) real-time phase contrast (RT-PC) MR is very useful to resolve the beat-by-beat variations and for patients for whom breath-holding poses a challenge; however its feasibility remains to be tested at low-field.

Goal(s): To develop a FB RT-PC MR technique on a clinical wide-bore 0.55T MR scanner with reduced gradient performance.

Approach: FB RT-PC was developed using a dual-density spiral readout with a modified golden-angle rotation strategy and compressed sensing reconstruction. Flow quantifications were compared with the conventional BH segmented PC approach.

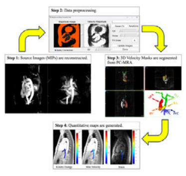
Results: Our proposed method yielded flow measurements of comparable accuracy and effectively captured the peak flow dynamics at low-field.

Impact: The proposed RT PC MR technique for low-field systems could enable flow imaging for patients with arrhythmias, critical illnesses, or claustrophobia, potentially making cardiac MRI more accessible and patient-friendly in a variety of clinical settings.

0090 Pitch: 8:15

Poster: 9:15

Screen 24



Venous Return in Chronic Obstructive Pulmonary Disease Assessed with 4D Flow MRI

Timothy W Houston[1], David Dushfunian [2], Michael Markl[2], Oliver Wieben[1], Martin R. Prince[3], Wei Shen[3], James Carr[2], David A. Bluemke[1], Michael Backman[3], Sachin Jambawalikar[3], Bharath Ambale Venkatesh[4], Joao Lima[4], Prachi Agarwal[5], John Paul Finn[6], Christopher B. Cooper[6], Jing Liu[7], Yoo Jin Lee[7], Joyce Schroeder[8], Dalane W. Kitzman[9], and Graham Barr[3]

[1]University of Wisconsin-Madison, Madison, WI, United States, [2]Northwestern University Feinberg School of Medicine, Chicago, IL, United States, [3]Columbia University, New York, NY, United States, [4]Johns Hopkins University School of Medicine, Baltimore, MD, United States, [5]University of Michigan School of Medicine, Ann Arbor, MI, United States, [6]University of California Los Angeles, Los Angeles, CA, United States, [7]University of California San Francisco, San Francisco, CA, United States, [8]University of Utah School of Medicine, Salt Lake City, UT, United States, [9]Wake Forest University, Winston-Salem, NC, United States

Keywords: Heart Failure, Blood vessels, COPD, Hemodynamics, Heart Failure, 4D Flow

Motivation: Chronic obstructive pulmonary disease (COPD) and emphysema are associated with hemodynamic changes in the pulmonary vasculature, possibly related to increased intra-thoracic pressure during expiration, altering venous return into the thorax.

Goal(s): Assess the association of respiratory dysfunction with hemodynamic parameters of venous return.

Approach: Velocity, kinetic energy, and stasis in the superior vena cava and inferior vena cava were quantified with 4D Flow MRI in 72 subjects across the COPD spectrum in an ongoing study (SPIROMICS HF).

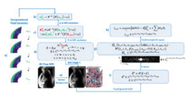
Results: Our results show an association of impaired (reduced) venous return to the thorax with airway obstruction as assessed by spirometry.

Impact: This study demonstrates impaired venous return in subjects with COPD, which warrant further investigations into the cardiopulmonary interactions of right heart flow in COPD and its potential value as a noninvasive marker of disease progression.

0091 Pitch: 8:15

Poster: 9:15

Screen 25



Impact of flow encoding strategies on velocity and turbulence quantification in 4D flow MRI

Pietro Dirix[1], Stefano Buoso[1], and Sebastian Kozerke[1]

[1]University and ETH Zurich, Zurich, Switzerland

Keywords: Synthetic MR, Velocity & Flow, Simulation

Motivation: Blood flow turbulence and velocity quantification with 4D flow MRI is sensitive to imaging parameters such as V_{enc} and undersampling factor, but their impact has not been clearly quantified yet.

Goal(s): Use synthetic 4D flow MRI data to determine the impact of encoding directions and strengths for turbulence and velocity quantification.

Approach: Personalized synthetic 4D flow MRI data are simulated for a given set of encoding velocity strengths and directions assuming a fixed scan budget of 15 minutes.

Results: Turbulent kinetic energy shows large variations depending on the encoding strategy, while velocity magnitudes are marginally affected by the choice.

Impact: Based on the simulations, a 7-point dual- approach represents an efficient approach for accurate velocity and turbulence quantification. However, the low-V_{enc} needs to be tuned to be sensitive to the ranges of expected intra-voxel standard deviations.

0092 Pitch: 8:15

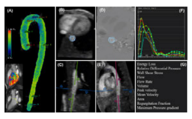
Poster: 9:15

Screen 26

Use of 4D Flow MRI to Indirectly Predict Cardiac Adverse Events Through Hemodynamic Alterations Induced by Exercise

Jiali Li[1], Qian Liu[1], Meining Chen[2], and Jing Chen[1]

[1]Department of Radiology, The Affiliated Hospital of Southwest Medical University, Lu Zhou, China, [2]MR Research Collaboration, Siemens Healthineers, Chengdu, China



Keywords: Flow, Cardiovascular

Motivation: Cardiovascular-related deaths are increasing in athletes, which necessitates a deeper understanding of hemodynamics.

Goal(s): Our goal was to use 4D flow MRI to assess athletes' cardiac and aortic hemodynamics and their links to myocardial fibrosis and cardiac remodeling risks.

Approach: Cardiac MRI was performed on 213 athletes and 32 matched controls. Hemodynamic parameters were measured and analyzed against myocardial fibrosis and cardiac remodeling risks.

Results: Athletes exhibited increased wall shear stress and energy loss. Hemodynamics differed markedly between groups. Our prediction model reliably displayed the potential of 4D flow in assessing cardiac risks.

Impact: Exercise can elevate aortic wall shear stress and energy loss. Four-dimensional flow cardiac MRI may allow predicting myocardial fibrosis or cardiac remodeling risks in athletes, thus informing clinicians of adverse event associations and guiding follow-up adjustments.

0093 Pitch: 8:15

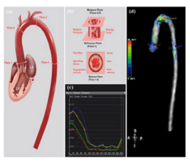
Poster: 9:15

Screen 27

Evaluation of Aortic Hemodynamics Using Four-Dimensional Flow of Magnetic Resonance Imaging in Rabbits with Liver Fibrosis

Jiali Li[1], Yuansheng Li[2], Xiaoyong Zhang[3], and Jing Chen[1]

[1]Department of Radiology, The Affiliated Hospital of Southwest Medical University, Lu Zhou, China, [2]School of Public Health, Southern Medical University, Guangzhou, China, [3]Clinical Science, Philips Healthcare, Chengdu, China



Keywords: Flow, Cardiovascular

Motivation: Hepatic fibrosis impacts systemic blood flow.

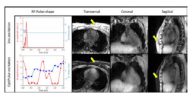
Goal(s): In this rabbit study, we tracked aortic hemodynamics during fibrosis development.

Approach: Thirty rabbits underwent biweekly 4D cardiac magnetic resonance (CMR) scans for 14 weeks post-bile duct ligation (BDL).

Results: Results revealed significant increases in wall shear stress, energy loss, and most aortic parameters at each plane by the 2nd week after bile duct ligation (BDL), peaking at the 6th week ($p < 0.05$). Liver fibrosis appeared at the 2nd, 4th, and 6th weeks post-BDL, corresponding to grades F2, F3, and F4. Plane 2's relative pressure difference strongly correlated with fibrosis severity (R=0.86).

Impact: The occurrence of liver fibrosis could increase WSS, EL, RPD and other hemodynamic parameters of aorta as early as the second week following BDL, which can be detected by 4D flow MRI.

0094 Pitch: 8:15 Poster: 9:15 Screen 28



[Free-running fat-suppressed radial whole-heart 4D flow using OptiPulse]

Robin Ferincz[1], Xavier Sieber[1], Efena Akporeha[1], Mariana B. L. Falcao[1], Jérôme Yerly[2], Michael Markl[3], Jonas Richiardi[1], Ruud B. van Heeswijk[1], Matthias Stuber[1], and Christopher William Roy[1]

[1]Department of Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Switzerland, Lausanne, Switzerland, [2]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, Lausanne, Switzerland, [3]Department of Radiology, Northwestern University, Feinberg School of Medicine, Chicago, IL, USA, Chicago, IL, United States

Keywords: Flow, Heart, Flow, Fat, Whole-heart, Congenital Heart Disease

Motivation: Free-running radial 4D flow has been shown to enable accurate whole-heart quantification and visualization of hemodynamics. However, unsuppressed fat signal can lead to artifacts, which may compromise image quality and cause errors in flow quantification.

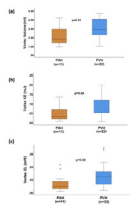
Goal(s): Our study therefore aims to reduce fat signal in radial 4D flow MRI.

Approach: We integrated a novel b-splines iteratively optimized water-excitation RF pulse generated with a previously described framework (OptiPulse) into a radial 4D flow sequence to suppress the signal from fat.

Results: We successfully integrated OptiPulse in radial 4D flow to suppress fat signal and demonstrated comparable quantitative flow assessment to non-fat-suppressed 4D flow.

Impact: The integration of b-splines iteratively optimized water-excitation RF pulses (OptiPulse) into a free-running radial whole-heart 4D flow sequence leads to significantly reduced fat-signal in a promising step towards more robust hemodynamic assessment in patients with large amounts of adipose tissue.

0095 Pitch: 8:15 Poster: 9:15 Screen 29



[Differentiating Pulmonary Hypertension Groups by 3D Vortex-contained energetics from 4D Flow MRI and Correlation with Right Heart Function]

Melika Shafeghat[1], Benjamin Freed[2], James Carr[1], and Mohammed Elbaz[1]

[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Cardiology, Northwestern University, Chicago, IL, United States

Keywords: Flow, Cardiovascular, Pulmonary Hypertention

Motivation: There is a lack of noninvasive methods to differentiate between different Pulmonary Hypertension Groups/types. Such differentiation is clinically critical because treatments of one group can be harmful to another.

Goal(s): We investigated a new noninvasive 4D Flow MRI-based method to differentiate between Pulmonary Arterial Hypertension (PAH) and Pulmonary Venous Hypertension (PVH), currently distinguished conclusively only through invasive catheterization.

Approach: Our study focused on analyzing 3D vortex flow and its energetics in the left pulmonary artery (LPA) using 4D Flow MRI.

Results: We found significant differences in vortex characteristics between PVH and PAH patients, with PVH showing larger vortex cores and higher energetics.

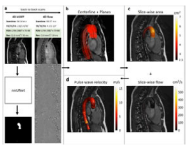
Impact: These findings suggest the potential of LPA vortex flow analysis as a noninvasive diagnostic marker for distinguishing between PAH and PVH and possibly assessing disease severity.

0096

Pitch: 8:15

Poster: 9:15

Screen 30



Combining 4D balanced SSFP and 4D flow MRI for highly localized 3D pulse wave velocity calculations

Renske Merton[1], Daan Bosshardt[1], Gustav J Strijkers[2], Aart J Nederveen[1], Eric M Schrauben[1], and Pim van Ooij[1]

[1]Radiology and Nuclear Medicine, Amsterdam UMC, Amsterdam, Netherlands, [2]Biomedical Engineering and Physics, Amsterdam UMC, Amsterdam, Netherlands

Keywords: Flow, Velocity & Flow, Aorta, Pulse wave velocity, Arterial stiffness

Motivation: To measure 3D pulse wave velocity (PWV) for the investigation of arterial stiffness on a local scale which could benefit patients with aortic disease.

Goal(s): To calculate aortic 3D PWV with the flow-area method and compare with the global method.

Approach: The flow-area method for PWV calculation is applied to 4D flow data combined with automatically-segmented 4D balanced SSFP scans along the thoracic aorta.

Results: This measurement is feasible and shows the expected trend of increasing PWV along the length of the aorta. Averaged values corresponded moderately with the global method.

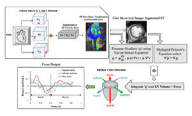
Impact: Increased arterial stiffness measured by PWV is a well-established risk factor for adverse cardiac events. Development of novel MRI technology to locally map arterial stiffness may allow for improved risk-stratification in cardiovascular disease and ultimately guide therapy.

0097

Pitch: 8:15

Poster: 9:15

Screen 31



Non-invasive Assessment of Left Ventricular Hemodynamic Forces in Mitral Patients using 4-Dimensional Flow Magnetic Resonance Imaging

Monisha Ghosh Srabanti [1] and Julio Garcia[2]

[1]Biomedical Engineering, University of Calgary, Calgary, AB, Canada, [2]Radiology, University of Calgary, Calgary, AB, Canada

Keywords: Valves, Quantitative Imaging, Mitral Valve Regurgitation, Hemodynamic Force, Novel Biomarker

Motivation: This study aims to address shortcomings in assessing mitral regurgitation (MR) by introducing left ventricular hemodynamic force (HDF) as a novel biomarker.

Goal(s): The primary objective of this study is to assess HDF's reliability through 4D flow MRI in distinguishing MR patients from healthy controls and stratifying severity, offering a more precise diagnostic tool.

Approach: This retrospective analysis used 4D flow MRI data to compute HDF in three directions, evaluating its correlation with MR.

Results: MR patients exhibit significantly altered HDF compared to controls. The HDF: peak systolic base-apex, E-wave inferior-anterior, E-wave base-apex, and peak diastolic septal-lateral suggest their potential as mitral biomarkers.

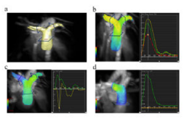
Impact: The introduction of hemodynamic force as a novel biomarker opens new research avenues, potentially reshaping cardiac non-invasive diagnostic techniques. This study may transform the assessment of mitral regurgitation, offering benefits to clinicians for early intervention and proper patient management.

0098

Pitch: 8:15

Poster: 9:15

Screen 32



Assessment of Pulmonary Arteries Hemodynamics in Athletes with 4D Flow MRI

Mingsong Tang[1], Meining Chen[2], and Jing Chen[1]

[1]Department of Radiology, The Affiliated Hospital of Southwest Medical University, Luzhou, China, [2]MR Research Collaboration, Siemens Healthineers, Chengdu, China

Keywords: Flow, Heart, Athlete; Pulmonary artery; 4D flow

Motivation: Long-term intense training in athletes can lead to pathological cardiac remodeling (CR) and potential myocardial fibrosis (MF), raising cardiovascular risks.

Goal(s): Employ 4D flow MRI to study pulmonary arterial hemodynamics in athletes and explore correlations with CR and MF.

Approach: Scanned 121 athletes and 21 controls using 3 T MRI scanner; 4D flow data analysis on CVI42; built machine learning models for differentiation based on cardiovascular conditions.

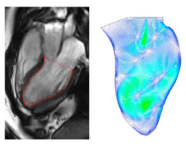
Results: Found significant associations between the altered pulmonary arterial hemodynamics parameters and CR and/or MF. Machine learning models identified athletes with cardiac anomalies.

Impact: We indicated that exercise can induce remodeling of the pulmonary circulation in athletes. The evaluation of pulmonary arterial 4D flow hemodynamics parameters can be beneficial for clinical follow-up of athletes.

0099 Pitch: 8:15

Poster: 9:15

Screen 33



MRI-based analysis of the blood flow in the left ventricle: 2D geometry-prescribed Cine-MRI based model versus 4D-Flow CMR

Delphine Perie[1], Agathe Bedoux[1], Pierre Dubois[1], and Sebastien Leclaire[1]

[1]*Mechanical Engineering, Polytechnique Montreal, Montreal, QC, Canada*

Keywords: Flow, Cardiovascular, Analysis/Processing, Data Processing, Flow, Heart, In Silico, Modelling, Simulation/Validation, Simulations, Velocity & Flow

Motivation: 4D-Flow CMR allows to analyze 3D blood flow patterns in the left ventricle, however it requires time-consuming acquisitions and complex pre and post-processing.

Goal(s): The objective is to develop a method to analyze blood flow patterns in the left ventricle without these disadvantages.

Approach: Using Cine-MRI and patient-specific modelling techniques, we introduced a new and semi-automated method to simulate the blood flow inside the left ventricle. Accuracy of the developed method was evaluated by comparing the results to 4D-Flow CMR analysis performed on one healthy subject.

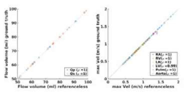
Results: Both techniques showed similar blood flow patterns and comparable hemodynamics parameters.

Impact: This patient-specific model is a relatively simple and time-saving method allowing blood flow analysis in the left ventricle based on Cine-MRI acquisition. It may be used to characterize blood flow in patients with heart disease at rest or under stress.

0100 Pitch: 8:15

Poster: 9:15

Screen 34



Referenceless 4D Flow MR for cardiac imaging

Chiara Trenti[1,2], Erik Ylipää[3,4], Tino Ebbers[1,2], Jan Engvall[5], and Petter Dyverfeldt[1,2]

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Keywords: Flow, Data Processing, Image reconstruction

Motivation: Scan times for clinical 4D Flow MRI are still around 5-10 mins, which is too long for ideal integration in clinical practice.

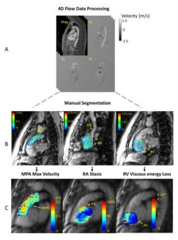
Goal(s): To investigate the possibility to reduce scan time by reconstructing three-directional velocity without the acquisition of reference scan in cardiac applications.

Approach: Training a conditional generative adversarial network (cGAN) to estimate the reference scan from the three-velocity encoded scan segments.

Results: Correlation coefficients for the pulmonary and systemic flow volumes and for maximum velocities were higher than 0.99, showing an excellent agreement between the cGAN-enabled referenceless 4D Flow MRI and conventional 4D flow MRI, thus potentially reducing scan time.

Impact: By reconstructing the three-directional velocity without the reference scan it is possible reduce scan time of 4D Flow MRI, alleviating costs and patient discomfort, which especially is important for elderly and impaired subjects.

0101 Pitch: 8:15 Poster: 9:15 Screen 35



Chronic Obstructive Pulmonary Disease is Associated with Impaired Cardiac Hemodynamics: A SPIROMICS HF Study

David Dushfunian[1], Timothy W. Houston[2], Michael Markl[1], Oliver Wieben[2], Martin R. Prince[3], Wei Shen[4], James Carr[1], David Bluemke[5], Michael Backman[6], Sachin R. Jambawalikar[3], Bharath Ambale Venkatesh[7], Joao Lima[7], Prachi Agarwal[8], Steven Lloyd[9], Paul Finn[10], Christopher B. Cooper[11], Jing Liu[12], Yoo Jin Lee[12], Joyce Schroeder[13], Dalane W. Kitzman[14], and R. Graham Barr[15]

[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [3]Department of Radiology, Columbia University Medical Center, New York, NY, United States, [4]Department of Pediatrics, Columbia University Medical Center, New York, NY, United States, [5]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [6]Columbia University Medical Center, New York, NY, United States, [7]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States, [8]Department of Radiology, University of Michigan School of Medicine, Ann Arbor, MI, United States, [9]University of Alabama at Birmingham Heersink School of Medicine, Birmingham, AL, United States, [10]Department of Radiology, University of California Los Angeles, Los Angeles, CA, United States, [11]Departments of Medicine and Physiology, University of California Los Angeles, Los Angeles, CA, United States, [12]Department of Radiology, University of California San Francisco, San Francisco, CA, United States, [13]Department of Radiology, University of Utah School of Medicine, Salt Lake City, UT, United States, [14]Department of Cardiology, Wake Forest University, Winston-Salem, NC, United States, [15]Department of Medicine, Columbia University Medical Center, New York, NY, United States

Keywords: Flow, Velocity & Flow, COPD, Lung, hemodynamics

Motivation: Previous studies have suggested impaired cardiovascular function in patients with chronic obstructive pulmonary disease (COPD). However, the association between lung disease severity and the degree of cardiac hemodynamic impairment is not well understood.

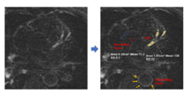
Goal(s): We aimed to characterize the hemodynamic changes seen in COPD in order to gain insight into the mechanisms relating COPD and heart failure.

Approach: We analyzed 4D-flow derived hemodynamics in a preliminary sample of 72 participants from the SPIROMICS-HF study.

Results: We found that impaired hemodynamics in the right atrium (blood flow kinetic energy and velocity) and pulmonary artery (flow stasis and velocity) are associated with greater COPD severity.

Impact: This study represents a key step in exploring the cardiopulmonary hemodynamic interaction in chronic obstructive pulmonary disease.

0102 Pitch: 8:15 Poster: 9:15 Screen 36



Coronary Artery Wall Contrast Enhancement Imaging Impact on Disease Activity Assessment in IgG4-RD a direct marker of coronary involvement

Yaqi Du[1], Guan Wang[1], Yun Bai[1], Xinrui Wang[1], and Ying Zhong[1]

[1]Department of Radiology, The First Hospital of China Medical University, Shenyang, China

Keywords: Vessel Wall, Cardiovascular, IgG4-related cardiovascular disease, cardiac magnetic resonance, coronary wall contrast enhancement, IgG4-RD responder index

Motivation: The coronary wall involvement in IgG4-related disease (IgG4-RD) is overlooked in conventional imaging, more sensitive approach is needed.

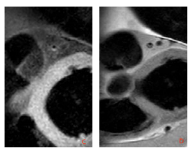
Goal(s): To investigate the feasibility of quantifying contrast enhancement (CE) to detect coronary involvement in IgG4-RD and the influence on disease activity assessment based on the IgG4-RD Responder Index (RI).

Approach: The coronary artery wall images of the IgG4-RD, systemic lupus erythematosus (SLE) patients and healthy subjects were analyzed and IgG4-RD-RI scores were collected for correlations analysis.

Results: Coronary artery wall CE can be a direct marker of coronary artery injury and may improve disease activity assessment in IgG4-RD.

Impact: Coronary artery wall CE can serve as an objective indicator of disease activity. Considering coronary artery wall CE in the IgG4-RD-RI scoring has the potential to enhance the comprehensiveness of disease activity assessment and enable more appropriate treatment decisions.

0103 Pitch: 8:15 Poster: 9:15 Screen 37



3D non-enhanced coronary MRA combined with wall imaging in the diagnosis of coronary artery stenosis

qiuju hu[1], yane zhao[2], DI TIAN[3], WEIBO CHEN[4], BAIJUN WANG[5], TONG CHEN[4], DONGSHENG JIN[2], and guangming lu[6]

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Keywords: Vessel Wall, Cardiovascular, Coronary artery disease

Motivation: Advancements in coronary MR angiography (CMRA)
have optimized the visualization of coronary anatomical structures, subsequently enhancing coronary artery stenosis, dilation, and certain anatomical variations【1-3】.Current meta-analysis shows that coronary MRA has a 79% accuracy rate for detecting obstructive CAD compared with gold-standard ICA

Goal(s): Thus,the combining wall imaging may potentially enhances the diagnosis performance of coronary artery stenosis

Approach: compare diagnostic performance of 3D -non enheanced CMRA with combined wall imaging

Results: Our study suggest that combining these two techniques may improve the accuracy of coronary stenosis.

Impact: CMRA has unique diagnostic in detecting coronary artery stenosis, and the improvement of diagnostic accuracywill further promote its clinical application.

0104 Pitch: 8:15 Poster: 9:15 Screen 38

Association between Aortic Morphology and Aortic Wall Properties

Bharath Ambale Venkatesh[1], Nadjia Kachenoura[2], Emilie Bollache[2], Thomas Dietenbeck[2], Alban Redheuil[3], Elie Mousseaux[4], and Joao Lima[1]

[1]Johns Hopkins University, Baltimore, MD, United States, [2]Sorbonne Universete, Paris, France, [3]Pitie Salpetriere APHP University Hospital, Paris, France, [4]Hôpital Européen Georges Pompidou, Paris, France

Keywords: Vascular, Machine Learning/Artificial Intelligence

Motivation: To understand how closely aortic morphology is associated with aortic wall properties.

Goal(s): (1) To correlate aortic shape using morphometrics to aortic stiffness indexed by pulse wave velocity
(2) To correlate shape to regional aortic wall shear stress

Approach: We use atlas-based shape analysis (morphometrics) to generate principal modes of shape variation, and then correlate modes of shape variation with pulse wave velocity to check their association. We also generate deep-learning based WSS using aortic shapes defined as point clouds forming the input to the neural network.

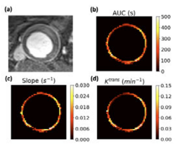
Results: Aortic shapes were moderately associated with aortic stiffness as well as regional wall shear stress.

Impact: Studying aortic morphological remodeling patterns may provide key insight into underlying disease processes that involve changes in aortic material wall properties and regional flow characteristics.

0105 Pitch: 8:15

Poster: 9:15

Screen 39



[Association of Dynamic Contrast Enhanced (DCE) MRI of Abdominal Aortic Aneurysm (AAA) Wall with Progression: A Prospective Study]

Ang Zhou[1], Huiming Dong[2], Joseph Leach[1], Jonas Schollenberger[1], Chengcheng Zhu[3], Yoo Jin Lee[1], James Iannuzzi[4], Warren Gasper[4], David Saloner[1], and Dimitrios Mitsouras[1]

[1]*Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States,* [2]*Department of Radiation Oncology, University of California Los Angeles, Los Angeles, CA, United States,* [3]*Department of Radiology, University of Washington, Seattle, WA, United States,* [4]*Department of Surgery, University of California San Francisco, San Francisco, CA, United States*

Keywords: Vascular, Cardiovascular

Motivation: Abdominal Aortic Aneurysms (AAAs) are common, and rupture has >80% mortality. The standard of care is regular surveillance and repair when maximum diameter thresholds are reached. Many ruptures occur before AAA reach these thresholds at surveillance.

Goal(s): The goal of this prospective study was to determine if AAA wall contrast kinetics using DCE MRI, presumably associated with inflammatory microvasculature, independently predict progression.

Approach: 23 AAA patients were followed over a mean follow-up interval of 14±6 months.

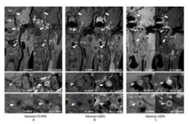
Results: K^{trans} was significantly associated with progression after controlling for AAA maximum diameter. This suggests that DCE MRI may provide useful information regarding future AAA progression.

Impact: Contrast kinetics in AAA wall tissue assessed by DCE MRI may be useful for improving AAA risk stratification.

0106 Pitch: 8:15

Poster: 9:15

Screen 40



[Associations between atherosclerotic luminal stenosis in the distal internal carotid artery and diffuse wall thickening in its upstream segment]

Jin Zhang[1], Beibei Sun[2], Peng Wu[3], Yongjun Cheng[3], Weibo Chen[3], and Huilin Zhao[2]

[1]*Radiology, Renji Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai, China,* [2]*Renji Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai, China,* [3]*Philips Healthcare, Shanghai, China*

Keywords: Vessel Wall, Atherosclerosis

Motivation: Significant atherosclerotic stenosis or occlusion in the distal carotid artery may induce diffuse wall thickening (DWT) in the upstream arterial wall.

Goal(s): This study aimed to assess the association of atherosclerotic steno-occlusive diseases in the distal internal carotid artery (ICA) with DWT in the upstream ipsilateral ICA.

Approach: Individuals with atherosclerotic stenosis in the distal ICA, detected by carotid MR vessel wall imaging, were enrolled.

Results: Significant correlations were found between distal ICA stenosis and DWT in the petrous ICA, DWT severity, the longitudinal extent of DWT in the ICA, enhancement in the petrous ICA) and enhancement degree.

Impact: Diffuse wall thickening is a common secondary change in atherosclerotic steno-occlusive disease in the intracranial carotid. This phenomenon constitutes a confounding factor in the distinction between atherosclerosis and inflammatory vasculopathies, and could be reversed after alleviated atherosclerotic stenosis.

Power Pitch

Pitch: Diffusion Clinical Applications

Power Pitch Theatre 3

Monday

Pitches: 8:15 - 9:15

Posters: 9:15 - 10:15

Moderators: Pek-Lan Khong & Su Lui

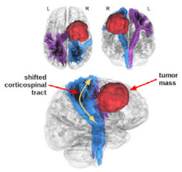
(no CME credit)

0107

Pitch: 8:15

Poster: 9:15

Screen 41



ODF-Fingerprinting reconstruction of corticospinal tracts for preoperative planning of brain tumor resection

Patryk Filipiak[1,2], Kamri Clarke[1,2], Timothy M. Shepherd[1,2], Saad I. Gondal[1,2,3], Mary Bruno[1,2], Dimitris G. Placantonakis[4], and Steven H. Baete[1,2,5]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Herricks High School, New Hyde Park, NY, United States, [4]Department of Neurosurgery, Perlmutter Cancer Center, Neuroscience Institute, Kimmel Center for Stem Cell Biology, NYU Langone Health, New York, NY, United States, [5]Vilcek Institute of Graduate Biomedical Sciences, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Tractography, Tractography & Fibre Modelling, preoperative planning, ODF-fingerprinting, pyramidal tract, corticospinal tract, brain tumor, BOLD activation, task fMRI

Motivation: Tractography enables preoperative visualization of major neural pathways altered or displaced by a brain tumor; however, it often fails to reconstruct the cortical terminations of corticospinal tracts due to the complex bending and branching formations of fibers.

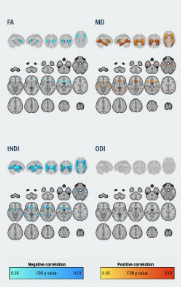
Goal(s): We aim to improve tracking of corticospinal tracts in their most challenging regions of hand and face projections to the motor cortex.

Approach: We refine reconstruction of fibers inside corticospinal tracts by incorporating ODF-Fingerprinting into the tracking pipeline.

Results: With ODF-Fingerprinting, we increased the overlap between the reconstructed corticospinal tracts and the cortical regions activated during task-based functional MRI involving hand and face movement.

Impact: Our improved reconstruction can help decrease the incidence of postoperative deficits by identifying the structural neural connections that need to be spared during tumor resection.

0108 Pitch: 8:15 Poster: 9:15 Screen 42



White matter neurite alterations in dementia with Lewy body bodies: influence of amyloid-β and tau

Elijah Mak[1,2], Robert Reid[1], Scott Przybelski[3], Timothy Lesnick[3], Christopher Schwarz[1], Matthew Senjem[1], Sheelakumari Raghavan [1], Prashanthi Vemuri[1], Clifford R Jack [1], Hoon K Min[1], Manoj K Jain[4], Toji Miyagawa[5], Leah K Forsberg[5], Julie Fields[6], Rodolfo Savica[5], Jonathan Graff-Radford[5], David T Jones [5], Hugo Botha [5], Erik K St. Louis[5,6], David S Knopman[5], Vijay Ramanan[5], Dennis Dickson[7], Neill R Graff-Radford[8], Tanis J Ferman[9], Ronald C Petersen[5], Val J Lowe[1], Bradley F Boeve [5], John T O'Brien[2], and Kejal Kantarci[1]

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Keywords: Microstructure, Dementia, Lewy bodies, NODDI, DTI, Amyloid, Tau

Motivation: The influence of Alzheimer's disease (AD) copathologies on white matter neurite changes in dementia with Lewy bodies (DLB) remains unclear.

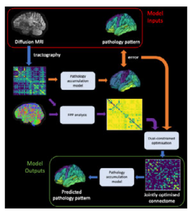
Goal(s): To delineate the severity of neurite abnormalities and their associations with amyloid and tau PET imaging in DLB.

Approach: We compared Neurite Orientation Dispersion and Density Imaging metrics in the DLB spectrum (DLBs, n=45) against controls (n=45), and evaluated their correlations with amyloid-β ([11C]-PiB) and tau ([18F]-Flortaucipir) PET.

Results: The DLBs exhibited widespread white matter injury relative to controls. Elevated tau deposition, but not amyloid-β burden, was significantly associated with neurite abnormalities, predominantly involving the temporal and limbic white matter tracts.

Impact: These findings demonstrate the impact of AD copathologies on widespread neurite abnormalities in people with DLB, underscoring the importance of further elucidating the mechanisms underlying amyloid-β and tau deposition, and evaluating anti-AD disease-modifying interventions for DLB.

0109 Pitch: 8:15 Poster: 9:15 Screen 43



Joint Estimation of Brain Connectivity and Propagation of Neurodegeneration

Anna Schroder[1], Elinor Thompson[1], Tiantian He[1], Marco Palombo[2], Simona Schiavi[3], Alessandro Daducci[4], Neil P. Oxtoby[1], and Daniel C. Alexander[1]

[1]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom, [2]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, Cardiff, United Kingdom, [3]ASG Superconductors S.p.A, Genoa, Italy, [4]Department of Computer Science, University of Verona, Verona, Italy

Keywords: Tractography, Brain Connectivity

Motivation: Models of propagation of neurodegeneration encode hypotheses on the mechanisms of pathology spread via the brain's connectome. However, they fail to accurately capture pathology patterns, partly due to errors in tractography-estimated connectomes.

Goal(s): We use this link between pathology and connectivity to help resolve errors in connectivity estimation. Specifically, we use disease-related pathology to jointly estimate brain connectivity and pathology propagation.

Approach: We introduce a new algorithm to use an estimate of the false-positive potential (FPP) of each connection to constrain the pathology-informed connectome-optimisation.

Results: Combining FPP and pathology-informed optimisation yields substantial improvement to both the connectome and the connectome-based prediction of pathology.

Impact: By jointly estimating pathology and the connectome, we advance both disease understanding and understanding of structural connectivity. The work is a first demonstration of the general idea of using pathology to inform on brain connectivity.

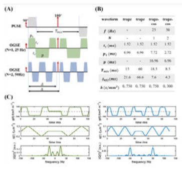
0110

MERIT AWARD SUMMA CUM LAUDE

Pitch: 8:15

Poster: 9:15

Screen 44



Quantifying Cervical Spinal Cord Pathology of Multiple Sclerosis Using Oscillating Gradient Spin-echo DWI

Sisi Li[1], Fan Liu[1], Yi Xiao[1], Diwei Shi[2], Mangsuo Zhao[3], Yuqi Zhang[3], Xianchang Zhang[4], Yishi Wang[4], Junzhong Xu[5,6,7], and Hua Guo[1]

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Keywords: Microstructure, Diffusion Tensor Imaging, oscillating gradient, diffusion time, spinal cord, multiple sclerosis

Motivation: Spinal cord MRI has both diagnostic and prognostic value for multiple sclerosis (MS) patients. Several quantitative MRI biomarkers show high sensitivity to characterize MS lesions but lack pathological specificity. Time-dependent DWI may reveal microstructural features and pathological variations in MS.

Goal(s): To explore diffusion time-dependence in the cervical spinal cord and its potential to quantify pathology of MS

Approach: Optimized oscillating gradient spin-echo (OGSE) DTI were performed for healthy volunteers (N=18) and MS patients (N=17).

Results: Diffusivities show time-dependence in the dorsal-columns and lateral-funiculis of healthy controls. The increase of RD in MS lesions is larger than healthy WM when diffusion time decreases.

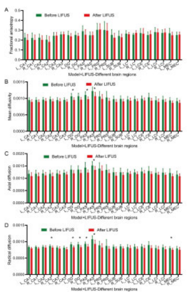
Impact: The time-dependence of diffusivities in the cervical spinal cord of healthy volunteers and MS patients are observed using optimized OGSE DWI sequences on a clinical scanner. This may reveal further insight into the microstructural differences and pathological variations in MS.

0111

Pitch: 8:15

Poster: 9:15

Screen 45



Low-intensity focused ultrasound Reverses Cisplatin-Induced Cognitive Impairment in Rats: Behavioral and DTI Evidence

Xiaowei Han[1], Jiahuan Liu[1], Xisong Zhu[1], and Jiangong Zhang[2]

[1]Department of Radiology, The Quzhou Affiliated Hospital of Wenzhou Medical University, Quzhou People's Hospital, Quzhou, China, [2]Department of Nuclear Medicine, The First people's Hospital of Yancheng, The Yancheng Clinical College of Xuzhou Medical University, Yancheng, China

Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging

Motivation: Cisplatin-Induced cognitive impairment, resulting from chemotherapeutic agents, is typically addressed through pharmacological treatments absent of effective rehabilitation therapy.

Goal(s): Aim to investigate the therapeutic efficacy of Low-Intensity Focused Ultrasound (LIFUS), with a specific emphasis on the hippocampus, using an established animal model.

Approach: We scrutinized the behavioral and cerebral alterations in rats with cisplatin chemotherapy, utilizing pre- and post-treatment behavioral phenotypes and diffusion weighted imaging (DTI) with a 9.4T MRI scanner.

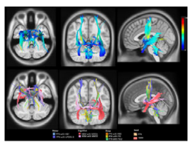
Results: Our findings revealed significant differences in indicators of biological behavior and DTI across specific brain regions in the LIFUS-treated group, suggesting that LIFUS holds potential in reversing brain damage.

Impact: Our research helps to understand brain plasticity changes after LIFUS treatment with cisplatin chemotherapy, providing the theoretical support for future clinical intervention in chemotherapy related cognitive impairment.

0112 Pitch: 8:15

Poster: 9:15

Screen 46



Dichotomizing Motor and Non-motor Correlates of Cholinergic Network Denervation in Parkinson’s Disease using Correlational Tractography

Pohchoo Seow[1], Yao Chia Shih[2], Septian Hartono[3], Weiling Lee[4], Pik Hsien Chai[4], Celeste Yan Teng Chen[5], Eng King Tan[5], and Ling Ling Chan[6]

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Keywords: Tractography, Parkinson's Disease

Motivation: Cholinergic denervation underlying clinical manifestations in Parkinson’s disease (PD) is complicated.

Goal(s): To clarify motor vs non-motor correlates of cholinergic denervation in PD and identify potential novel therapeutic targets.

Approach: We evaluated for significant associations between projections of the nucleus basalis of Meynert and pedunculopontine nucleus and motor/non-motor scores using correlational tractography in a case-control PD cohort.

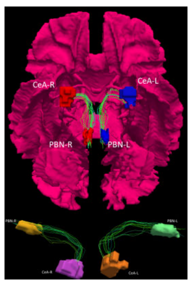
Results: Intracellular and extracellular diffusivity demonstrated significant correlations with motor, cognitive and sleep assessment scores in patients. Significantly reduced intra- and extracellular diffusivity of the PPN-cholinergic-motor projection were seen. The cholinergic projections were dichotomized where the most correlated segments innervated ventral posterolateral thalamic nuclei.

Impact: The motor and non-motor correlates of cholinergic denervation show potential as objective clinical markers to characterize the PD spectrum while mapping of the cholinergic projection with highest correlation could identify substructure areas as novel stimulation target.

0113 Pitch: 8:15

Poster: 9:15

Screen 47



Investigation of Human Brain Parabrachial Nucleus (PBN) - Central Amygdala (CeA) Pathway by Diffusion Tractography

Chandana Kodiweera[1], Byeol Kim[2], and Tor D Wager[1,2]

[1]Dartmouth Brain Imaging Center, Department of Psychological and Brain Sciences, Dartmouth College, Hanover, NH, United States, [2]Department of Psychological and Brain Sciences, Dartmouth College, Hanover, NH, United States

Keywords: Tractography, Brain Connectivity, nociceptive pain pathway, chronic pain, anxiety, Parabrachial nucleus, Center amygdala, ball and sticks model, msmt-csd, probabilistic diffusion tractography

Motivation: The parabrachial nucleus (PBN) to the central amygdala (CeA) is a critical pathway for multiple types of aversive, unconditional threat behaviors including chronic pain states in animals. However, there do not exist connectivity studies on this pathway in the human brain by diffusion tractography.

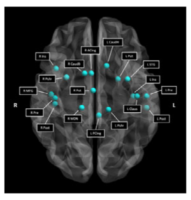
Goal(s): Study of connectivity between PBN and CeA by diffusion tractography.

Approach: Probabilistic tractography with the ball-and-stick model (FSL) and multi-shell, multi-tissue constrained spherical deconvolution, and fixel-based analysis (MRTRIX).

Results: The study showed the existence of a PBN-CeA pathway in the human brain. Average streamline density of this pathway differs across the subjects while the cross section is comparable.

Impact: This study has discovered that a PBN-CeA pathway exists in both hemispheres of the human brain, which is consistent with our previous functional connectivity study. This finding will open up new avenues of research on fear conditioning, anxiety, and pain.

0114 Pitch: 8:15 Poster: 9:15 Screen 48



[Microstructural Characterization of Network-Based Neurodegeneration in Multiple Sclerosis Using High Gradient Diffusion MRI.]

Florence L. Chiang[1], Eva Krijnen[2], Laleh Eskandarian[1], Hong-Hsi Lee[1], Hansol Lee[1], Eric C. Klawiter[2], and Susie Y. Huang[1]

[1]*Radiology, Massachusetts General Hospital, Boston, MA, United States,* [2]*Neurology, Massachusetts General Hospital, Boston, MA, United States*

Keywords: Microstructure, Gray Matter, Neurodegeneration

Motivation: Findings of this study help clarify the microstructural substrate of network-based gray matter (GM) atrophy and improve current understanding of network concepts in multiple sclerosis (MS).

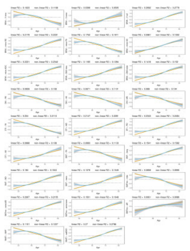
Goal(s): The goal of this study was to assess network behavior of microstructural alterations in atrophy-prone GM.

Approach: We leveraged high gradient diffusion MRI to probe GM at the mesoscopic scale by using the SANDI (Soma and Neurite Density Imaging) method.

Results: Our results demonstrated decreased cell body density in atrophy-prone GM of MS, which correlates with clinical disability. Further, covariance of localized GM microstructural alteration suggests that neuronal loss may relate in part to network-based effects.

Impact: Decreased cell body density in atrophy-prone gray matter in multiple sclerosis is correlated with clinical disability and exhibits network behavior. Findings may support future development of quantitative non-invasive methods for sensitive monitoring of disease progression to enable prompt clinical intervention.

0115 Pitch: 8:15 Poster: 9:15 Screen 49



[Distinct longitudinal brain white matter microstructure changes and associated polygenic psychiatric and neurodegenerative disorder risk]

Max Korbmacher[1,2,3], Dennis van der Meer[2,4], Dani Beck[2,5,6], Daniel Edvard Askeland-Gjerde[2], Eli Nina Eikefjord[1,3], Arvid Lundervold[1,3,7,8], Ole A. Andreassen[2,9], Lars T. Westlye[2,6,9], and Ivan I. Maximov[1,2]

[1]*Department of Health and Functioning, Western Norway University of Applied Sciences, Bergen, Norway,* [2]*NORMENT Centre for Psychosis Research, Division of Mental Health and Addiction, University of Oslo and Oslo University Hospital, Oslo, Norway,* [3]*Mohn Medical Imaging and Visualization Centre (MMIV), Bergen, Norway,* [4]*Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, Netherlands,* [5]*Department of Psychiatric Research, Diakonhjemmet Hospital, Oslo, Norway,* [6]*Department of Psychology, University of Oslo, Oslo, Norway,* [7]*Department of Radiology, Haukeland University Hospital, Bergen, Norway,* [8]*Department of Biomedicine, University of Bergen, Bergen, Norway,* [9]*KG Jebsen Centre for Neurodevelopmental Disorders, University of Oslo, Oslo, Norway*

Keywords: DWI/DTI/DKI, Brain, Ageing | White Matter | Microstructure | Brain Ageing | Polygenic Risk | Magnetic Resonance Imaging | Diffusion MRI

Motivation: White matter microstructural (WMM) changes are a crucial feature of ageing and disease development. There is yet no comprehensive mapping of such changes.

Goal(s): Providing an overview of WMM changes at different spatial scales, and relationship of these changes to polygenic risk scores (PGRS) of developing psychiatric disorders and Alzheimer's disease.

Approach: WMM metrics were estimated using multiple diffusion approaches, associated with age and PGRS, and ageing changes (inter-scan interval:2.44±0.73 years) assessed at different spatial scales.

Results: We find spatially distributed WMM-changes and PGRS-associations across the brain (most age-sensitive: central and cerebellar WMM). Brain longitudinal changes reflected disorder PGRS better than cross-sectional measures.

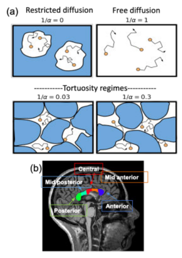
Impact: The manuscript details for the first time longitudinal WMM changes in a large longitudinal sample (UK Biobank, N=2,676), and provides the currently most comprehensive overview of PGRS associations with WMM *change* and WMM (using an additional cross-sectional validation sample, N=31,056).

0116 Pitch: 8:15 Poster: 9:15 Screen 50

Selective filters of translational molecular diffusion dynamics in human brain microstructures

Analia Zwick[1,2,3], Ezequiel L. Saidman[3], Stefano Tambalo[4], Manuela Moretto[4], Lisa Novello[4], Thorsten Feiweier[5], Jorge Jovicich[4], and Gonzalo A. Alvarez[1,2,3]

[1]Centro Atómico Bariloche, CONICET, CNEA, Bariloche, Argentina, Bariloche, Argentina, [2]Instituto de Nanociencia y Nanotecnologia, CNEA, CONICET, Bariloche, Argentina, Bariloche, Argentina, [3]Instituto Balseiro, CNEA, Bariloche, Argentina, Bariloche, Argentina, [4]Center for Mind/Brain Sciences - CIMeC, University of Trento, Rovereto, Italy, Rovereto, Italy, [5]Siemens Healthcare GmbH, Erlangen, Germany, Erlangen, Germany



Keywords: Microstructure, Diffusion/other diffusion imaging techniques

Motivation: Our primary aim is to enhance non-invasive tissue-microstructure characterization as a diagnostic paradigm through advanced MRI methods.

Goal(s): We explore microscopic tortuosity in human white-matter using the Non-uniform Oscillating-Gradient Spin-Echo (NOGSE) contrast in a clinical 3T MRI-scanner.

Approach: The NOGSE contrast was obtained by subtracting distinct OGSE acquisitions, allowing the discrimination of signals from molecules within specific brain compartments.

Results: We found restriction-sizes consistent with human histological findings, and evidence that the dominant signals originate from extra-axonal spaces, supporting microscopic tortuosity effects. This compartment-size specific contrast opens a path for diagnosis based on quantitative imaging.

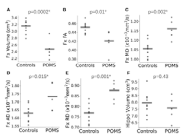
Impact: We characterize microscopic-tortuosity mechanisms in human-brain white-matter through the Non-uniform Oscillating-Gradient Spin-Echo contrast, which targets the signal of confined molecules in specific microscopic-sizes. This novel contrast, demonstrated at 3T-MRI, promises a quantitative tissue-microstructure paradigm for medical diagnosis of diseases.

0117 Pitch: 8:15 Poster: 9:15 Screen 51

High-resolution Fluid-suppressed Diffusion Tractography Shows Altered Fornix Volume and Diffusion Metrics in Pediatric Multiple Sclerosis

Carly Weber[1], Colin Wilbur[2], and Christian Beaulieu[1,3]

[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada, [2]Pediatric Neurology, University of Alberta, Edmonton, AB, Canada, [3]Radiology and Diagnostic Imaging, University of Alberta, Edmonton, AB, Canada



Keywords: Tractography, White Matter, microstructure, brain, adolescents, MS

Motivation: It is unknown if the fornix (main output tract of the hippocampus) is affected in pediatric multiple sclerosis (MS), which would suggest its early involvement.

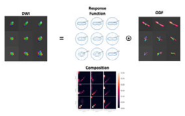
Goal(s): Are the volume and diffusion metrics of the fornix affected in pediatric MS as it is in adult MS, and does fornix injury precede damage to the hippocampus?

Approach: Fornix diffusion tensor imaging and whole-brain MPRAGE were acquired from pediatric MS patients and controls. The fornix was identified with tractography.

Results: Pediatric MS showed a much (29%) smaller fornix with abnormal diffusion metrics indicative of early injury, but had no difference in hippocampus volume, compared to controls.

Impact: Diffusion tractography identifies marked injury to the fornix, a small white matter tract important for cognition, in children and adolescents with multiple sclerosis, while the hippocampus volume is unaffected, implicating the fornix as an early brain target in this disease.

0118 Pitch: 8:15 Poster: 9:15 Screen 52



[Blind spherical deconvolution of multi-shell diffusion MRI to model regional changes in pathology]

Siebe Leysen[1,2], Ahmed Radwan[2,3], Frederik Maes[1,2], Stefan Sunaert[2,3,4], and Daan Christiaens[1,2,3]

[1]Department of Electrical Engineering, ESAT/PSI, KU Leuven, Leuven, Belgium, [2]Medical Imaging Research Center, UZ Leuven, Leuven, Belgium, [3]Department of Imaging and Pathology, Translational MRI, KU Leuven, Leuven, Belgium, [4]Department of Radiology, KU Leuven, Leuven, Belgium

Keywords: Diffusion Modeling, Signal Representations

Motivation: Diffusion-weighted MRI (dMRI) has significantly enhanced our ability to investigate the brain's microstructure, but analysis in pathology remains difficult.

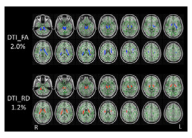
Goal(s): This study introduces a voxelwise approach to concurrently estimate the Orientation Distribution Function (ODF) and response function for fiber orientation analysis and tractography.

Approach: The proposed blind deconvolution method models the kernel as a sum of axially-symmetric Gaussian functions, defined in spherical harmonics. It is evaluated through simulations and in-vivo experiments in healthy volunteers and glioma patients, demonstrating its efficacy in ODF estimation and data fitting.

Results: This novel approach presents better modeling of pathology and offers promising results for white matter analysis.

Impact: We introduce a blind deconvolution method for brain microstructure analysis with DWI that concurrently estimates a voxelwise ODF and kernel. This method can aid tractography and provide new image contrasts in the presence of pathology.

0119 Pitch: 8:15 Poster: 9:15 Screen 53



[Brain White Matter Microstructural Abnormalities in Children with Global Developmental Delay: A Tract-Based Spatial Statistics Analysis]

Xiaoxue Zhang[1], Xin Zhao[1], Jinxia Guo[2], Xiaoan Zhang[1], Yanyong Shen[1], and Changhao Wang[1]

[1]the Third Affiliated Hospital of Zhengzhou University, Zhengzhou, China, [2]GE Healthcare MR Research, Beijing, China

Keywords: DWI/DTI/DKI, Diffusion/other diffusion imaging techniques, Tract-Based Spatial Statistics;neurodevelopmental disorder;children

Motivation: The diagnosis of global developmental delay (GDD) heavily relies on clinical scale assessments, which are highly subjective and present challenges for early diagnosis and intervention.

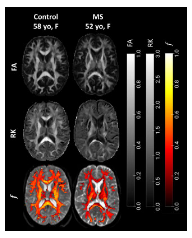
Goal(s): The purpose of this study was to investigate the changes in white matter microstructure in children with GDD.

Approach: We used a diffusional kurtosis imaging (DKI)-based TBSS approach to analyze the whole brain.

Results: Our findings indicate abnormalities in multiple white matter brain regions among children with GDD. Additionally, DKI parameters were found to be correlated with clinical developmental levels.

Impact: The DKI can offer quantitative parameter values for assessing microstructural changes in the brain of GDD, making it a promising diagnostic tool.

0120 Pitch: 8:15 Poster: 9:15 Screen 54



[Brain microstructure charts in controls and multiple sclerosis patients using clinical diffusion MRI]

Jenny Chen[1], Benjamin Ades-Aron[1], Ying Liao[1], Michelle Pang[2], Valentin Stepanov[1], Timothy M. Shepherd[1], Elizabeth Chasen[1], Jelle Veraart[1], Dmitry S. Novikov[1], and Els Fieremans[1]

[1]New York University Grossman School of Medicine, New York, NY, United States, [2]University of Hawai'i at Manoa, Honolulu, HI, United States

Keywords: DWI/DTI/DKI, White Matter

Motivation: Currently, brain charts index gray matter brain volume from T1-weighted MRI, whose sensitivity is limited to millimeter resolution, thereby unable to probe early signs of aging and pathology at the cellular level.

Goal(s): To introduce normative data for diffusion MRI (dMRI) and apply it to multiple sclerosis (MS) patients to evaluate sensitivity and accuracy.

Approach: We created normative data using diffusion tensor, diffusion kurtosis, and standard model imaging metrics in white matter. Then, assessed MS subjects by comparing to these normative data.

Results: dMRI metrics from MS patients deviate from normative data, suggesting brain charts may be used to benchmark brain health.

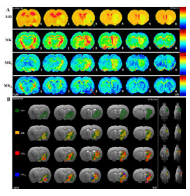
Impact: This study is the first step to achieve a brain-age framework from clinically feasible dMRI scans that provides meaningful insight into microstructural processes underlying brain aging and disease– possibly enabling quantitative assessment of treatment response to future disease-modifying therapies.

0121 Pitch: 8:15
Poster: 9:15
Screen 55

[In vivo tensor-valued diffusion MRI evaluates isotropic and anisotropic kurtosis mismatch in a middle cerebral artery occlusion stroke model]

Mingyao Liang[1,2], Jiangyu Yuang[1,2], Tingting Gu[3], Yaohui Tang[3], and Yi He[1,2]

[1]the Fifth Affiliated Hospital, Sun Yat-sen University, Zhuhai, China, [2]Guangdong-Hong Kong-Macao University Joint Laboratory of Interventional Medicine, the Fifth Affiliated Hospital, Sun Yat-sen University, Zhuhai, China, [3]Department of Biomedical Engineering, Shanghai jiaotong university, Shanghai, China



Keywords: Microstructure, Ischemia, MKI MKA mismatch isotropic kurtosis anisotropic kurtosis

Motivation: Diffusion-weighted imaging (DWI) is widely used in the early detection of stroke, providing valuable information on the infarct core and ischemic penumbra. The mismatch between DWI and more advanced dMRI enhances the accuracy of stroke lesion characterization.

Goal(s): Our goal is to explore whether advanced tensor-valued diffusion MRI (dMRI) can yield sensitive microstructural readouts and evaluate the mismatch between anisotropic and isotropic kurtosis as a potential biomarker for stroke.

Approach: We performed tensor-valued dMRI in a middle cerebral artery occlusion (MCAO) rodent model.

Results: The tensor-valued diffusion MRI demonstrated significant mean diffusivity, mean kurtosis, anisotropic kurtosis, and isotropic kurtosis lesion mismatch.

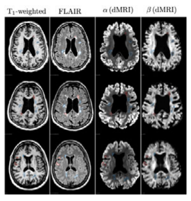
Impact: Tensor-valued diffusion MRI reveals the isotropic and anisotropic in kurtosis/diffusion lesion mismatch in an animal model of acute stroke, the tensor-valued dMRI may help characterize different microstructural features of acute stroke lesions for precision medicine.

0122 Pitch: 8:15
Poster: 9:15
Screen 56

[Sticks or no sticks? White matter microstructure in multiple sclerosis from high-b scaling]

Santiago Coelho[1,2], Valentin Stepanov[1,2], Nalini Jeet[1,2], Timothy M Shepherd[1,2], Dmitry S Novikov[1,2], and Els Fieremans[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States



Keywords: Microstructure, Multiple Sclerosis

Motivation: Representing axons as impermeable sticks is a cornerstone of white matter modeling, e.g. for the Standard Model and related models. However, the validity of this framework in pathology remains unknown.

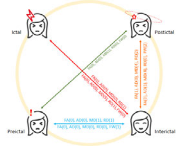
Goal(s): Validate the modeling assumption of axons as impermeable sticks in multiple sclerosis white matter.

Approach: We analyze the functional form of the orientationally-averaged signal as a function of b-value up to b=10,000 s/mm^2.

Results: We find that normal-appearing white matter, T1 black-holes, and T1-hypointense lesions show distinct deviations from the healthy tissue power-law $b^{-1/2}$ signal scaling. Simulations reveal these deviations may be specific markers for microglia inflammation and unmyelinated leaky axons.

Impact: We assess the validity of the modeling assumption of water diffusion along impermeable axons in multiple sclerosis tissue. Pathological processes such as microglial inflammation or demyelination show different behaviors in this experimental regime, highlighting the potential for an imaging biomarker.

0123 Pitch: 8:15 Poster: 9:15 Screen 57



White matter changes across the migraine cycle evaluated with Diffusion Tensor Imaging and the impact of Free Water

Irene Guadilla[1,2], Ana R Fouto[2], Álvaro Planchuelo-Gómez[3], Antonio Tristán-Vega[3], Amparo Ruiz-Tagle[2], Inês Esteves[2], Gina Caetano[2], Nuno A Silva[4], Pedro Vilela[5], Raquel Gil-Gouveia[6,7], Santiago Aja-Fernández[3], Patrícia Figueiredo[2], and Rita G Nunes[2]

[1]Universidad Autónoma de Madrid, Madrid, Spain, [2]Institute for Systems and Robotics - Lisboa and Department of Bioengineering, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal, [3]Laboratorio de Procesado de Imagen, Universidad de Valladolid, Valladolid, Spain, [4]Learning Health, Hospital da Luz, Lisbon, Portugal, [5]Imaging Department, Hospital da Luz, Lisbon, Portugal, [6]Neurology Department, Hospital da Luz, Lisbon, Portugal, [7]Center for Interdisciplinary Research in Health, Universidade Católica Portuguesa, Lisbon, Portugal

Keywords: Diffusion Modeling, Diffusion Tensor Imaging, Migraine

Motivation: About 25% of female migraine patients suffer from menstrual-related migraine, which has been poorly studied.

Goal(s): To identify white matter alterations across the migraine cycle in patients with episodic menstrual-related migraine without aura.

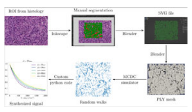
Approach: Diffusion MRI allows to assess alterations in the brain tissue microenvironment. Moreover, including the free-water contribution in the diffusion signal can give information about biological mechanisms, such as inflammation, and more directly expose the tissue alterations by removing free water contamination.

Results: Significant differences were found in the diffusion parameters of the white matter tracts of the menstrual-related migraine patients.

Impact: We found significant alterations in the diffusion parameters of the white matter tracts of episodic menstrual-related migraine patients across migraine cycle using standard diffusion tensor imaging (DTI) and Free-Water corrected DTI.

0124 Pitch: 8:15 Poster: 9:15 Screen 58

MERIT AWARD MAGNA CUM LAUDE



A Monte Carlo simulation framework for histology-informed diffusion MRI parameter estimation in cancer

Athanasios Grigoriou[1,2], Anna Voronova[1,2], Kinga Bernatowicz[1], Sara Simonetti[3,4], Garazi Serna[3], Núria Roson[5,6], Manuel Escobar[5,6], Maria Vieito[7,8], Paolo Nuciforo[3], Rodrigo Toledo[9], Elena Garralda[10], Roser Sala-Llonch[11,12], Marco Palombo[13,14], Raquel Perez-Lopez[1], and Francesco Grussu[1]

[1]Radiomics Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [2]Department of Biomedicine, Faculty of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain, [3]Molecular Oncology Group, Vall d'Hebron Institute of Oncology, Barcelona, Spain, [4]Prostate Cancer Translational Research Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [5]Institut de Diagnòstic per la Imatge (IDI), Barcelona, Spain, [6]Department of Radiology, Hospital Universitari Vall d'Hebron, Barcelona, Spain, [7]GU, Sarcoma and Neuroncology Unit, Hospital Universitari Vall d'Hebron, Barcelona, Spain, [8]Drug Development Unit, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [9]Biomarkers and Clonal dynamics group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [10]Early Clinical Drug Development Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [11]Department of Biomedicine, Faculty of Medicine, Institute of Neurosciences, Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, Spain, [12]Centro de Investigación Biomédica en Red de Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN), Barcelona, Spain, [13]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom, [14]School of Computer Science and Informatics, Cardiff University, Cardiff, United Kingdom

Keywords: Simulation/Validation, Microstructure, Monte-Carlo, Histology

Motivation: Analytical biophysical diffusion MRI (dMRI) models fail to capture the full complexity of diffusion processes.

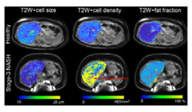
Goal(s): We propose a Monte Carlo (MC) simulation framework enabling the numerical implementation of biophysical models with unprecedented fidelity to histology.

Approach: Our framework enables simulating diffusion within cancer environments reconstructed from histology. It provides paired examples of dMRI signals and histological properties, which can be used to build numerical microstructure parameter estimators.

Results: Our approach enables more accurate estimation of key properties such as cell size compared to fitting of classical multi-compartment analytical models.

Impact: We propose a Monte Carlo (MC) simulation framework enabling the implementation of biophysicalmodels with unprecedented fidelity to histology. The framework improves microstructure inference compared to standard analytical fitting, and may provide more robust biomarkers in diseases such ascancer.

0125 Pitch: 8:15 Poster: 9:15 Screen 59



Characterization of liver inflammation in non-alcoholic steatohepatitis using MRI cytometry

xiaoyu jiang[1], Manhal Izzy[2], Mary Kay Washington[2], Junzhong Xu[2], and John Gore[2]

[1]*Vanderbilt University Medical Center, Nashville, TN, United States,* [2]*Vanderbilt University Medical Center, nashville, TN, United States*

Keywords: Microstructure, Diffusion/other diffusion imaging techniques

Motivation: Addressing the unmet need for non-invasive non-alcoholic steatohepatitis (NASH) diagnosis.

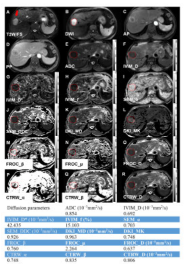
Goal(s): Assessing MRI cytometry's potential for quantifying alterations in cell sizes and cell densities linked to inflammation, a critical factor in NASH diagnosis.

Approach: Histology-based simulations were used to assess MRI cytometry's performance across various SNR levels in normal and NASH liver tissues. Additionally, used MRI cytometry to distinguish healthy liver from NASH with a clinical 3T scanner.

Results: Both simulations and in vivo data revealed increased cell density and reduced cell sizes in inflammatory areas compared to steatosis and healthy liver tissues.

Impact: Findings of this study establish a strong foundation for future investigations into the role of non-invasive assessment of liver cellular characteristics in diagnosing NASH, with the ultimate goal of reducing the necessity for liver biopsy.

0126 Pitch: 8:15 Poster: 9:15 Screen 60



Multiple advanced diffusion models for preoperative prediction of macrotrabecular-massive subtype in solitary hepatocellular carcinoma

Yongjian Zhu[1], Wei Cai[1], Yueluan Jiang[2], Yinqiao Yi[3], Guang Yang[3], and Xinming Zhao[1]

[1]*Department of Diagnostic Radiology, National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China,* [2]*MR Research Collaboration, Siemens Healthineers, Beijing, China,* [3]*Shanghai Key Laboratory of Magnetic Resonance, East China Normal University, Shanghai, China*

Keywords: Microstructure, Diffusion/other diffusion imaging techniques, Tumor

Motivation: Pretherapeutic characterization of the aggressive macrotrabecular-massive (MTM) subtype hepatocellular carcinoma (HCC) may promote the implementation of precision treatment and improvement of prognosis.

Goal(s): To investigate the value of multiple advanced diffusion models in identifying the MTM subtype of HCC preoperatively.

Approach: DWI of twelve b-values (0-2000 s/mm^2) were performed in 70 patients with HCC. Multiple diffusion-derived parameters were extracted and compared between MTM and non-MTM HCC. The predictive efficacy of various diffusion parameters was assessed.

Results: CTRW_α exhibited the highest predictive performance with an AUC of 0.861 among individual parameters, a combination of parameters could improve the AUC to 0.912.

Impact: MTM is a distinct subtype of HCC and is associated with aggressive biological behavior, but it might be a suitable candidate for immunotherapy. Our result demonstrated that non-Gaussian diffusion parameters could serve as promising biomarkers for predicting MTM preoperatively.

Study Group Business Meeting
MR of Cancer Business Meeting

Room 324 Monday 9:15 - 10:15

(no CME credit)

Plenary Session
Monday Plenary

Organizers: Adrienne Campbell-Washburn, Shaoying Huang, Kathryn Keenan, Najat Salameh, Mathieu Sarracanie

Plenary Hall (Hall 603-604) Monday 11:15 - 12:15 *Moderators:* Adrienne Campbell-Washburn & Shaoying Huang

11:15 New Contrasts

David Lurie[1]

[1]*University of Aberdeen, United Kingdom*

11:35 New Applications
Kevin Sheth[1]

[1]*Yale Center for Brain & Mind Health*

11:55 New Access
Clarissa Cooley[1]

[1]*Massachusetts General Hospital, Charlestown, MA, United States*

Other
Gold Corporate Symposium Siemens Healthineers
Plenary Hall (Hall 603-604) Monday 12:30 - 13:30

(no CME credit)

Study Group Business Meeting
Perfusion Business Meeting
Room 303-304 Monday 13:45 - 14:45

(no CME credit)

Study Group Business Meeting
Interventional MR Business Meeting
Room 324 Monday 13:45 - 14:45

(no CME credit)

Digital YIA Poster
Young Investigator Award Poster Session
Exhibition Hall (Hall 403) Monday 13:45 - 15:45

(no CME credit)

Weekday Course
Forensic & Histology MRI: Bridging Physics, Biology & Pathology
Organizers: Najat Salameh, Rita Schmidt

Summit 1 Monday 13:45 - 15:45 *Moderators:* Le Roy Chong & Cornelia Laule

13:45 Forensic Brain MRI
Claudia Lenz[1] and Eva Scheurer[1]

[1]*University of Basel, Basel, Switzerland*

Keywords: Neuro: Brain

Forensic medicine employs scientific disciplines to solve legal queries, with forensic imaging, including MRI, as its newest branch. Postmortem cases are investigated to clarify the cause and manner of death, to reconstruct violent events, to determine the time of death and the presence of diseases. Postmortem MRI faces challenges such as temperature variations, postmortem changes and formalin fixation effects. This talk gives an overview on the advantages and challenges of in situ and ex situ postmortem examinations. It emphasizes methods for adapting MRI techniques for forensic brain MRI, highlighting the current research for forensic purposes and the validation of biomarkers.

14:15 Biophysical Models of Quantitative MRI for Anatomy & Histology
Evgeniya Kirilina[1]

[1]*Max Plank Institute for Cognitive Brain Science, Germany*

14:45 Forensic MRI of the Whole Body: Challenges & Opportunities

Eva Scheurer[1,2] and Claudia Lenz[1]

[1]Institute of Forensic Medicine, Health Department Basel-Stadt, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland

Keywords: Neuro: Brain

TBA

15:15 UTE for Fracture Detection & Age Evaluation

Jiang Du[1]

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

Keywords: Musculoskeletal: Skeletal, Image acquisition: Quantification, Image acquisition: Sequences

This lecture talks about recent technical developments in ultrashort echo time (UTE) magnetic resonance imaging and applications in fracture detection and age evaluation. A series of techniques have been developed for high contrast imaging of cortical and trabecular bone. Quantitative UTE techniques have also been developed for mapping of T1, T2*, magnetization transfer ratio (MTR), MT modeling of macromolecular fraction (MMF), quantitative susceptibility mapping (QSM) of bone susceptibility, as well as total, bound, and free water in bone. Applications in fraction detection and age evaluation are also discussed.

Weekday Course

Imaging Trauma in the Cardiovascular System

Organizers: Michael Atalay, Tarique Hussain, Andrew Scott, Tobias Wech

Summit 2 — Monday 13:45 - 15:45 — *Moderators:* Dana Peters & Bernd Wintersperger

14:15 Repetitive Exercise-Induced Cardiac Trauma in Endurance Athletes

TBD

14:45 Cerebrovascular Vessel Wall Imaging in Trauma

Mahmud Mossa-Basha[1]

[1]University of Washington, United States

15:15 Takotsubo: A Myocardial Response to Trauma

Kim-Lien Nguyen[1]

[1]David Geffen School of Medicine at UCLA, Los Angeles, CA, United States

Keywords: Cardiovascular: Cardiovascular, Cardiovascular: Myocardium, Cross-organ: Tissue characterisation

Takotsubo cardiomyopathy represents a myocardial response to acute physiologic stress and is characterized by reversible left ventricular apical ballooning in the absence of angiographically significant coronary artery disease. Although the diagnosis is usually confirmed at the time of invasive coronary angiography, multimodality imaging can be performed to clinch the diagnosis earlier and non-invasively. Of the modalities, cardiovascular magnetic resonance imaging has a central role due to its strengths in tissue characterization and vascular depiction. This presentation will discuss the physiology and provide evidence to support the use of MRI and MRA in Takotsubo cardiomyopathy.

Oral

Non-BOLD fMRI

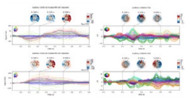
Hall 606 — Monday 13:45 - 15:45 — *Moderators:* Kamil Uludag & Olli Gröhn

13:45 Introduction

Kamil Uludag

University of Toronto, Canada

0127 13:57 [Investigating neural responses using fast, non-selective MRI and simultaneous EEG]



A Tyler Morgan[1], Peter J Molfese[1], J Andrew Derbyshire[1], Renzo Huber[1], and Peter A Bandettini[1]

[1]NIMH, Bethesda, MD, United States

Keywords: fMRI Acquisition, fMRI, DIANA, neural

Motivation: Recent reports of DIANA responses open the possibility of non-invasively recording neural activity using fMRI.

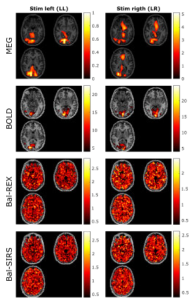
Goal(s): We aim to test fast, non-selective MRI to better evaluate the feasibility of capturing DIANA responses in the human brain.

Approach: We develop a fast bSSFP sequence without gradient encoding to record the center of k-space during neural activation with a temporal resolution of 3ms.

Results: We observe MRI response dynamics on the order of tens to hundreds of milliseconds, and compare to simultaneously acquired EEG measurements.

Impact: We tested a fast, non-selective MRI sequence to provide preliminary evidence for direct measurement of neural responses in the human brain, and compare these responses to simultaneously acquired EEG measurements.

0128 14:09 [Exploring the sensitivity limits of neuronal current imaging with MRI and MEG in the human brain]



Milena Capiglioni[1], Davide Tabarelli[2], Federico Turco[1], Stefano Tambalo[2], Roland Wiest[1], and Jorge Jovicich[2]

[1]Institute for Diagnostic and Interventional Neuroradiology, Support Center for Advanced Neuroimaging (SCAN), University of Bern, Bern, Switzerland, [2]Center for Mind/Brain Sciences, University of Trento, Rovereto (Trento), Italy

Keywords: Bioeffects & Magnetic Fields, Multimodal, Spin-lock, Pulse sequence design, New Signal Preparation Schemes

Motivation: In-vivo use of Spin-lock (SL) rotary MR saturation contrast, despite encouraging phantom studies, raises questions about its sensitivity and practicality in neural magnetic field imaging.

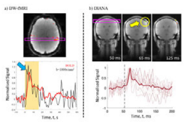
Goal(s): Determine if SL contrast effectively maps human neuronal activation, evaluating its sensitivity and localization against MEG and 3T BOLD-fMRI.

Approach: Thirteen volunteers underwent SL-based scanning during visual stimulation, alongside BOLD and magnetoencephalography, with phantom experiments validating the paradigm and processing pipelines.

Results: Preliminary analysis revealed significant activation in the expected visual region for three subjects in SL contrast maps. Low detection was attributed to sensitivity limits estimated in the phantom, falling below MEG-estimated neural fields.

Impact: We assess Spin-lock 3T MR contrast for human neuronal activation mapping. Promising initial results highlight the need for refinement due to sensitivity limitations in neural field detection, supported by phantom MRI and MEG measurements.

0129 14:21



[Neurovascular & experimental confounds when probing neuronal activity with fast fMRI: exploring evasive DIANA & DW-fMRI.]

Elisa Zamboni[1], Isaac Watson[2], Frida Torkelsen[3], James McStravick[4], and Aneurin James Kennerley[4]

[1]School of Psychology, University of Nottingham, Nottingham, United Kingdom, [2]School of Physics, Engineering, and Technology, University of York, York, United Kingdom, [3]Department of Chemistry, University of York, York, United Kingdom, [4]Department of Sports and Exercise Sciences, Manchester Metropolitan University, Manchester, United Kingdom

Keywords: fMRI Acquisition, Neuro, Neuronal Activity, Line Scan Imaging

Motivation: Exploring the cerebrum's functional organisation and processing is challenging. Functional Magnetic Resonance Imaging (fMRI) measures neuronal activity (NA) noninvasively, but relies on indirect signals related to cerebral haemodynamics.

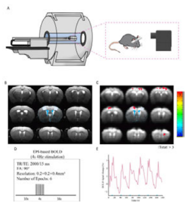
Goal(s): We rigorously investigate if NA in the human brain can be measured using diffusion-weighted fMRI and Direct Imaging of Neuronal Activity (DIANA).

Approach: We utilise DW-fMRI and DIANA at 3 Tesla to record the responses in the somatosensory cortex following electric stimulation of the digits.

Results: We confirm BOLD responses in somatosensory cortex. Both DW-fMRI and DIANA also show stimulus-locked responses. However, we express concerns regarding electrical stimulation noise artefacts and neuronal inhibition.

Impact: This study advances our understanding of neuronal activity measurement using innovative fMRI techniques. It sheds light on the challenges, potential artefacts, and optimal strategies for precise human brain mapping, which is crucial for both basic research and clinical applications.

0130 14:33



[Direct Neuronal Activity-related (DIANA) fMRI in Awake Mice]

Wanru Meng[1], Yufei Guan[1], Yifan Qiu[1], Sicheng Zuo[1], Mingyao Liang[1], Ganghan Yang[2], Ye Li[3], and Yi He[1]

[1]Guangdong-Hong Kong-Macao University Joint Laboratory of Interventional Medicine, the Fifth Affiliated Hospital, Sun Yat-sen University, Zhuhai, China, [2]Shenzhen Institute of Advanced Technology， Chinese Academy of Sciences, Zhuhai, China, [3]Shenzhen Institute of Advanced Technology， Chinese Academy of Sciences, Shenzhen, China

Keywords: Task/Intervention Based fMRI, fMRI (task based), DIANA

Motivation: Toi et al. reported a revolutionary approach of direct imaging of neuronal activity (DIANA) by fMRI in anesthetized mice at 9.4 T. However, anesthesia has a profound impact on the central nervous system, leading to modifications in physiological parameters.

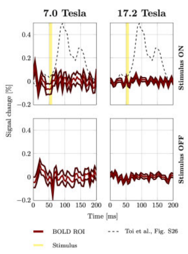
Goal(s): Our goal is to investigate Direct Neuronal Activity-related (DIANA) fMRI in awake mice.

Approach: We performed the event-related cerebral functional magnetic resonance imaging and DIANA experiment in habit-trained awake mice.

Results: In response to the electrical stimulation, a statistically significant increase in the DIANA signal was observed in the contralateral S1FL compared with the prestimulus signal ($p < 0.005$, $n = 6$ mice).

Impact: Direct detection of neural activity allows us to better understand the rapid dynamics of neural activity, which will help improve the understanding and diagnosis of neurological diseases.

0131 14:45



No observation of DIANA signals in rats at 7.0 and 17.2 Tesla

Martijn A Cloos[1], Erwan Selingue[2], Shota Hodono[1], and Luisa Ciobanu[2]

[1]Australian Institute for Bioengineering and Nanotechnology, University of Queensland, St Lucia, Australia, [2]NeuroSpin/CEA, Gif-sur-Yvette, France

Keywords: fMRI Acquisition, fMRI, DIANA

Motivation: Direct Imaging of Neuronal Activity (DIANA) was proposed by Toi et al. in Science 2022. Before DIANA can be adopted, key findings must be reproduced.

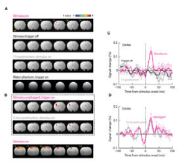
Goal(s): Independent reproduction of the results shown in supplemental Figure 26 of Toi et al.

Approach: Rats were scanned at 7.0T and 17.2T using a visual paradigm consisting of a 10ms blue flash every 200ms.

Results: No DIANA signal was detected, even though the temporal signal to noise ratio was sufficient to detect signal changes of 0.1%. However, a slow hemodynamic signal, much larger than the expected DIANA signal, was observed between measurements with and without stimulus.

Impact: Our failure to detect a DIANA signal in rat at 7.0T and 17.2T, echo's findings by Hodono et al. (Imaging Neuroscience) and Choi et al. (bioRxiv), indicating DIANA is not ready for use in neuroscientific studies.

0132 14:57



A different interpretation of the DIANA fMRI signal

Valerie Doan Phi van[1], Sajal Sen[1], and Alan Jasanoff[1]

[1]Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Probes & Targets, Brain Connectivity

Motivation: A recent study argued that it is possible to detect neuroelectrical potentials using an fMRI scanning approach called DIANA. Although DIANA signals coincide with electrophysiological measurements, no mechanism for the effect was reported

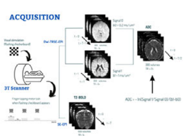
Goal(s): We sought to implement DIANA in order to understand the origins of the reported results.

Approach: We applied variants of the DIANA pulse sequence under test and control conditions, comparing results with simulations.

Results: We observed DIANA signals but show that neural activity is neither necessary nor sufficient for this. Instead, the DIANA signal appears to result largely from nonideal aspects of pulse sequence timing.

Impact: Our study suggests that the DIANA signal arises from an artifact in the line scan pulse sequence. This indicates possible pitfalls in implementing such sequence designs and emphasizes the continuing need for fMRI-based direct readouts of neural activity.

0133 15:09



Apparent Diffusion Coefficient and Blood Oxygenation Level Dependent imaging during Neural Activity in the Visual Cortex

Jasmine Khedidja Nguyen-Duc[1], Inès de Riedmatten[1], Wiktor Olszowy[2], Arthur Spencer[1], and Ileana Jelescu[1]

[1]CHUV, Lausanne, Switzerland, [2]EPFL, Lausanne, Switzerland

Keywords: Task/Intervention Based fMRI, Modelling, Non-BOLD fMRI, Novel contrast mechanisms

Motivation: Diffusion fMRI explores brain dynamics via water ADC variations from cellular fluctuations, distinct from BOLD imaging as it bypasses neurovascular coupling. Despite its potential, dFMRI remains underexplored in fMRI research.

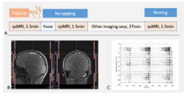
Goal(s): The goal of this work is to validate the utility of ADC in fMRI.

Approach: Two imaging techniques were utilized: DW-TRSE-EPI and SE-EPI, capturing ADC timecourses and T2-BOLD contrast. The study investigated correlations between a visual paradigm and voxel timecourses.

Results: Voxels exhibiting negative ADC and positive BOLD task responses align within the visual cortex. Likewise, voxels displaying positive ADC and negative BOLD responses predominantly align in the default mode network.

Impact: Diffusion fMRI could serve as a complementary method to BOLD imaging, both exploring neural activity through distinct approaches.

0134 15:21



Quantum-Sensing MRI: Neuronal Firings in Human Brains under Finger-Tapping in a Wide Range of Ages

Yongxian Qian[1], Xingye Chen[1,2], Ying-Chia Lin[1], Simon Henin[3], Nahbila-Malikha Kumbella[1], Zena Rockowitz[3], James Babb[1], Yulin Ge[1], Arjun Masurkar[3], Anli Liu[3], and Yvonne W. Lui[1]

[1]Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Vilcek Institute of Graduate Biomedical Sciences, New York University Grossman School of Medicine, New York, NY, United States, [3]Neurology, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Aging, Nerves, quantum sensing

Motivation: The qsMRI has the potential for non-invasive detection of neuronal electrical activities (action potentials or firings) in the human brain. This emerging technique, however, is still in infant stage and needs more studies to show its potentials.

Goal(s): This study explores whether qsMRI detects the change in neuronal firings during a finger-tapping task in a wide range of ages.

Approach: A group of healthy subjects (27–84 years old) were studied on a 3T MRI scanner, using three tasks: finger-tapping, no tapping, and resting state.

Results: Firing rate varied with age, and older people showed higher firing rate during tapping than resting.

Impact: These positive results further demonstrated the potential of qsMRI to detect neuronal firings in humans, and will encourage researchers to use the technique in a wide range of studies on brain functions and neurological disorders including aging and Alzheimer's disease.

15:33 Discussion

Kamil Uludag

University of Toronto, Canada

Oral

Age-Related Changes in the Brain

Nicoll 1 | Monday 13:45 - 15:45 | *Moderators:* In-Young Choi & Binu Thomas

0135 13:45

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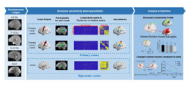


Connectivity-based parcellation of primary and high-order cortex from infancy to adult

Zuozhen Cao[1], Mingyang Li[1], Zhiyong Zhao[1], Yao Shen[1], Yiqi Shen[1], and Dan Wu[1]

[1]Key Laboratory for Biomedical Engineering of Ministry of Education, Department of Biomedical Engineering, College of Biomedical Engineering & Instrument Science, Zhejiang University, HangZhou, China

Keywords: Aging, Aging, parcellation

Motivation: The human brain undergoes a remarkable development from newborn to adulthood in cortex, white matter, and connectivity in previous studies. We speculated connectivity-based cortical parcellation may also change during this process.

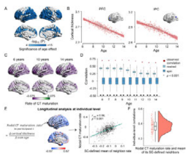
Goal(s): To explore whether and how connectivity-based parcellations of different cortices changed from neonate to adult.

Approach: We utilized diffusion MRI (dMRI) to investigate the structure connectivity-based parcellations of cortical sub-regions and compared the parcellation-related features among infants, toddlers, and adults.

Results: We observed significantly altered parcellation profiles and changing connectivity patterns during developed. Especially, we found larger alternations in high-order cortex, such as insula, compared to primary sensory and motor cortices.

Impact: Connectivity-based parcellation provided a new insight to assess the development of human brain. Primary cortex has developed sufficiently in early life while high-order cortex developed significantly from newborn to adult. Future studies will fill the gap from toddler to adult.

0136 13:57 <u>Structural connectome shapes the maturation of cortical morphology from childhood to adolescence</u>



Xinyuan Liang[1], Lianglong Sun[1], Xuhong Liao[2], Tianyuan Lei[1], Mingrui Xia[1], Dingna Duan[1], Zilong Zeng[1], Qiongling Li[1], Zhilei Xu[1], Weiwei Men[3], Yanpei Wang[1], Shuping Tan[4], Jia-Hong Gao[3], Shaozheng Qin[1], Sha Tao[1], Qi Dong[1], Tengda Zhao[1], and Yong He[1]

[1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [2]School of Systems Science, Beijing Normal University, Beijing, China, [3]Center for MRI Research, Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, [4]Beijing Huilongguan Hospital, Beijing, China

Keywords: Structural Connectivity, Brain Connectivity, Adolescents

Motivation: Cortical thinning is an important hallmark of the maturation of brain morphology during childhood and adolescence. However, the connectome-based wiring mechanism that underlies cortical maturation remains unclear.

Goal(s): We aim to model how the maturational pattern of cortical morphology is shaped by white matter connectome architecture.

Approach: We integrated neuroimaging, connectome, transcriptome analyses and computational modeling.

Results: We found that the maturational patterns of cortical morphology are constrained by the white matter connectome and are particularly represented using a network-based diffusion model. Such constraints are predominantly located in frontoparietal nodes and are linked with the expression of genes associated with microstructural developmental processes.

Impact: Our results highlight the importance of white matter network structure in shaping the coordinated maturation of regional cortical morphology, which demonstrates the feasibility of using a network model to reveal the maturational principle of cortical morphology from childhood to adolescence.

0137 14:09 <u>Choroid Plexus Structural and vascular Changes Associated with Aging in the HCP Dataset</u>

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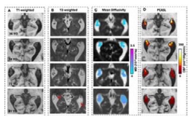

Zhe Sun[1,2,3], Chenyang Li[1,2,3], Thomas Wisniewski[4,5], and Yulin Ge[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [3]Vilcek Institute of Graduate Biomedical Sciences, NYU Grossman School of Medicine, New York, NY, United States, [4]Center for Cognitive Neurology, NYU Grossman School of Medicine, New York, NY, United States, [5]Departments of Pathology and Psychiatry, NYU Grossman School of Medicine, New York, NY, United States

Keywords: Aging, Aging, Human Connectome Project, choroid plexus

Motivation: Analyzing ChP changes in normal aging is essential for grasping its role in neurological disorders.

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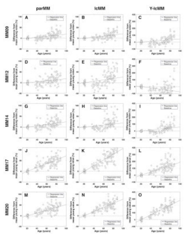
Goal(s): To evaluate ChP changes with age using diffusion and perfusion MRI in a lifespan HCP-aging dataset.

Approach: MR images of 641 healthy participants aged from 36 to 90 years old were analyzed to extract diffusion and perfusion measurements of ChP to investigate their age-related changes.

Results: With age, the ChP undergoes significant changes, including increased volume, reduced blood flow, elevated MD values, and a more rapid decline in blood flow compared to gray and white matter.

Impact: This study offers a comprehensive evaluation of age-related changes in the ChP, enhancing our comprehension of its potential involvement in age-related cognitive decline. Furthermore, age-related ChP alterations exhibit distinct patterns compared to changes in gray and white matter.

0138 14:21



[Age-related differences in macromolecular resonances observed in ultra-short-TE STEAM MR spectra at 7 T]

Guglielmo Genovese[1], Melissa Terpstra[1], Pavel Filip[1,2], Silvia Mangia[1], J. Riley McCarten[3,4], Laura S. Hemmy[3,5], and Małgorzata Marjańska[1]

[1]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Department of Neurology, Charles University, First Faculty of Medicine and General University Hospital, Prague, Czech Republic, [3]Geriatric Research, Education and Clinical Center, Veterans Affairs Health Care System, Minneapolis, MN, United States, [4]Department of Neurology, University of Minnesota, Minneapolis, MN, United States, [5]Department of Psychiatry, University of Minnesota, Minneapolis, MN, United States

Keywords: Spectroscopy, Data Analysis, Macromolecules, LCModel, ultra-high field

Motivation: Macromolecular signals mainly originate from amino-acids within flexible cytosolic proteins, contributing to ^{1}H-MR spectra. Previous studies have yielded inconsistent results regarding age-related differences in macromolecular resonances.

Goal(s): To investigate the macromolecular content across a wide age range in a large cohort of healthy participants.

Approach: Spectroscopy data were acquired at 7 T. The macromolecular content was investigated in 134 datasets from a cohort ranging in age from 19 to 89 years.

Results: Age-related effects were observed for macromolecular peaks. Some macromolecular resonances had significantly higher content at 30-40 years of age while others at 60-70 years of age.

Impact: Our findings strengthen the necessity of using age-matched measured macromolecules during quantification of metabolite concentrations. The ability to detect differences in macromolecular content may be helpful for understanding the neurodegenerative processes associated with aging.

0139 14:33

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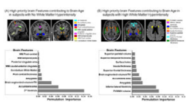

[Quantitating Neuroanatomic Volumetry and White Matter Hyperintensity Lesion wrapped in AI Model in Aging Cohorts as a determinant of Brain Age]

Neha Yadav[1], Niraj Kumar Gupta[1], and Vivek Tiwari[1]

[1]Department of Biological Sciences, Indian Institute of Science Education and Research Berhampur, Berhampur, India

Keywords: Aging, Aging, Brain Age, Volumetry, White Matter Hyperintensity

Motivation: In an aging population, a subset of individuals at any age group present with low white matter hyperintensity (WMH) volume in the brain, while another subset has intermediate to high WMH load.

Goal(s): To establish a Brain Age Estimation model involving WMH lesion quantification as a clinical indicator of Brain Health.

Approach: We have investigated the 'Brain Health' in terms of Brain Age using neuroanatomic volume, thickness together with WMH load across cognitively normal, impaired and Alzheimer's Disease subjects.

Results: An increased Brain Age gap is observed for the subjects with elevated WMH load compared to the brains with low WMH.

Impact: Brain health is a composite representation of structural, fiber and vascular health. For the first time, a MR based quantitative platform with WMH load and comprehensive neuroanatomic volumetry is established, which estimates 'Brain Age' as an indicator of Brain Health.

0140 14:45

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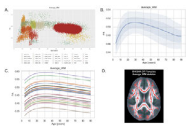

Normative modeling of brain white matter microstructure using diffusion tensor metrics in 52,719 participants

Julio Ernesto Villalón Reina[1], Alyssa H. Zhu[1], Talia M. Nir[1], Sophia I. Thomopoulus[1], Emily Laltoo[1], Elnaz Nourollahimoghadam[1], Sebastian Benavidez[1], Clara A. Moreau[1], Yixue Feng[1], Tamoghna Chattopadhyay[1], Leila Nabulsi[1], Katherine E. Lawrence[1], Neda Jahanshad[1], and Paul M. Thompson[1]

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Keywords: White Matter, Diffusion Tensor Imaging

Motivation: It is currently difficult to compute normative models for diffusion MRI metrics of the brain's white matter across the lifespan due to scanner/protocol effects that are hard to eliminate during harmonization.

Goal(s): We set out to build large-scale multi-site normative models for DTI metrics of the white matter of the human brain.

Approach: Hierarchical Bayesian Regression was run on ROI metrics derived using the ENIGMA-DTI protocol to determine the age trajectory and centile curves of DTI metrics.

Results: We built DTI reference models based on 52,719 subjects that allowed us to detect deviations from the norm for patients with brain diseases.

Impact: These reference models are valuable for detecting microstructural deviations from the normal range, while modeling scanner, protocol and cohort effects. They will be used in our ENIGMA consortium to map profiles of microstructural anomalies in >20 neurological and psychiatric conditions.

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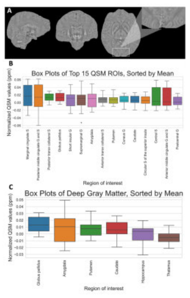


Submillimeter Isotropic in vivo Quantitative Susceptibility Mapping: Application to Women with Suspected Coronary Microvascular Dysfunction

Arzu C Has Silemek[1,2], Sreekanth Madhusoodhanan[1], Janet Wei [3], Oana Dumitrascu[4], Sarah Kremen[1], Debiao Li[2], Michael D Nelson[5], Zaldy S Tan[6], Jeffrey Wertheimer[7], Yibin Xie[2], Noel Bairey Merz[3], Wei Gao[2], and Pascal Sati[1]

[1]Department of Neurology, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Biomedical Sciences and Imaging, Biomedical Imaging Research Institute (BIRI), Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Barbra Streisand Women's Heart Center, Smidt Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [4]Department of Neurology, Mayo Clinic College of Medicine and Science, Scottsdale, AZ, United States, [5]Department of Kinesiology, The University of Texas at Arlington, Arlington, TX, United States, [6]Departments of Neurology and Medicine, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [7]Department of Physical Medicine and Rehabilitation, Cedars-Sinai Medical Center, Los Angeles, CA, United States

Keywords: Aging, Quantitative Susceptibility mapping, Heart, Brain, women, INOCA, Aging, Dementia

Motivation: The study's motivation lies in overcoming the low-resolution limitations of Quantitative susceptibility mapping (QSM) in 3T-MRI, which is critical for investigating brain aging and neurodegeneration.

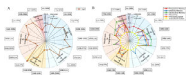
Goal(s): We aimed to construct high-resolution QSM using submillimeter T2*-3D-EPI sequence to measure iron deposition in the cortical and deep gray matter of women with suspected coronary microvascular dysfunction.

Approach: The approach involved a novel imaging protocol, TGV-based QSM reconstruction, and statistical analysis correlating iron deposition with cardiovascular health markers.

Results: Results indicate a significant association between brain iron accumulation and microvascular heart conditions, pointing to a potential interconnected pathology in women with suspected coronary microvascular dysfunction.

Impact: The study's high-resolution QSM technique could revolutionize neuroimaging, allowing clinicians to detect microvascular changes early and personalize treatments. It opens avenues for exploring the systemic nature of microvascular diseases, potentially altering approaches to managing neurodegenerative and cardiovascular conditions.

0142 15:09



[Dedifferentiation of functional hierarchical axis captures individual differences in cognition performance and disease progression]

Chenye Shen[1], Chaoqiang Liu[1], Nanguang Chen[1], and Anqi Qiu[1,2,3]

[1]Biomedical Engineering, National University of Singapore, Singapore, Singapore, [2]Department of Health Technology and Informatics, Hong Kong Polytechnic University, Hung hom, Hong Kong, [3]Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States

Keywords: Functional Connectivity, Aging

Motivation: The healthy aging brain exhibits functional dedifferentiation, yet a consensus on its characterization remains elusive, hindering individual-level assessment of unhealthy aging.

Goal(s): We aim to utilize the functional hierarchical axis to elucidate primary alterations in functional dedifferentiation during healthy aging.

Approach: We developed a measure to quantify the heterogeneity of network dedifferentiation along the functional hierarchical axis, and assessed its relevance to cognition and neurological diseases at an individual level.

Results: Functional dedifferentiation in attention and control networks captures substantial individual differences in aging, cognition, and diseases. The heterogeneity of functional dedifferentiation along the functional hierarchical axis predicts domain-specific disease risk.

Impact: Brain aging primarily entails association and control network integrity deterioration on the functional hierarchical axis. The individual differences of functional dedifferentiation on this axis provide risk assessments of unhealthy brain aging.

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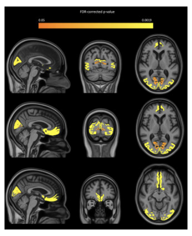


[Brain arteriolosclerosis in community-based older adults is associated with lower gray matter volume]

Ana Tomash[1], Mahir Tazwar[1], Md Tahmid Yasar[1], David A Bennett[2], Julie A Schneider[2], and Konstantinos Arfanakis[1,2]

[1]Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, United States, [2]Rush Alzheimer's Disease Center, Rush University Medical Center, Chicago, IL, United States

Keywords: Dementia, Blood vessels, Arteriolosclerosis, Brain, Pathology, Ex-vivo applications, Gray matter, Neurodegeneration, Vascular

Motivation: Despite brain arteriolosclerosis being one of the most prevalent small vessel diseases in older adults, its association with regional brain volumes has not been investigated.

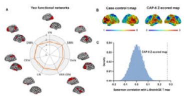
Goal(s): To investigate the association of brain arteriolosclerosis with regional gray matter volumes.

Approach: Regional brain volumetry on ex-vivo MRI and detailed neuropathological examination were combined in a large number of community-based older adults that came to autopsy.

Results: More severe brain arteriolosclerosis was associated with lower volume in a number of gray matter regions, including medial orbitofrontal, superior frontal, pericalcarine, cuneus, and lateral occipital areas, independently of the effects of other neuropathologies.

Impact: The finding that brain arteriolosclerosis is associated with lower regional gray matter volumes independently of the effects of other neuropathologies enhances our understanding of the brain anomalies associated with this common small vessel disease pathology.

0144 15:33 The Influence of Accelerated Brain Aging on Coactivation Pattern Dynamics in Parkinson's Disease



Su Yan[1] and Wenzhen Zhu[1]

[1]*Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China*

Keywords: Parkinson's Disease, Parkinson's Disease

Motivation: Aging has been widely recognized as the primary risk factor for brain degeneration, and Parkinson's disease (PD) tends to follow accelerated aging trajectories.

Goal(s): The aim of this study was to investigate the influence of structural brain aging on large-scale functional network temporal dynamics in PD.

Approach: The level of brain aging was assessed by calculating global and local brain age gap estimates from T1-weighted images. Coactivation patterns of the whole brain were identified from fMRI to capture neural network activity.

Results: Accelerated structural brain aging in PD affected brain function, which manifested as aberrant brain network dynamics.

Impact: These findings relate whole-brain coactivation patterns to spatial variation in accelerated brain aging, providing insights into the neuropathological mechanisms in neurodegenerative diseases and implying the possibility of intervention for PD progression by slowing the brain aging process.

Oral

Quantitative Image Acquisition

Nicoll 2 | Monday 13:45 - 15:45 | *Moderators:* Maša Božić-Iven & Ruud van Heeswijk

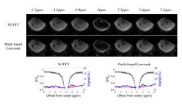
13:45 Introduction

Ruud van Heeswijk

Lausanne University Hospital (CHUV), Switzerland

0145 13:57 Simultaneous 3D CEST imaging of phosphocreatine and glycogen in skeletal muscle at 5T

MERIT AWARD SUMMA CUM LAUDE



Xi Xu[1,2], Xinran Chen[3], Yuanyuan Liu[1], Chongxue Bie[1], Siqi Cai[1,2], Hao Wu[1], Dong Liang[1], Hairong Zheng[1], Yang Zhou[1], and Yanjie Zhu[1]

[1]*Shenzhen Institute of Advanced Technology, ShenZhen, China,* [2]*University of Chinese Academy of Sciences, BeiJing, China,* [3]*Department of Electronic Science, Xiamen University, Xiamen, China*

Keywords: Quantitative Imaging, CEST & MT

Motivation: The metabolic heterogeneities in human are high, it is crucial to improve the slice-encoding coverage in phosphocreatine and glycogen mapping.

Goal(s): To develop a 3D-CEST sequence for simultaneous mapping of phosphocreatine and glycogen within the acceptable time.

Approach: The optimal sequence using stack-of-star readouts was applied. The patch-based low-rank reconstruction was introduced to accelerate the scan. The concentrations were quantified with *ex-vivo* and *in-vivo* experiments.

Results: The coverage in slice-encoding dimension was improved to 140 mm. The scan time was reduced from 41.8 to 11.2 minutes. The concentrations of PCr and glycogen were 36.8 ± 14.4 mM and 80.4 ± 12.5 mM, respectively.

Impact: This study demonstrates the feasibility of a 3D-CEST imaging method that simultaneously quantifies phosphocreatine and glycogen in skeletal muscle at 5T. It can be accomplished within 11.2 minutes using patch-based low-rank reconstruction. It shows great potential in evaluateing metabolic heterogeneities.

0146 14:09

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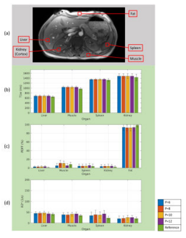

[Hybrid Multi-Echo Radial Look-Locker (hME-rLL) Acquisition for Joint Estimation of water-T1, PDFF, and R2*]

Eze Ahanonu[1], Ute Goerke[2], Brian Toner[3], Kevin Johnson[4], Vibhas Deshpande[5], Shu-Fu Shih[6], Xiaodong Zhong[6], Holden Wu[6], Ali Bilgin[1,7], and Maria Altbach[8]

[1]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States, [2]Siemens Healthineers, Tucson, AZ, United States, [3]Applied Mathematics, University of Arizona, Tucson, AZ, United States, [4]Department of Medical Imaging, University of Arizona, Tucson, AZ, United States, [5]Siemens Healthineers, Austin, TX, United States, [6]Department of Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States, [7]Biomedical Engineering, University of Arizona, Tucson, AZ, United States, [8]Medical Imaging, University of Arizona, Tucson, AZ, United States

Keywords: Quantitative Imaging, Liver, T1 mapping, R2* mapping, PDFF mapping

Motivation: Reducing the time required to achieve comprehensive liver evaluation will improve scanning efficiency and increase access to non-invasive diagnostic tools

Goal(s): To develop an acquisition protocol which allows accurate estimation of water-only T1 ($$$T1w$$$), PDFF, and R2*

Approach: Combing dual-echo and extended-echo (>2) readout into a single acquisition, using the extended-echo acquisition to estimate the field-map, R2*, and PDFF. Then using the R2* and field maps to perform fat/water decomposition on the dual-echo acquisition for $$$T1w$$$ estimation.

Results: Both phantom and in vivo results demonstrated that $$$T1w$$$, R2*, and PDFF can be accurately estimated using the proposed approach.

Impact: Increasing the efficiency of MRI sequence and protocols allows for reduced scan time and improved scanner efficiency. These contributions make the diagnostic process easier for patients and physicians, which should result in improved healthcare.

0147 14:21

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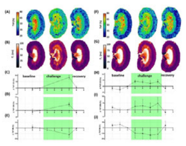

[In Vivo Monitoring of Renal Tubule Volume Fraction During Acute Tubular Pressure Increase Using Dynamic T2 Mapping]

Ehsan Tasbihi[1,2], Thomas Gladytz[1], Jason M. Millward[1], João Periquito[1], Ludger Starke[1,3], Sonia Waiczies[1], Kathleen Cantow[4], Erdmann Seeliger[4], and Thoralf Niendorf[1]

[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [2]Charité – Universitätsmedizin, Berlin, Germany, [3]Hasso Plattner Institute for Digital Engineering, University of Potsdam, Germany, Potsdam, Germany, [4]Experimental and Clinical Research Center, a joint cooperation between the Charité Medical Faculty and the Max Delbrück Center for Molecular Medicine, Berlin, Germany

Keywords: Quantitative Imaging, Kidney, tubule volume fraction, MRI, T2 mapping, multi-exponential analysis

Motivation: The increasing incidence of kidney diseases is a global concern and current biomarkers are inadequate. Changes in renal tubule volume fraction (TVF) may serve as a rapid biomarker for kidney disease and provide a better understanding of renal (patho-)physiology.

Goal(s): This study aims to measure TVF in in vivo rat kidney during acute tubular pressure increase.

Approach: This study uses the amplitude of the long T_2-component as a surrogate for TVF in rats, by applying multiexponential analysis of the T_2-driven signal decay.

Results: The results demonstrate that our approach is promising for research into quantitative assessment of renal TVF in in vivo applications.

Impact: This is the first report on in vivo assessment of relative changes in the renal TVF, which provides a potential rapid, noninvasive marker for kidney disease. This approach will be invaluable for gaining a better mechanistic understanding of renal (patho-)physiology.

0148 14:33

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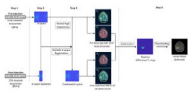


Reduced gadolinium dose by an optimized multi-parametric MR-STAT protocol

Fei Xu[1], Edwin Versteeg[1], Hongyan Liu[1], Miha Fuderer[1], Stefano Mandija[1], Oscar van den Heide[1], Vera C. Keil[2], Anja van der Kolk[3,4], Jan Willem Dankbaar[5], Sarah M. Jacobs[3], Tom J. Snijders[6], Cornelis A.T. van den Berg[1], and Alessandro Sbrizzi[1]

[1]Computational Imaging Group for MR diagnostics & therapy, Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [2]Department of Radiology and Nuclear Medicine, Amsterdam University Medical Center, Vrije Universiteit Amsterdam, Amsterdam, Netherlands, [3]Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [4]Department of Medical Imaging, Radboud University Medical Center, Nijmegen, Netherlands, [5]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [6]Department of Neurology and Neurosurgery, UMC Utrecht Brain Center, University Medical Center Utrecht, Utrecht, Netherlands

Keywords: Quantitative Imaging, Quantitative Imaging, MR-STAT; Contrast Enhancement Imaging

Motivation: Several concerns have been raised about the harmful effects of gadolinium-based contrast agent (GBCA) usage during MRI exams.

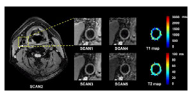
Goal(s): To reduce the GBCA dose in MRI protocols.

Approach: We developed an optimized and fast MR-STAT protocol for “pre- and post-injection” quantitative MRI and applied it to two retrospective simulated patient datasets and one prospective in-vivo scan.

Results: The inferred lesion masks generated by comparing “pre- and post-injection” T_1 maps demonstrated that the proposed relaxometry-based method was able to correctly detect the lesions. Furthermore, the performance for the low-dose protocol was comparable to that of the full-dose one.

Impact: The quantification of T1 changes after administering GBCA by using the accelerated MR-STAT protocol potentially enables a substantial reduction in both GBCA dose and acquisition time in clinical protocols.

0149 14:45



Black blood cine vessel wall imaging based dynamic quantitative mapping of carotid artery vessel wall

Ning Xu[1], Shuo Chen[1], Huiyu Qiao[1], Zhongsen Li[1], Ziming Xu[1], Shuwan Yu[1], Jiachen Liu[1], Rui Shen[1], Xinyu Tong[1], and Xihai Zhao[1]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine Tsinghua Univeristy, Beijing, China

Keywords: Quantitative Imaging, Quantitative Imaging, vessel wall imaging

Motivation: Dynamic quantitative carotid artery vessel wall imaging can effectively reduce the blurring effect caused by vascular pulsation.

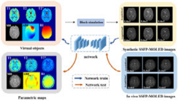
Goal(s): This study aims to develop a black blood cine sequence based dynamic quantitative carotid artery vessel wall imaging method.

Approach: A VFA and ViMSDE duration-based BB cine quantitative sequence was proposed to acquire dynamic multi-contrast images. Dictionary matching method was introduced to estimate quantitative parameters from complicate signal equation.

Results: The proposed protocol was in excellent agreement with standard mapping sequence in both phantom and volunteer experiment. Dynamic T1 and T2 maps has shown its potential in eliminating pulsation resulting blurring

Impact: Dynamic T1 and T2 maps can be acquired with less pulsation related blurring. Dynamic and accurate quantitative information is expected to better assist clinical decision-making.

0150 14:57



Fast mapping of simultaneous M0, T1, T2, T2*, B1, and ΔB0 using SSFP-based Multiple Overlapping-Echo Detachment Imaging

Jingying Yang[1], Qinqin Yang[1], Weikun Chen[1], Liuhong Zhu[2], Zhigang Wu[3], Yudan Zhou[1], Jianjun Zhou[2], Zhong Chen[1], Shuhui Cai[1], and Congbo Cai[1]

[1]Xiamen University, Xiamen, China, [2]Department of Radiology, Zhongshan Hospital (Xiamen) Fudan University, Xiamen, China, [3]Clinical & Technical Support, Philips Healthcare, China

Keywords: Pulse Sequence Design, Quantitative Imaging

Motivation: Long acquisition times have hindered many quantitative magnetic resonance imaging methods.

Goal(s): In order to reduce the collection time, we propose a rapid and quantitative method for multi-parameter quantification.

Approach: Multiple overlapping echo detachment (MOLED) imaging can enable multiparametric quantitative mapping for a single slice in just hundreds of milliseconds. To achieve simultaneous quantitative imaging of M_0, T_1, T_2, T_2*, B_1, and ΔB_0, we proposed the SSFP-MOLED method.

Results: The results of both phantom and vivo experiments on a 3T whole-body scanner demonstrate that our method can accurately quantify multiple parameters, indicating promising clinical applications.

Impact: We present a novel and efficient mapping method for multiparametric MRI (M_0, T_1, T_2, T_2*, B_1, and ΔB_0). This method not only enhances the efficiency of data collection for clinicians but also improves the diagnostic reliability of multi-center hospitals.

0151 15:09

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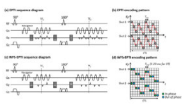


Water/fat separated Echo Planar Time-resolved Imaging (EPTI) for efficient distortion-free multi-contrast imaging

Zhangxuan Hu[1,2], Zijing Dong[1,2], Timothy G. Reese[1,2], Lawrence L. Wald[1,2,3], Jonathan R. Polimeni[1,2,3], and Fuyixue Wang[1,2]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Fat & Fat/Water Separation, Fat

Motivation: Echo Planar Time-resolved Imaging (EPTI) can produce distortion- and blurring-free multi-echo images with high efficiency. For its broader application such as in body imaging, the challenge of fat suppression/separation needs to be addressed.

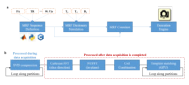
Goal(s): Achieving efficient water/fat separation using EPTI for high-quality fast multi-contrast/quantitative imaging in the presence of fat tissues.

Approach: In this study, water/fat separated EPTI (WFS-EPTI) was proposed to achieve this by: (1) designing a novel in-phase and out-of-phase EPTI acquisition and encoding scheme; and (2) adopting a k-space-based water/fat separation method.

Results: Experimental results demonstrated the efficacy of WFS-EPTI for water/fat separation and fat-robust distortion-free multi-contrast/quantitative imaging.

Impact: The proposed WFS-EPTI effectively separates water and fat signals, while providing efficient acquisition of high-resolution, distortion-free multi-contrast images and quantitative maps. It can extend EPTI to a broader range of applications.

0152 15:21



<u>A MR Fingerprinting Development Kit (MRFDK) for Quantitative 3D Brain Imaging</u>

Rasim Boyacioglu[1], Thomas Kluge[2], Guido Buonincontri[2], Wei-Ching Lo[3], Stephan Kannengiesser[2], Mathias Nittka[2], Dan Ma[4], Mark A Griswold[1], and Yong Chen[1]

[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Siemens Healthineers AG, Erlangen, Germany, [3]Siemens Medical Solutions USA, Boston, MA, United States, [4]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

Keywords: MR Fingerprinting, MR Fingerprinting

Motivation: MRF acquisitions rely on offline reconstructions due to their computationally intensive processing pipelines which hinders integration into clinical workflows.

Goal(s): To introduce and test a development kit for MRF, enabling 1) efficient whole brain 3D MRF acquisitions, 2) embedded dictionary calculation, and 3) rapid online post-processing.

Approach: The method was evaluated with phantom and in vivo brain imaging for multiple MRF variants and receive coils.

Results: Due to full scanner integration, high-quality T_1 and T_2 maps were presented on the host computer within 1 min after the MRF scan was completed, enabling timely visualization of the outcome.

Impact: The MRF development kit has high potential to promote reproducibility, large-scale clinical evaluation and translation of the novel MRF technique.

0153 15:33

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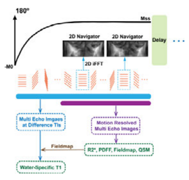


<u>Motion-Robust Multiparametric MRI of the Liver at 3T: Simultaneous Estimation of Water-Specific T1, PDFF, Motion-Resolved R2*, and QSM</u>

Jingjia Chen[1,2], Ding Xia[3], Hersh Chandarana[1,2], Daniel K Sodickson[1,2], and Li Feng[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Biomedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States

Keywords: Quantitative Imaging, Quantitative Imaging

Motivation: Quantitative multiparametric MRI has the potential to improve the characterization of liver diseases, but its clinical implementation is limited by challenges such as respiratory motion and slow imaging speed.

Goal(s): To develop a motion-robust multiparametric MRI technique that enables simultaneous estimation of water-specific T1, PDFF, motion-resolved R2*, and QSM of the liver from a single acquisition at 3T.

Approach: Our technique employs inversion recovery-prepared golden-angle multi-echo stack-of-stars sampling in combination with advanced low-rank subspace reconstruction for generating different quantitative parameters.

Results: Free-breathing multiparametric estimation of 3D water-specific T1, PDFF, R2* and QSM with motion compensation has been successfully demonstrated in volunteers and patients.

Impact: This new technique is capable of estimating water-specific T1, PDFF, motion-resolved R2*, and QSM of the liver from a single acquisition at 3T. It holds potential to promote the use of quantitative MRI in moving organs such as the liver.

Oral

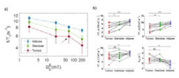
Low-Field High-Quality MRI

Nicoll 3 | Monday 13:45 - 15:45 | *Moderators:* Joseba Alonso & Natalia Gudino

13:45 Introduction

Joseba Alonso
Spanish National Research Council (CSIC, Q2818002D), Spain

0154 13:57



Field Cycling Imaging: a novel very low field modality to characterize breast cancer

Vasiliki Mallikourti[1], James Ross[1], Oliver Maier[2], Katie Hanna[3], Ehab Husain[4], Gareth Davies[1], David Lurie[1], Gerald Lip[4], Hana Lahrech[5], Yazan Masannat[4], and Lionel Broche[1]

[1]Aberdeen Biomedical Imaging Centre, University of Aberdeen, Aberdeen, United Kingdom, [2]Institute of Biomedical Imaging, Graz University of Technology, Graz, Austria, [3]Institute of Medical Sciences, University of Aberdeen, Aberdeen, United Kingdom, [4]Breast Unit, Aberdeen Royal Infirmary, Aberdeen, United Kingdom, [5]University Grenoble Alpes, Inserm U1205, BrainTech Lab, Grenoble, France

Keywords: Low-Field MRI, Low-Field MRI, breast cancer

Motivation: Field Cycling Imaging (FCI) has never been used in clinics and its capability in medical diagnosis has not yet demonstrated.

Goal(s): Our goal was to demonstrate the capabilities of FCI as an imaging modality to diagnose breast cancer by measuring the T_1 variations at low field from 2.3 to 200 mT.

Approach: Ten patients were imaged with our recent FCI prototype scanner and images were compared with standard clinical imaging and histology.

Results: FCI provides relevant biomarkers of molecular dynamics that detect tumours and discriminate invasive from non-invasive tumours. In addition, FCI is insensitive to breast density and provides accurate tumour delineation.

Impact: FCI, which uses variant low field strengths, could complement clinical imaging without contrast agents non-invasively and could improve the estimation of tumour size and resection margins, even for dense breasts, including DCIS which is often under/over-estimated in clinical imaging.

0155 14:09

MERIT AWARD
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Spatiotemporal encoding MRI at a portable low field system without parallel imaging

Yueqi Qiu[1,2], Ke Dai[1,2], Sijie Zhong[1,2], Hao Chen[1,2], Lucio Frydman[3], and Zhiyong Zhang[1,2]

[1]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [2]National Engineering Research Center of Advanced Magnetic Resonance Technologies for Diagnosis and Therapy (NERC-AMRT), Shanghai Jiao Tong University, Shanghai, China, [3]Department of Chemical and Biological Physics, Weizmann Institute of Science, Rehovot, Israel, Rehovot, Israel

Keywords: Low-Field MRI, Low-Field MRI, SPEN, Field Inhomogeneity, less distortion, low SAR

Motivation: Geometric distortions in echo-planar acquisitions pose challenges for correction in portable low-field MRI due to significant field inhomogeneities.

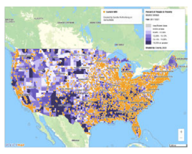
Goal(s): Our goal was to apply spatiotemporal encoding (SPEN) MRI at a 110 mT portable low-field system, aiming for nearly distortion-free echo-planar images.

Approach: We leveraged the low SAR in low-field MR to optimize the SPEN technique for substantial gains in sensitivity. SPEN-based 2D imaging ,3D imaging and DWI were compared with EPI-based imaging and EPI TopUp correction results.

Results: Approximately distortion-free SPEN acquisitions including robust 2D, 3D imaging and DWI demonstrated the potential clinical values of SPEN in the portable low field systems.

Impact: SPEN MRI provides a unique and robust fast echo planar acquisition approach to obtain nearly distortion-free images at low-cost portable low field systems, thereby expanding the prospects for rapid imaging, navigation, and functional imaging in portable low-field MRI.

0156 14:21



[Low Field MRI as a Potential Equalizer: Addressing Healthcare Disparities Through Socioeconomic Status and MRI Access in the United States]

Michael Bermingham[1], Mikkael Lamoca[1], Roman Czornobil[1], Abby Dale[1], Amelia Amelia Gilbert[1], Jeffrey Burnette[1], James Myers[1], Sandra Rothenberg [1], and Iris Asllani[1,2]

[1]Rochester Institute of Technology, Rochester, NY, United States, [2]University of Sussex, Brighton, United Kingdom

Keywords: Low-Field MRI, Health Care Economics, MRI value

Motivation: While the USA boasts one of the highest numbers of MRIs per million inhabitants, the impact of social determinants of health on accessibility remains uncertain. This issue becomes particularly relevant as Low Field MRI could level the playing field and mitigate existing inequities.

Goal(s): Primary goal was to investigate the relationship between MRI availability and poverty rate in the US.

Approach: We tested the correlation between poverty rate and both the quantity and geographical distribution of MRIs.

Results: The number of MRI units exhibited an exponential decline (R^2=0.9823) with the poverty rate, with geographical location and other pertinent socioeconomic factors playing a role.

Impact: LF MRI has attributes that make it particularly suitable for implementation in low-middle income countries (LMICs). Nevertheless, features like affordability and portability can also potentially be pivotal in addressing healthcare disparities within the US.

0157 14:33

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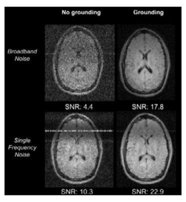


Finding common ground: Subject grounding to reduce electromagnetic interference at 46 mT

Beatrice Lena[1], Bart de Vos[1], and Andrew Webb[1]

[1]C.J. Gorter MRI Center, Radiology Department, Leids Universitair Medisch Centrum, Leiden, Netherlands

Keywords: Low-Field MRI, Low-Field MRI, EMI reduction

Motivation: Electromagnetic interference (EMI) reduction is essential to utilize low-field point-of-care MRI devices in different environments with different noise conditions.

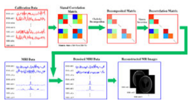
Goal(s): Improving EMI reduction by subject grounding

Approach: Noise scans and brain images were acquired with and without subject grounding. This is done with normal imaging conditions and when adding broadband noise or single frequency EMI.

Results: The SNR of the images was improved by a factor of ~4 when grounding the subject and adding broadband EMI to the experiment. A factor ~2 improvement in SNR was observed for the single frequency EMI and a factor of 1.5 improvement for the normal imaging conditions.

Impact: Subject grounding effectively reduced EMI interference. It may be relevant to investigate whether this setup would be able to reduce EMI from medical equipment, or general environmental EM noise in typically challenging POC settings (ICU, emergency room, in remote locations)

0158 14:45



[Inter-Channel Correlation-based EMI Noise Removal for Shielding-Free Low-field Portable MRI]

Yiman Huang[1,2], Shuxian Qu[2,3], and Xiaotong Zhang[1,2,3,4]

[1]College of Electrical Engineering, Zhejiang University, Hangzhou, China, [2]MOE Frontier Science Center for Brain Science and Brain-machine Integration, Zhejiang University, Hangzhou, China, [3]The Interdisciplinary Institute of Neuroscience and Technology, College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [4]Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China

Keywords: Low-Field MRI, Low-Field MRI

Motivation: The current electromagnetic interference (EMI) noise removal approaches for low-field portable magnetic resonance imaging (MRI) only focus on single receive coil EMI removal, which ignores noise relationship among coil elements of RF coil arrays.

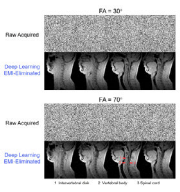
Goal(s): Our goal was to remove EMI noise in receive coils not only related to EMI detectors, but also among receive coil elements.

Approach: A signal correlation matrix was constructed from signals acquired by EMI coils and receive coils, and decorrelation matrix was calculated for EMI noise removal.

Results: Phantom results and pilot *in vivo* human brain images showed that the proposed method have better EMI noise removal rate.

Impact: The proposed EMI noise removal method for unshielded low-field MRI can better improve signal-to-noise ratio (SNR) compared to state-of-the-art methods, which enable the EMI noise removal for array coils in low-field portable MRI application.

0159 14:57



[Cervical Spine MRI on a RF Shielding-Free 0.05T MRI Scanner]

Yujiao Zhao[1,2], Christopher Man[1,2], Vick Lau[1,2], Shi Su[1,2], and Ed X. Wu[1,2]

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

Keywords: Low-Field MRI, Low-Field MRI

Motivation: To develop low-cost and patient-friendly MRI scanners to address global healthcare disparities.

Goal(s): To demonstrate cervical spine (C-spine) MRI on a low-cost and RF shielding-free 0.05T MRI scanner.

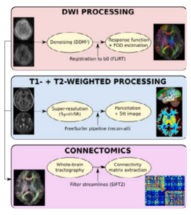
Approach: Typical imaging protocols were implemented on a newly developed 0.05T MRI scanner. The scanner is compact, RF shielding-free, and acoustically quiet during scanning. Further, a deep learning electromagnetic interference (EMI) elimination method and a data-driven reconstruction strategy were designed.

Results: The deep learning EMI elimination method effectively removed EMI noise, and the data driven reconstruction method suppressed image noise and artifacts while increasing spatial resolution, leading to significantly improved image quality.

Impact: We demonstrate high-quality C-spine MRI on a low-cost and shielding-free 0.05T MRI scanner through exploiting computing power and extensive high-field MRI data. These developments will lead to a new generation of affordable, patient-centric, and computing-powered MRI scanners.

0160 15:09

Connectomics at 64 mT



Álvaro Planchuelo-Gómez[1,2], James Gholam[1], Joshua Ametepe[1], Francesco Padormo[3], Leandro Beltrachini[1], Mara Cercignani[1], and Derek K Jones[1]

[1]*CUBRIC, Cardiff University, Cardiff, United Kingdom,* [2]*Imaging Processing Laboratory, Universidad de Valladolid, Valladolid, Spain,* [3]*Hyperfine, Inc., Guildford, CT, United States*

Keywords: Low-Field MRI, Brain Connectivity, Connectomics

Motivation: Neuroscience MRI research, including assessment of structural connectomics, has been largely limited to high-resource settings.

Goal(s): To democratise assessment of brain connectivity by demonstrating the first ever diffusion-weighted imaging (DWI)-based connectomics at 64 mT.

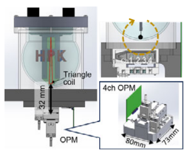
Approach: 15-direction DWI data were acquired at 64 mT. Whole-brain tractograms were recovered after deep learning based denoising and constrained spherical deconvolution. Whole-brain adjacency matrices and graph-theory parameters were extracted, and their test-retest agreement and variability assessed. For one subject, results were compared to high-field MRI.

Results: Global graph-theory parameters (e.g., small-worldness) showed high test-retest agreement. However, inter-hemispheric connectivity was overestimated at 64 mT compared to high-field results.

Impact: Our unique combinations of low-field (64 mT) diffusion-weighted imaging, denoising, spherical deconvolution and connectomics opens up new research opportunities, allowing the assessment of structural connectivity and network neuroscience studies of under-served populations where this has never previously been possible.

0161 15:21

OPM-MEG/ULF-MRI Hybrid System: towards acquisition of both MR image and neural magnetic field



Hiroyuki Ueda[1], Takenori Oida[2], Takahiro Moriya[2], Akinori Saito[2], Yosuke Ito[1], and Motohiro Suyama[2]

[1]*Department of Electrical Engineering, Kyoto University, Kyoto, Japan,* [2]*Hamamatsu Photonics K.K., Hamamatsu, Japan*

Keywords: Hybrid & Novel Systems Technology, Low-Field MRI

Motivation: To overcome the limitations of signal co-registration in MEG, we constructed MEG/MRI hybrid system.

Goal(s): To demonstrate feasibility of this system. High-sensitivity OPMs in a reasonable magnetic shield with MRI system.

Approach: Phantom experiments. Phantom includes triangle coil and MEG measures its magnetic field. MRI scanned this phantom with 3D-SE sequence.

Results: We recognized signal peak generated by 100 nAm current dipole moment in amplitude spectrum density visually. We also confirmed the structure of the phantom in 3D MR images.

Impact: We made MEG/MRI hybrid system for the purpose of accurate signal co-registration between them. MEG employed scalar-mode OPM, and its noise level was 367 fT/rHz. We scanned phantom using 7-mT MRI scanner and confirmed its structure.

15:33

Discussion

Joseba Alonso

Spanish National Research Council (CSIC, Q2818002D), Spain

Oral

Therapeutic Evaluations in Animal Models

Room 325-326 Monday 13:45 - 15:45 *Moderators:* Durga Udayakumar & Bram Coolen

0162 13:45

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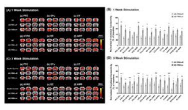


Prolonged Central Thalamic Intermittent Theta-Burst Stimulation Rescued Memory Deficits in Alzheimer's Disease Mouse Model

Yi-Chen Lin[1], Ssu-Ju Li[1], Yu-Chun Lo[2], Yun-Ting Liu[1], Yi-Chen Lee[3], Ting-Chieh Chen[1], Ching-Wen Chang[1], Yao-Wen Liang[1], Ching-Te Chen[4], Sheng-Huang Lin[5,6], and You-Yin Chen[1,2]

[1]Department of Biomedical Engineering, National Yang Ming Chiao Tung University, Taipei, Taiwan, [2]PhD Program in Medical Neuroscience, College of Medical Science and Technology, Taipei Medical University, Taipei, Taiwan, [3]School of Medicine, College of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan, [4]Abbott Neuromodulation, Austin, TX, United States, [5]Department of Neurology, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Hualien, Taiwan, [6]Department of Neurology, School of Medicine, Tzu Chi University, Hualien, Taiwan

Keywords: Alzheimer's Disease, Alzheimer's Disease, Intermittent theta-burst stimulation (iTBS)

Motivation: Addressing the global AD crisis by investigating CT-iTBS as a non-pharmacological treatment to enhance memory and cognition.

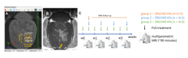
Goal(s): To explore the therapeutic efficacy and determine the optimal treatment protocol of CT-iTBS in AD while unveiling its potential underlying mechanism for enhancing memory and cognitive functions.

Approach: Utilized brain magnetic resonance imaging analysis, behavioral tests, and immunofluorescence staining for assessing the therapeutic effect of different durations of CT-iTBS treatment.

Results: Prolonged CT-iTBS significantly enhanced cognitive and memory behaviors, altered brain functional connectivity, promoted a neuroprotective effect, and reduced amyloid accumulation in AD mouse model. These findings present a promising therapeutic avenue for AD patients.

Impact: Our findings revealed a highly promising avenue for enhancing the quality of life for individuals with AD and provided insights into the potential underlying neuroprotective mechanisms of CT-iTBS in alleviating memory deficits.

0163 13:57



Longitudinal study tracking physiological changes through multiparametric MRI during repeated MRgFUS-induced BBB opening

Sébastien Rigollet[1,2], Thomas Ador[3,4], Erik Dumont[1], Chantal Pichon[3,4,5], Emmanuel Barbier[2,6], Anthony Delalande[3,4], and Vasile Stupar[2,6]

[1]Image Guided Therapy, Pessac, France, [2]Univ. Grenoble Alpes, Inserm U1216, Grenoble Institut des Neurosciences, Grenoble, France, [3]Université d'Orléans, CNRS, UPR 4301, Centre de Biophysique Moléculaire, Orléans, France, [4]ART ARNm, Inserm UMS55 and University of Orléans, Orléans, France, [5]Institut Universitaire de Paris, Paris, France, [6]Univ. Grenoble Alpes, Inserm , CHU Grenoble Alpes, CNRS, IRMaGe, Grenoble, France

Keywords: Small Animals, Focused Ultrasound, MR-guided FUS, Multiparametric MRI

Motivation: Long-term delivery of therapeutic agents via repeated MRgFUS is an innovative approach for enhancing glioblastoma treatment but underlying mechanisms are not well documented.

Goal(s): Find the best strategy for long-term drug delivery after multiple MRgFUS mediated BBB opening.

Approach: Repeated MRgFUS treatments were delivered up to 8 sessions over one month along with a multi-parametric MRI protocol follow-up to measure physiological, hemodynamic and oxygenation parameters in order to assess the safety and effectiveness of the procedure.

Results: Intensive, repeated treatments, may lead to tissue modifications that require attention and limit the frequency of ultrasound mediated drug delivery to once a week.

Impact: Long-term delivery of therapeutics through a FUS-induced permeabilized BBB redefines therapeutic strategies as it improves patient outcomes. To ensure the best translation towards clinical treatment, evaluation of hemodynamics and oxygenation modifications in the CNS is necessary to refine treatment parameters.

0164 14:09

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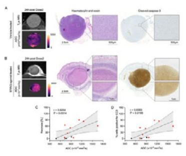


[Sustained Tumour Response to Repeated STING Activation Assessed by Diffusion Weighted MRI]

Upasana Roy[1], Carol Box[1], Malin Pedersen[1], Jessica K. R. Boult[1], Antonio Rullan[1], Michael Schmohl[2], Mario Amend[2], Sebastian Carotta[3], Anne Vogt[3], Kevin J. Harrington[1], and Simon P. Robinson[1]

[1]Radiotherapy and Imaging, The Institute of Cancer Research, London, United Kingdom, [2]Boehringer Ingelheim Pharma GmbH & Co. KG, Biberach, Germany, [3]Boehringer Ingelheim RCV GmbH & Co KG, Vienna, Austria

Keywords: Biology, Models, Methods, Cancer, Biomarker

Motivation: Cancer immunotherapy with cyclic GMP-AMP synthase (cGAS)-stimulator of interferon gene (STING) agonists aims to generate an immune response by T cell priming, activation and infiltration into the tumour microenvironment leading to cell death.

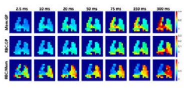
Goal(s): The clinical development of STING agonists would benefit from imaging biomarkers that inform on intratumoural pharmacodynamics and potentially anti-tumour response.

Approach: Longitudinal diffusion-weighted MRI in a thyroid xenograft model indicated sustained increase in ADC as an imaging biomarker of tumour microenvironment changes following treatment with a STING agonist.

Results: The potential use of MRI as an indicator of early STING pathway related pharmacodynamic effects *in situ* is demonstrated.

Impact: Increased ADC is a sensitive, clinically-translatable imaging biomarker of tumour response to a STING agonist.

0165 14:21



[Hyperpolarized 129Xe MRI of the Irradiated Lung using a Chemical Shift Imaging – Chemical Shift Saturation Recovery (CSI-CSSR) Technique]

Luis Loza[1], Kai Ruppert[1], Yohn Taylor[2], Jiawei Chen[1], Faraz Amzajerdian[1], Mostafa Ismail[1], Hooman Hamedani[1], Harrilla Profka[1], Ian Duncan[1], and Rahim Rizi[1]

[1]University of Pennsylvania, Philadelphia, PA, United States, [2]University College London, London, United Kingdom

Keywords: Small Animals, Hyperpolarized MR (Gas), RILI, radiation, CSSR

Motivation: Chemical shift saturation recovery (CSSR) measurements are incredibly useful for quantifying pulmonary gas exchange and uptake; because CSSR is a spectroscopic technique, however, such measures are only global in nature.

Goal(s): Our goal was to develop an imaging-based technique for spatially-resolving CSSR measurements.

Approach: We demonstrated our technique's utility in a rodent model of radiation-induced lung injury.

Results: Images of hyperpolarized-129Xe dissolved in the pulmonary membrane (Mem) and red blood cells (RBC) showed higher Mem signal and reduced RBC signal in radiated vs non-radiated lungs. Septal wall thickness (SWT) measurements derived on a quadrant level also revealed elevated SWT in the irradiated region.

Impact: We demonstrated a new imaging technique for regionally quantifying radiation-induced alterations in pulmonary gas exchange and uptake. This study lays the groundwork for future investigations aimed at improving radiotherapy strategies, mitigating radiotoxicity, and treating radiation-associated illness.

0166 14:33

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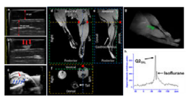


[Multi-Modal Protein-Engineered Theranostic Fibers: Drug encapsulation, Imaging, and enhanced 19F MRS]

Dustin Britton[1], Jakub Legocki[1,2], Orlando Aristizabal[3], Orin Mishkit[3], Chengliang Liu[1], Sihan Jia[1], Paul Douglas Renfrew[4], Richard Bonneau[4,5,6], Jin Kim Montclare[1,3,7,8], and Youssef Z Wadghiri[3]

[1]Department of Chemical and Biomolecular Engineering, NYU Tandon, Brooklyn, NY, United States, [2]New York University, Brooklyn, NY, United States, [3]Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [4]Flatiron Institute - Simons Foundation, New York City, NY, United States, [5]Computer Science Department, NYU Courant, New York City, NY, United States, [6]Center for Genomics and Systems Biology, NYU, New York, NY, United States, [7]Chemistry, NYU, New York, NY, United States, [8]Department of Biomaterials, NYU College of Dentistry, New York, NY, United States

Keywords: Probes & Targets, Multimodal, theranostic, temperature probe, fluorine

Motivation: Theranostic materials allows for simultaneous therapeutic and diagnostic disease intervention.

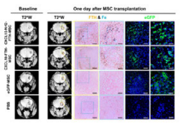
Goal(s): We aimed to engineer a protein-based theranostic with multiple imaging modalities.

Approach: Using noncannonical amino acid incorporation of trifluoroleucine (TFL), we synthesize fluorinated coiled-coil, $Q2_{TFL}$, imageable by ^{1}H MRI and high-frequency ultrasound, and sensitive to ^{19}F MRS.

Results: $Q2_{TFL}$ demonstrates reduced signal contrast in ^{1}H MRI, echogenic signals under high-frequency ultrasound, and enhances sensitivity in linear ratiometric ^{19}F MRS. This allows for thermoresponsiveness and potential protein conformation analysis. $Q2_{TFL}$ serves as a promising platform for versatile and effective theranostic agents, bringing together therapeutic and diagnostic modalities in a compact and efficient manner.

Impact: Q2TFL, a fluorinated protein fiber, enables drug delivery and offers unique multimodal imaging. It acts as a temperature probe and protein structure monitor, paving the way for innovative theranostic biomaterials.

0167 14:45



[An MRI-visible mesenchymal stem cell therapy reinvigorates T lymphocytes in glioblastoma]

Jianing Li[1], Ruichen Yang[1], Junwei Chen[1], Qin Wen[1], Kan Deng[2], Jiaji Mao[1], and Jun Shen[1]

[1]Department of Radiology, Sun Yat-Sen University, Sun Yat-Sen Memorial Hospital, Guangzhou, China, [2]Philips Healthcare, Guangzhou, China

Keywords: Probes & Targets, MR-Guided Interventions, Glioblastoma, Mesenchymal stem cells

Motivation: Immunotherapy resistance in glioblastoma (GBM) has been linked to a paucity of tumor-infiltrating T lymphocytes and concurrent T-cell dysfunction.

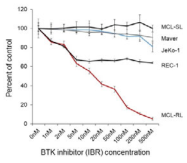
Goal(s): This research aims to determine whether MRI-visible mesenchymal stem cells (MSCs) could be employed for GBM immunotherapy.

Approach: CXCL10-Nrf2-FTH-MSCs with enhanced T lymphocyte recruitment (*Cxcl10 gene*), oxidative stress tolerance (*Nrf2 gene*), and MRI visibility (*Fth gene*) were genetically engineered. With the guidance of FTH-MRI, these MSCs were injected into the tumor periphery of orthotopic GL261 GBMs in mice.

Results: In vivo MRI monitoring and histology examinations demonstrated that CXCL10-Nrf2-FTH-MSCs can significantly limit GBM growth by reviving T lymphocytes within the tumor.

Impact: FTH-MRI is a practical method for guiding intracranial stem cell transplantation. MRI-guided peritumoral implantation of CXCL10-Nrf2-FTH-MSCs provides a novel immunotherapeutic approach based on tumoricidal stem cells for the treatment of GBM.

0168 14:57 **Metabolic detection of BTK inhibition in mantle cell lymphoma models**



Kavindra Nath[1], Pradeep Gupta[1], Stepan Orlovskiy[1], Neil Sen[2], Shengchun Wang[2], Jyoti Tomar[1], David Nelson[1], Fernando Arias-Mendoza[1,3], Jerry Glickson[1], and Mariusz Wasik[2]

[1]University of Pennsylvania, Philadelphia, PA, United States, [2]Fox Chase Cancer Center, Philadelphia, PA, United States, [3]Advanced Imaging Research, Inc., Cleveland, OH, United States

Keywords: Biology, Models, Methods, Cancer, BTK inhibition, mantle cell lymphoma models, early metabolic biomarker of response, 1H MRS with slice selective double frequency Hadamard Selective Multiple Quantum Coherence transfer pulse sequence, STEAM pulse sequence

Motivation: The current approaches to assess Bruton's kinase inhibitor (BTK) therapeutic effects in cancer are not ideal.

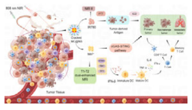
Goal(s): Employing metabolic imaging, we evaluated the mode of action of ibrutinib (IBR), a BTK inhibitor, in mantle cell lymphoma (MCL) cells and xenografts.

Approach: Our approach using ^{1}H MRS demonstrated that, in sensitive MCL models, IBR significantly impacted critical metabolic pathways, including glycolysis, glutaminolysis, and phospholipid metabolism, but had far less of an impact on IBR-poorly responsive cells.

Results: Changes in ^{1}H MRS detectable lactate, alanine, and choline concentrations on various MCL models emerged as promising biomarkers of response or resistance to IBR.

Impact: Decreased intra-tumoral concentrations of lactate, alanine, and choline measured by ^{1}H MRS during treatment can potentially become early and sensitive biomarkers of BTK inhibition in MCL and, likely, other lymphoma treatments.

0169 15:09 **Multifunctional Nanocomposite for Enhanced Diagnosis and Therapeutic Intervention in Breast Cancer via T1-T2 dual-enhanced and NIR II imaging**



Xiuhong Guan[1], Xin Huang[2], Zhiyong Wang[3], Guoxi Xie[2], and Ci He[4]

[1]Department of Radiology, Jinan University, Guangzhou, China, [2]School of Biomedical Engineering, Guangzhou Medical University, Guangzhou, China, [3]School of Materials Science and Engineering, Sun Yat-sen University, Guangzhou, China, [4]Department of Radiology, The Sixth Affiliated Hospital (Qingyuan People's Hospital), Guangzhou Medical University, Guangzhou, China

Keywords: Small Animals, Cancer, cancer immunotherapy, gas-photothermal therapy, magnetic resonance imaging, stimulator of interferon genes pathways, triple-negative breast cancer

Motivation: Breast cancer exhibits high incidence and mortality rates. We reports a functional nanosystem composed of Pluronic F127, manganese chloride ($MnCl_2$), and IR780 dye. The nanosystem possesses multimodal imaging capabilities using near-infrared II (NIR-II) and T1-T2 dual-enhanced MRI, guiding photothermal therapy, and enhancing the STING pathway to combat triple-negative breast cancer.

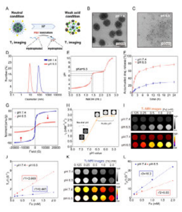
Goal(s): Effectively suppress TNBC growth and metastasis, with good biocompatibility..

Approach: MC@NS nanosystem could diagnose the tumor and confirm the time window of treatment via NIR II/MRI dual-modal imaging, and effectively suppress tumor growth thought phototherapy, STING pathway and anti-tumor immunity.

Results: It effectively suppress tumor growth thought phototherapy, STING pathway and immunotherapy.

Impact: This nanosystem, through T1-T2 dual-enhanced MRI and NIR II multimodal imaging, enabled tumor diagnosis and guided photothermal therapy, effectively suppressing tumor growth by combining photothermal therapy and STING pathway to enhance immunogenic cell death, providing a novel theranostic strategy.

0170 15:21 [Acidic Tumor Microenvironment-Activated MRI Nanoprobes for Modulation and Visualization of Anti-PD-L1 Immunotherapy]



Kai Fan[1] and Shenghong Ju[1]

[1]Jiangsu Key Laboratory of Molecular and Functional Imaging, Department of Radiology, Zhongda Hospital, Medical School, Southeast University, 87 DingJiaQiao Road, Nanjing, 210009, P. R. China., Jiangsu,Nanjing, China

Keywords: Probes & Targets, Cancer

Motivation: Molecular imaging holds revolutionary significance in the diagnosis and treatment of tumors.

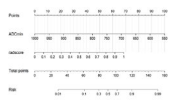
Goal(s): Clinical trials targeting immune checkpoint receptors with immune checkpoint blockade (ICB) therapies has encountered limited efficacy in pancreatic cancer.

Approach: MRI-guide ICB therapy (MRGIT) strategy for enhancing and guiding anti-PD-L1 therapy was proposed.

Results: The successful inhibition of tumor growth via MRGIT strategy in pancreatic tumor models demonstrates that it may be efficiently reverse the immunosuppressive PDAC and improve the ICB therapy with the employment of MRI technology.

Impact: The MRGIT strategy bridging the antitumor immune response with the MRI technique, which devised a potent tool that holds great promise for improving cancer diagnosis and facilitating the development of personalized treatment strategies tailored to individual patients.

0171 15:33 [Magnetic resonance imaging-based radiomic for predicting infiltration levels of CD68+ tumor-associated macrophages in Glioblastomas]



Qing Zhou[1] and Junlin Zhou[1]

[1]Lanzhou University Second Hospital, Lanzhou, China

Keywords: Preclinical Image Analysis, Nervous system

Motivation: Predicting Tumor-Associated Macrophages (TAMs) levels using preoperative non-invasive imaging can influence patients with Glioblastoma (Gb) treatment decision-making and evaluate prognosis.

Goal(s): This study aimed to combine imaging and radiomics features of preoperative for predicting CD68 + macrophage infiltration.

Approach: Retrospective collection 143 patients with Gb. Divided patients into high CD68+TAMs（≥14.8%）and low CD68+TAMs (<14.8%) groups. The radiomics features extraction were based on CE-T1WI and T2WI. Multi-parameter stepwise regression was used to create the models.

Results: The combined model, with ADCmin and radiomics features, had the best performance revealing AUCs of 0.865 and 0.825 for the training and testing sets, respectively.

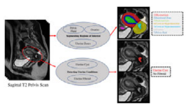
Impact: To provide imaging biomarkers for the evaluation of the TAMs infiltration of Gb by using machine learning combined with MR imaging parameters, reveal the relationship between images features and TAMs, and construct an evaluation model to predict macrophage before surgery.

Oral

Female Pelvis: Obstetrics to Oncology

Room 331-332 | Monday 13:45 - 15:45 | *Moderators:* Nandita DeSouza & Masako Kataoka

0172 13:45



[An AI-Based Solution for MR Image Analysis of the Female Reproductive System]

Javad Khaghani[1,2], Siavash Khallaghi[1,2], Saqib Basar[1,2], Yosef Chodakiewitz[2], Rajpaul Attariwala[1,2], and Sam Hashemi[1,2]

[1]Voxelwise Imaging Technology Inc, Vancouver, BC, Canada, [2]Prenuvo, Vancouver, BC, Canada

Keywords: Uterus, Reproductive, Female Reproductive System, Machine Learning, Artificial Intelligence

Motivation: To quantify female reproductive anatomy in MR imaging.

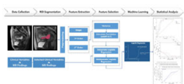
Goal(s): To develop an AI-based solution to segment the regions of interest (RoIs) for the uterine zone, ovaries, pelvic fluid, and detect benign uterine conditions.

Approach: A deep learning based method is applied on a large representative population of 9334 sagittal T2-weighted female pelvis scans to extract normative menstrual cycle- and aging-curves for various RoIs.

Results: Our proposed normative curves define the standard menstrual cycle and aging trends. RoI segmentation, fibroid, and cyst detection models achieve average foreground dice, specificity and accuracy scores of 83.9%, 95.2% and 94.37%, respectively.

Impact: Proposing a robust, precise AI solution for analyzing female reproductive organs on MR imaging, including uterine zones, ovaries, pelvic fluid, and fibroids/cysts. Using this, we define standard aging and menstrual cycle curves for women.

0173 13:57



[The MRI-based radiomics nomogram for predicting massive hemorrhage during dilatation and curettage]

Feng Gao[1], Le Fu[1], Jiejun Cheng[1], Jie Shi[2], and Yong Zhang[2]

[1]Shanghai first maternity and infant hospital, Shanghai, China, [2]MR Research, GE Healthcare, Beijing, China

Keywords: Uterus, Uterus, Cesarean scar pregnancy;

Motivation: Dilation and Curettage (D&C) is the preferred treatment for Cesarean scar pregnancy (CSP) patients. However, current methods for preoperative assessment of intraoperative bleeding are limited.

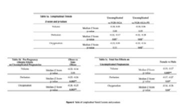
Goal(s): To develop a nomogram using radiomics and MRI-based clinical information to predict massive hemorrhage during D&C in CSP patients.

Approach: 116 CSP patients were enrolled. Radiomics features and clinical variables were analyzed to conduct the radiomics and the clinical models. The nomogram was established by combining Radscore and the selected clinical variables.

Results: Among the three models, the nomogram achieved the highest prediction performance with an AUC of 0.926 for test data.

Impact: This study first developed the MR-based radiomics nomogram to accurately predict massive hemorrhage preoperatively in CSP patients.

0174 14:09



[Longitudinal Trends and Effects in Placenta Multiparametric MRI (mpMRI) in Early Gestation]

Raymi Odalys Ramirez[1], Carla Janzen[2], Jennifer Kim[3], Brian Lee[3], Sherin U Devaskar[2], and Kyung Hyun Sung [4]

[1]Physics and Biology in Medicine, University of California Los Angeles, Los Angeles, CA, United States, [2]University of California Los Angeles, Los Angeles, CA, United States, [3]Pediatrics, University of California Los Angeles, Los Angeles, CA, United States, [4]Radiology, University of California Los Angeles, Los Angeles, CA, United States

Keywords: Placenta, Placenta

Motivation: This study is motivated by the clinical need to understand and monitor early gestational placenta development.

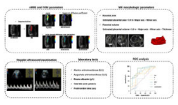
Goal(s): The goal is to show that multi-parametric placenta imaging during early gestation is a clinical tool to flag possible pregnancies in danger of multiple adverse effects.

Approach: This study includes data from a previous perspective study where MRI was taken at two separate timepoints during early gestation. Information on volume, perfusion, and oxygenation were evaluated for longitudinal trends as well as changes driven by obesity and fetal sex outcomes.

Results: We show statistically significant differences of longitudinal trends in most of the parameters between study cohorts.

Impact: The results in this study could allow for clinicians to gain insight on pregnancy development within the early second trimester currently unavailable with the current imaging with Doppler ultrasound. This will allow for overall life improvement for mother and fetus.

0175 14:21



[Using Virtual Magnetic Resonance Elastography and IVIM to Evaluate Placental Microstructure and Microcirculation in Gestational Hypertension]

Jing Deng[1], Yuwei Cao[1], Feifei Qu[2], Aining Zhang[1], Meng Zhao[1], Xin Zhou[3], Xihu Mu[1], Yanglei Wu[4], Jiacheng Song[1], Feiyun Wu[1], and Ting Chen[1]

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Keywords: Placenta, fMRI, Gestational hypertension, perfusion, placenta, virtual magnetic resonance elastography

Motivation: Detecting placental dysfunction using MRI before placental macrovascular lesions by ultrasound may help the early identification of placental pathologic changes in gestational hypertension (GH).

Goal(s): To explore changes in placental elasticity and perfusion in GH and control groups using MRI.

Approach: Placental elasticity and perfusion were assessed using virtual magnetic resonance elastography (vMRE) and intravoxel incoherent motion (IVIM). The vMRE and IVIM parameters, MR morphologic parameters, and ultrasound and lab test results were compared between the two groups.

Results: Placental stiffness and perfusion fraction helped distinguish between the two groups, with no substantial differences in the other parameters.

Impact: Virtual magnetic resonance elastography and intravoxel incoherent motion can quantify placental elasticity and circulation at the microscopic level, and are superior to the ultrasound parameters, in gestational hypertension. They may serve as a vital noninvasive supplement to assess placental dysfunction.

0176 14:33

MERIT AWARD
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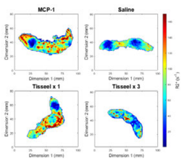

[Quantitative Placental R2* Mapping on Rhesus Macaques with Thrombotic and Inflammatory Injury Model]

Ruo-Yu Liu[1], Logan T. Keding[2,3], Jessica Vazquez[2,3], Jitka Starekova[4], Ante Zhu[4,5], Ruiming Chen[1], Heather A. Simmons[2,6], Puja Basu[2], Andres F. Mejia[2], Aleksandar K. Stanic[6], Dinesh Shah[6], Kevin M. Johnson[1,4], Diego Hernando[1,4], Thaddeus G. Golos[2,3,6], and Oliver Wieben[1,4]

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Keywords: Placenta, Quantitative Imaging, R2* mapping, Biomarkers, Contrast Agents, Ferumoxytol

Motivation: Pregnancy complications are often associated with placenta dysfunction, which lacks non-invasive assessment in early pregnancy.

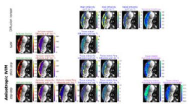
Goal(s): Evaluating placental R2* as a non-invasive and quantitative biomarker to identify and monitor pregnancy complications.

Approach: We introduce a novel thrombotic and inflammatory placental injury model of rhesus macaques and report mean values, histograms, and spatial distribution of placental R2* based on blood oxygenation level dependent (BOLD) MR imaging at different gestational ages before and after iron nanoparticle (ferumoxytol) administration.

Results: Higher overtime and post-contrast increase in mean values and more heterogeneous spatial patterns of R2* are observed in placentas with induced injury.

Impact: A refined nonhuman primate model for thrombosis and inflammation is introduced for investigating placental pathology. Larger R2* increases over time and immediately after ferumoxytol injections suggest the potential for R2* to be an indicator of pathology with or without contrast.

0177 14:45



[Simplified Anisotropic IVIM using Spherical Means and an Application in the Placenta]

Paddy J. Slator[1,2], Luke Pleva[3,4], Lucy Higgins[5,6], Edward Johnstone[5,6], Alexander Heazell[5,6], Daniel C. Alexander[7], Josephine H. Naish[3,4], and Kate Duhig[5,6]

[1]Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom, [2]School of Computer Science and Informatics, Cardiff University, Cardiff, United Kingdom, [3]BHF Manchester Centre for Heart and Lung Magnetic Resonance Research, University of Manchester, Manchester, United Kingdom, [4]Division of Cardiovascular Sciences, Faculty of Biology, Medicine and Health, University of Manchester, Manchester, United Kingdom, [5]Maternal and Fetal Health Research Centre, Institute of Human Development, University of Manchester, Manchester, United Kingdom, [6]St. Mary's Hospital, Manchester University Hospitals NHS Foundation Trust, University of Manchester, Manchester, United Kingdom, [7]Centre for Medical Image Computing and Department of Computer Science, University College London, London, United Kingdom

Keywords: Placenta, Placenta

Motivation: The intravoxel incoherent motion (IVIM) model can separately assess diffusion in tissue and perfusion in vasculature. However, anisotropic extensions to IVIM that model coherently orientated vasculature are complex and difficult to fit.

Goal(s): Enhance the IVIM model to account for macroscopic anisotropy in vascular structures, while minimizing the increase in model complexity.

Approach: We model perfusion and diffusion compartments using constrained tensors and estimate the tensor parameters via the spherical mean.

Results: Our spherical mean anisotropic IVIM approach quantifies and maps anisotropy in perfusion and diffusion compartments and captures microstructural and microcirculatory alterations in the placenta during pregnancy.

Impact: Existing anisotropic IVIM models are complex and clinically impractical. We demonstrate a spherical mean approach that simplifies the disentanglement of perfusion- and diffusion-related anisotropy. This can enable rapid quantification of biomarkers for detecting microcirculatory and microstructural changes in anisotropic tissue.

0178 14:57

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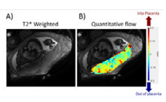


[A combined T2* weighted gradient echo and 1D quantitative flow sequence for investigating placental function]

George Jack Hutchinson[1], Amy Turnbull[1], Louise Dewick[2], Chris Bradley[1,3], Andrew Peters[1], Nia Jones[2], Kate Walker[2], and Penny Gowland[1]

[1]The Sir Peter Mansfield Imaging Centre, The University of Nottingham, Nottingham, United Kingdom, [2]The School of Medicine, The University of Nottingham, Nottingham, United Kingdom, [3]Biomedical Research centre, Hospital NHS Trust, The National Institute for Health Research, Nottingham, United Kingdom

Keywords: Placenta, Placenta, Quantitative flow

Motivation: Both oxygenation and blood flow are key measures of placental function; if we could dynamically, and simultaneously measure T2* and flow we could investigate placental function over time.

Goal(s): To Implement and test a gradient echo, quantitative flow sequence with EPI readout in the placenta.

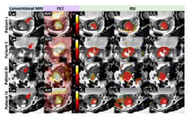
Approach: 4 participants were scanned at 3T using the sequence, and the T2* and velocity maps produced were investigated.

Results: The T2* weighted image retained sufficient contrast, and the quantitative flow was repeatable across subjects, measuring similar velocities in the placenta (<0.1cm/s) that has previously been measured with MRI.

Impact: This sequence has promise for dynamically investigating placental function, simultaneously providing information about oxygenation and blood flow. This will allow us to evaluate placental function in compromised pregnancies over time, and investigate the role of placental contractions.

0179 15:09

MERIT AWARD MAGNA CUM LAUDE



[Evaluation of a cervical cancer-specific restriction spectrum imaging model on an independent pilot cohort using PET/MRI: pre- and post-therapy]

Elin Lundström[1,2,3], Ana E Rodríguez-Soto[1], Elisabeth Hedlund[3], Björg Jónsdóttir[4], Katarzyna Kozar[3], Christopher Conlin[1], Stephane Loubrie[1], Stephan Jordan[1], Alexandra Schlein[1], Sheida Ebrahimi[1], J Stefan Peterson[5], Arnaud Guidon[6], Joshua Kuperman[1], Tyler M Seibert[1,7,8], Anders Dale[1,9], Per Liss[2,3], Anthoula Koliadi[10,11], and Rebecca Rakow-Penner[1]

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Keywords: Pelvis, Diffusion/other diffusion imaging techniques, restriction spectrum imaging, cervical cancer

Motivation: Restriction spectrum imaging (RSI) can potentially improve cervical cancer evaluation pre- and post-therapy, particularly in separating persistent malignancy from post-treatment edema.

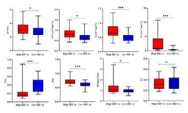
Goal(s): To evaluate a cervical cancer-specific RSI model for assessment on an independent pilot cohort examined with combined PET/MRI.

Approach: Four patients underwent PET/MRI before (chemo)radiotherapy. Two of them also underwent PET/MRI within 4 weeks of treatment, MRI 3 months post-treatment and PET/MRI 6 months post-treatment. Two healthy volunteers underwent MRI only.

Results: Preliminary results showed increased tumor conspicuity on RSI compared to conventional pre-therapy PET/MRI and promising results early post-therapy.

Impact: Cervical cancer-specific restriction spectrum imaging (RSI), evaluated on an independent pilot cohort, indicates increased tumor conspicuity compared to conventional pre-therapy PET/MRI and promising results post-therapy. Future work will target early therapy response assessment in combined RSI-PET/MRI at a larger scale.

0180 15:21



[APTw Combined with Multiple Models DWI of Endometrial Cancer: Correlations between Multimodal Parameters and HIF-1α Expression]

Changjun Ma[1,2], Shifeng Tian[1], Qingling Song[1], Lihua Chen[1], Liangjie Lin[3], Jiazheng Wang[3], and Ailian Liu[1]

[1]Department of Radiology,, The First Affiliated Hospital of Dalian Medical University, Dalian, China, [2]Department of Medicine, Dalian University of Technology, Dalian, China, [3]Clinical and Technical Support,, Philips Healthcare, Beijing, China

Keywords: Pelvis, Pelvis

Motivation: Hypoxia inducible factor (HIF-1α) is a major transcriptional factor regulating gene expression under hypoxic conditions and could serve as an important biomarker for tumor aggressiveness or radiation resistance.

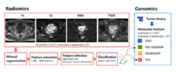
Goal(s): This study aimed to investigate whether the multimodal functional MRI technique can be used for quantitatively measuring HIF-1α expression.

Approach: APT, ADC, D, D*, f, MK, and MD values were calculated and compared between HIF-1α high expression and HIF-1α low expression groups.

Results: APT, ADC, D, D*, MK and MD values were significantly higher in high HIF-1α expression than in low HIF-1α expression groups, whereas f value was significantly lower in high HIF-1α expression .

Impact: The quantitative parameters of APTw combined with multi-model diffusion-weighted sequences allowed quantitative assessment of EC HIF-1α expression, and the combined quantitative parameters further enhanced the assessment efficacy.

0181 15:33 [A Radiogenomics Model for Classifying Molecular Subtypes of Endometrial Cancer: A Two-Center Retrospective Study]



Wenyi Yue[1], Ruxue Han[2], Haijie Wang[3], Chen Zhang[4], Yang Song[4], Xiaoyun Liang[3], He Zhang[5], Hua Li[2], and Qi Yang[1]

[1]Department of Radiology, Beijing Chaoyang Hospital, Capital Medical University, Beijing, China, [2]Department of Gynecology and Obstetrics, Beijing Chaoyang Hospital, CapitalMedical University, Beijing, China, [3]Institute of Research and Clinical Innovations, Neusoft Medical Systems Co., Ltd, Beijing, China, [4]MR Research Collaboration; Siemens Healthineers, Beijing, China, [5]Department of Radiology,Obstetrics and Gynecology Hospital of Fudan University, Shanghai, China

Keywords: Uterus, Uterus, Radiogenomics

Motivation: To explore genetically based molecular profiling of endometrial cancer (EC) patients to delineate prognostic risk groups.

Goal(s): To demonstrate the potential of radiogenomics for classification of EC molecular subtypes, 254 EC patients with histologically and genetically proven EC from two-center were enrolled.

Approach: A radiomics model based on four sequences was combined with genomics features to form the final diagnosed model.

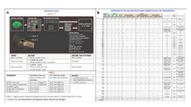
Results: Our results showed a medium-to-high diagnostic performance to distinguish molecular subtypes with AUC of 0.849 and 0.673 in internal and external test sets, respectively. The radiogenomics model could guide clinicians in administering individual treatments for EC patients.

Impact: Our results demonstrate that the predictive model derived from MRI imaging features holds significant promise in identifying molecular subtypes in endometrial cancer. This model has the potential to guide clinicians in tailoring individualized treatments for EC patients.

Oral
Electromagnetic Tissue Properties

Room 334-336 | Monday 13:45 - 15:45 | *Moderators:* Emma Biondetti & Nitish Katoch

0182 13:45 [The first MR Electrical Properties Tomography (MR-EPT) reconstruction challenge: preliminary results of simulated data]



Stefano Mandija[1,2], Alessandro Arduino*[3], Cornelis A.T. van den Berg*[1,2], Patrick Fuchs*[4], Ilias Giannakopoulos*[5], Yusuf Ziya Ider*[6], Kyu-Jin Jung*[7], Ulrich Katscher*[8], Dong-Hyun Kim*[7], Riccardo Lattanzi*[5,9], Thierry G. Meerbothe*[1,2], Khin-Khin Tha*[10], and Luca Zilberti*[3]

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Keywords: Electromagnetic Tissue Properties, Electromagnetic Tissue Properties, Conductivity

Motivation: To benchmark MR-Electrical Properties Tomography (MR-EPT) reconstruction methods.

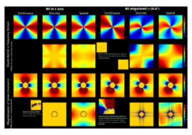
Goal(s): To present an overview of the first MR-EPT reconstruction challenge participation and the results of its phase 1.

Approach: The challenge consisted of 3 phases:1) reconstructions from a simulated (blind) dataset (ground-truth EPs not provided);2) reconstructions from several simulated dataset (ground-truth EPs provided for few training dataset for tuning algorithm parameters);3) EPs reconstructions from measured data.

Results: 52 participants registered to the challenge; 39 submitted their results. For phase 1, all participants submitted a reconstructed conductivity map; 12 submitted a reconstructed permittivity map. The results show large variability in reconstruction accuracy and precision.

Impact: The results of phase 1 of the first MR-EPT reconstruction challenge show large variations in the estimated conductivity and permittivity maps demonstrating the need of benchmarking reconstruction methods on common datasets.

0183 13:57



Artifact free Projection onto Dipole Fields via a Generalized Frequency-domain Discrete Dipole Kernel

Carlos Milovic[1], Mathias Lambert[2], Patrick Fuchs[3], Oliver Kiersnowski[3], Chaoyue Wang[4], Zheng Wang[5], and Cristian Tejos[2]

[1]School of Electrical Engineering, Pontificia Universidad Catolica de Valparaiso, Valparaiso, Chile, [2]Pontificia Universidad Catolica de Chile, Santiago, Chile, [3]Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [4]SJTU-Ruijin-UIH Institute for Medical Imaging Technology, Shanghai Jiaotong University School of Medicine, Shanghai, China, [5]School of Psychological and Cognitive Sciences; Beijing Key Laboratory of Behavior and Mental Health; IDG/McGovern Institute for Brain Research; Peking-Tsinghua Center for Life Sciences, Peking University, Beijing, China

Keywords: Susceptibility/QSM, Quantitative Susceptibility mapping, Background field removal

Motivation: Overcoming striping artifacts in the background removal step is a common challenge, especially in non-orthogonal (oblique) B0 field orientations.

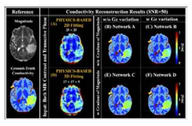
Goal(s): Develop a robust solution to eliminate striping artifacts while improving the accuracy of QSM images.

Approach: We introduce a novel approach, employing a generalized discrete kernel to suppress striping artifacts generated by the Projection onto Dipole Fields method.

Results: Our approach successfully addresses striping artifacts and enhances the accuracy of PDF solutions, even at non-orthogonal B0 field angles, promising artifact-free results.

Impact: Our work promises to benefit the EMTP community by providing a more robust solution for addressing striping artifacts. This can lead to improved diagnostic accuracy and higher-quality imaging, ultimately enhancing patient care and advancing MRI technology.

0184 14:09



Data-driven Electrical Conductivity Reconstructions via transceive phase and signal magnitude gradient data from the three imaging directions

Chan-Hee Park[1], Thierry G. Meerbothe[2,3], Kyu-Jin Jung[1], Chuanjiang Cui[1], Mina Park[4], Yoonho Nam[5], Cornelis A.T. van den Berg[2,3], Stefano Mandija[2,3], and Dong-Hyun Kim[1]

[1]Department of Electrical and Electronic Engineering, Yonsei University, Seoul, Korea, Republic of, [2]Department of Radiotherapy, Division of Imaging and Oncology, UMC Utrecht, Utrecht, Netherlands, [3]Computational Imaging Group for MR Diagnostics and Therapy, UMC Utrecht, Utrecht, Netherlands, [4]Department of Radiology, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, Republic of, [5]Divison of Biomeidcal Engineering, Hankuk University of Foreign Studies, Yongin-Si, Korea, Republic of

Keywords: Electromagnetic Tissue Properties, Electromagnetic Tissue Properties

Motivation: Phase-based conductivity reconstructions suffer from poor structural information and lack of conductivity information from through plane (z-direction) phase variations.

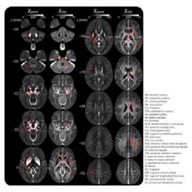
Goal(s): To present an end-to-end process that utilizes gradient information from the transceive phase and tissue magnitude in all three directions (in-plane: x/y and through plane: z) to address the issue of boundary artifacts in conductivity reconstructions and lack of conductivity information from the z-direction.

Approach: This method was trained on simulated data (SNR=50), and tested both on simulated and measured in-vivo data.

Results: This approach reduces boundary errors and shows higher accuracy in conductivity reconstructions compared to conventional methods.

Impact: In contrast to existing tissue conductivity reconstruction algorithms that operate under the assumption of negligible through-plane (z) transceive phase contributions, our approach demonstrates enhanced efficacy and more accurate conductivity reconstructions by explicitly considering through-plane phase variations.

0185 14:21



A human brain atlas of χ-separation (chi-separation) for normative iron and myelin distributions

Kyeongseon Min[1], Beomseok Sohn[2], Woo Jung Kim[3,4], Chae Jung Park[5], Soohwa Song[6], Dong Hoon Shin[6], Kyung Won Chang[7], Na-Young Shin[8], Minjun Kim[1], Hyeong-Geol Shin[9,10], Phil Hyu Lee[11], and Jongho Lee[1]

[1]Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of, [2]Department of Radiology, Samsung Medical Center, Seoul, Korea, Republic of, [3]Institute of Behavioral Sciences in Medicine, Yonsei University College of Medicine, Seoul, Korea, Republic of, [4]Department of Psychiatry, Yongin Severance Hospital, Yongin, Korea, Republic of, [5]Department of Radiology, Yongin Severance Hospital, Yongin, Korea, Republic of, [6]Heuron Co., Ltd, Seoul, Korea, Republic of, [7]Department of Neurosurgery, Severance Hospital, Seoul, Korea, Republic of, [8]Department of Radiology, Severance Hospital, Seoul, Korea, Republic of, [9]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [10]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [11]Department of Neurology, Severance Hospital, Seoul, Korea, Republic of

Keywords: Susceptibility/QSM, Software Tools, Susceptibility source separation, Atlas, Iron imaging, Myelin imaging

Motivation: Abnormal iron and myelin distributions are associated with neurodegenerative diseases. An advanced susceptibility mapping technique, χ-separation, can disentangle paramagnetic iron and diamagnetic myelin contributions in quantitative susceptibility mapping.

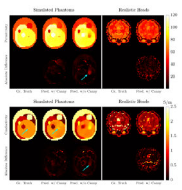
Goal(s): In this study, a normative χ-separation atlas is created from 106 healthy volunteers.

Approach: To this end, individual χ-separation maps were registered to a common space and averaged across subjects.

Results: The resulting χ-separation atlas reflects well-known iron and myelin-rich structures in the brain. The analysis based on regions of interest revealed distinct characteristics of normative para- and diamagnetic susceptibility profiles throughout subcortical nuclei, thalamic nuclei, and white matter fibers.

Impact: Our χ-separation atlas would be utilized as a reference for imaging susceptibility in the brain and may assist in accurate localization of targets for intervention such as deep brain stimulation or high-intensity focused ultrasound.

0186 14:33



Electrical Property Mapping using Vision Transformers and Canny Edge Detection

Ilias Giannakopoulos[1], Xinling Yu[2], Giuseppe Carluccio[3], Gregor Koerzdoerfer[4], Karthik Lakshmanan[1,5], Hector Lise de Moura[1], Jose Cruz Serralles[1], Jerzy Walczyk,[1], Zheng Zhang[2], and Riccardo Lattanzi[1,5,6]

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Keywords: Electromagnetic Tissue Properties, Electromagnetic Tissue Properties, Machine Learning

Motivation: To estimate tissue electrical properties (EP) non-invasively for specific absorption rate management and as biomarkers for pathology characterization.

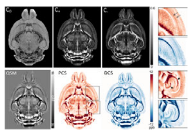
Goal(s): To train neural networks for mapping transmit magnetic fields (B_1^+) onto EP.

Approach: We developed a 3D vision transformer that takes the B_1^+ and an edge mask based on Canny filtering of the MR image as the inputs. The targets were the EP of the object. We trained on simulated tissue mimicking objects and fine-tuned on realistic head models.

Results: Our network successfully reconstructed the EP in a phantom experiment, and detected a synthetic cyst in a realistic head model in simulation.

Impact: We propose a supervised learning approach using vision transformers and Canny edge detection to perform electrical property (EP) mapping. The network successfully reconstructs the EP using experimentally measured fields and is a promising first step towards clinically-usable in-vivo EP reconstructions.

0187 14:45



[Distinguishing microgliosis and tau deposition in the mouse brain using paramagnetic and diamagnetic susceptibility source separation]

Jayvik Joshi[1], Minmin Yao[2,3], Wenzhen Duan[2,3], and Manisha Aggarwal[4]

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Keywords: Susceptibility/QSM, Microstructure, Brain

Motivation: Susceptibility source separation methods to disentangle sub-voxel paramagnetic and diamagnetic susceptibility sources may provide higher specificity to distinguish tissue microstructural alterations.

Goal(s): Our goal was to investigate sub-cellular histopathological alterations in an established tauopathy mouse model using quantitative susceptibility source separation.

Approach: Brains of PS19 mice and wild-type controls (n = 5 each) were imaged at 11.7 T. We used the DECOMPOSE-QSM model to calculate paramagnetic and diamagnetic component susceptibility maps.

Results: Susceptibility maps revealed significant localized alterations in specific regions of the hippocampus and entorhinal cortex, which were found to correspond to regional microgliosis and tau deposition seen with immunohistology.

Impact: Our findings demonstrate unique sensitivity of paramagnetic and diamagnetic susceptibility changes to distinguish regional microgliosis and tau deposition in the brain. Quantitative magnetic susceptibility source separation may therefore provide a sensitive method to assess sub-cellular histopathological alterations in tauopathies.

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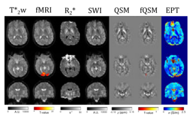


[Rapid High Resolution Integrated Structural and Functional Susceptibility and Conductivity Mapping in the Human Brain]

Oliver C Kiersnowski[1], Patrick Fuchs[1], Jannette Nassar[1], Oriana Arsenov[1], Jierong Luo[1], Anita Karsa[1], Stephen Wastling[2,3], and Karin Shmueli[1]

[1]Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]Neuroradiological Academic Unit, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [3]Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, United Kingdom

Keywords: Susceptibility/QSM, Quantitative Susceptibility mapping, Electrical Properties Tomography, EPT, fMRI, fQSM, fQCM

Motivation: Quantitative susceptibility mapping (QSM), electrical conductivity mapping (EPT) and fMRI show promise in characterising neurodegenerative diseases but each currently needs a separate time-consuming acquisition.

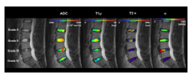
Goal(s): To develop a single, rapid acquisition for simultaneous structural and functional QSM and EPT, providing multi-modal contrasts to facilitate development of biomarkers for neurological diseases.

Approach: We developed a multi-echo 2D EPI sequence with 1.3 mm isotropic resolution and 4.02 s TR enabling acquisition of 70 timepoints in 6 min 15 s. We optimised QSM, EPT and fQSM reconstruction pipelines.

Results: We obtained high-quality structural QSM and EPT, alongside fMRI and fQSM activations from a visual stimulus.

Impact: Demonstrating that this efficient multi-echo EPI acquisition rapidly produces high-quality simultaneous QSM, fQSM and EPT reconstructions alongside conventional T_2*-weighted, SWI and fMRI contrasts in 6 min 15 s will allow it to be incorporated into clinical studies of neurodegenerative diseases.

0189 15:09



[Potential of phase-based electrical conductivity in evaluating lumbar intervertebral disc degeneration]

Khin Khin Tha[1], Maho Kitagawa[2], Daiki Sakamoto[2], Hiroyuki Hamaguchi[3], and Ulrich Katscher[4]

[1]Global Center for Biomedical Science and Engineering, Hokkaido University Faculty of Medicine, Sapporo, Japan, [2]Laboratory for Biomarker Imaging Science, Hokkaido University Graduate School of Biomedical Science and Engineering, Sapporo, Japan, [3]Hokkaido University Graduate School of Biomedical Science and Engineering, Sapporo, Japan, [4]Philips Research Laboratories, Hamburg, Germany

Keywords: Electromagnetic Tissue Properties, Electromagnetic Tissue Properties, intervertebral disc, lumbar, degeneration

Motivation: Visual assessment of T2-weighted image constitutes the mainstay in evaluating the severity of intervertebral disc degeneration (IVD) degeneration. Quantitative MRI indices that strongly correlate with the degree of degeneration are lacking.

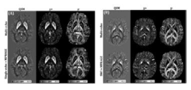
Goal(s): This study aimed to evaluate if electrical conductivity (σ) derived from phase-based EPT was sensitive to the degenerative changes of lumbar IVD.

Approach: EPT was conducted, along with DWI, T1ρ, and T2* imaging, in 54 patients with lumbar IVD degeneration. The diagnostic performance of σ was compared with that of ADC, T1rho, and T2*.

Results: σ can compliment the other quantitative MRI indices in evaluating lumbar IVD degeneration.

Impact: This is the first study which evaluated the potential clinical usefulness of σ derived from phase-based EPT in evaluating the severity of degeneration of lumbar IVD.

0190 15:21



[Feasibility of susceptibility separation using single-echo gradient-echo and MPRAGE]

Nashwan Naji[1], Jeff Snyder[1], and Alan Wilman[1]

[1]Department of Radiology and Diagnostic Imaging, University of Alberta, Edmonton, AB, Canada

Keywords: Susceptibility/QSM, Quantitative Susceptibility mapping, Susceptibility separation, R2*, SWI, MPRAGE, single-echo GRE

Motivation: Susceptibility separation enables exploring sub-voxel contributions of iron/myelin but requires multi-echo gradient-echo to calculate the R2* map. Extending its applicability to single-echo measurements such as in SWI-focused studies, would allow wider usage.

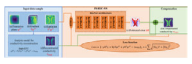
Goal(s): To develop and validate at 3T an approach that produces brain para- and diamagnetic maps from SWI with information from MPRAGE images typically collected for structural imaging.

Approach: R2* was estimated from SWI and MPRAGE using Bloch simulations, followed by production of para- and diamagnetic maps using calculated R2* and R2 maps, and SWI phase.

Results: Comparable maps to those produced from multi-echo images were obtained.

Impact: The proposed method enables producing para- and diamagnetic maps from SWI studies, with the possibility of retrospective application if SWI raw phase and T1w images exist.

0191 15:33



A Self-supervised Physics-informed Reconstruction Error Compensation Neural Network for Magnetic Resonance Electrical Property Tomography

Ruian Qin[1], Adan Jafet Garcia Inda[2], Zhongchao Zhou[1], Tianyi Yang[1], Nevrez Imamoglu[3], Jose Gomez-Tames[1,4], Shao Ying Huang[5,6], and Wenwei Yu[1,4]

[1]*Department of Medical Engineering, Chiba University, Chiba, Japan,* [2]*Science & Technology Research Laboratories, Cresco, Tokyo, Japan,* [3]*Digital Architecture Research Center, National Institute of Advanced Industrial Science and Technology, Tokyo, Japan,* [4]*Center for Frontier Medical Engineering, Chiba University, Chiba, Japan,* [5]*Engineering Product Development Department, Singapore University of Technology and Design, Singapore, Singapore,* [6]*Department of Surgery, National University of Singapore, Singapore, Singapore*

Keywords: Electromagnetic Tissue Properties, Electromagnetic Tissue Properties

Motivation: The recent physics-informed neural network (PINN) for Magnetic resonance electrical properties tomography (MREPT) still reply on ground truth as boundary conditions for back propagations.

Goal(s): It is aimed to propose a PINN that uses only the residuals of an MREPT analytic model rather than ground truth data.

Approach: A PINN framework which uses the aforementioned residuals to guide the network learning process of an neural network, enhancing the accuracy and reliability of the reconstruction, was proposed to compensate for the conductivity reconstruction errors of the Stabilized-EPT.

Results: The results show increased accuracy of the reconstruction of conductivity for both normal and tumorous tissues.

Impact: Feasibility of more accurate conductivity reconstruction without any ground truth information is demonstrated. This may lead to practical cancer detection.

Power Pitch

Pitch: MRE, Diffusion & APT for Body Applications

Power Pitch Theatre 1

Monday

Pitches: 13:45 - 14:45

Posters: 14:45 - 15:45

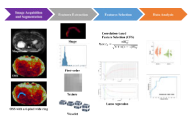
Moderators: Timothy Bray

(no CME credit)

0192 Pitch: 13:45

Poster: 14:45

Screen 1



Predicting VETC in Hepatocellular Carcinoma Using Radiomic Features from Peritumoral Mechanical Strain Assessed by MR Elastography

Keni Zheng[1], Mengsi Li[2], Yi Sui[1], Xiang Shan[1], Emi Hojo[1], Armando Manduca[3], Richard Ehman[1], Jin Wang[2], and Ziying Yin[1]

[1]*Radiology, Mayo Clinic, Rochester, MN, United States,* [2]*The Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, China,* [3]*Physiology and Biomedical Engineering, Mayo Clinic, Rochester, MN, United States*

Keywords: Liver, Liver, MRI, MR Elastography (MRE), HCC, VETC, Radiomics, texture features

Motivation: Vessels encapsulating tumor clusters (VETC) is a powerful indicator of aggressive Hepatocellular carcinoma (HCC) associated with recurrence, which is expected to be noninvasively identified using imaging techniques.

Goal(s): This study aims to develop a potential mechanical biomarker utilizing radiomics features extracted from MR Elastography (MRE)-assesed peritumoral shear strain to predict VETC in HCC.

Approach: Radiomics features were extracted from the tumor boundary on an octahedral shear strain (OSS) map. Feature selection techniques were used to identify relevant features to construct a radiomics score.

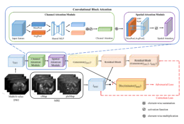
Results: Three radiomics features were utilized to construct a radiomics score, demonstrating potential for MRE-based strain analysis in predicting VETC.

Impact: A radiomics score constructed by radiomics features derived from MRE-based strain analysis in the peritumoral region show promise in predicting VETC in HCC patients. This study results show non-invasive VETC prediction potential in HCC, impacting personalized treatment and patient outcomes.

0193 Pitch: 13:45

Poster: 14:45

Screen 2



Multi-b values DWI-based Virtual High-resolution MR Elastography and Validation on Liver Fibrosis and Inflammation Prediction

Longyu Sun[1], Yikun Wang[2], Xumei Hu[1], Xueqin Xia[3], Mengting Sun[1], Qing Li[1], Meng Liu[1], Yinghua Chu[4], Xinyu Zhang[1], Ruokun Li[2], and Chengyan Wang[1]

[1]Human Phenome Institute, Fudan university, Shanghai, China, [2]Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Institute of Science and Technology for Brain-Inspired Intelligence, Fudan University, Shanghai, China, [4]Simens Healthineers Ltd, Shanghai, China

Keywords: Liver, Liver, DWI, MRE, Liver fibrosis, RegGAN, CBAM

Motivation: Liver biopsy is the standard clinical approach for diagnosing liver fibrosis. However, its invasiveness and possibility of sampling errors impose inherent limitations.

Goal(s): To evaluate the reproducibility and reliability of the virtual MRE based on DWI and compare it with MRE to assess its efficiency in diagnosing liver fibrosis.

Approach: RegGAN was employed to forecast MRE and rectify the outcomes. And CBAM was utilized to quantify the influence of diverse b-values in DWI.

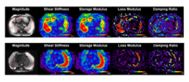
Results: RegGAN-CBAM demonstrates favorable performance in both image and stiffness prediction of MRE. The liver fibrosis grading based on stiffness predictions demonstrates a high level of accuracy and sensitivity.

Impact: The prediction methodology of 3D MRE based on DWI exhibits a notable level of diagnostic efficiency and reliability. This approach serves as a non-invasive method with practical applicability in the clinical assessment of liver fibrosis.

0194 Pitch: 13:45

Poster: 14:45

Screen 3



Three-dimensional MR Elastography Identifies Portal Hypertension in Cirrhosis: A Prospective Multicenter Study

Zhiying Wang[1], Minghui Zhou[1], Chen Pan[1], Baihe Luo[1], Jialin Li[1], Qiang Liu[1], and Yu Shi[1]

[1]Department of Radiology, Shengjing Hospital of China Medical University, Shenyang, Liaoning, China

Keywords: Liver, Elastography

Motivation: Hepatic venous pressure gradient (HVPG) is the gold standard for diagnosing portal hypertension, but it is invasiveness, cost, and feasibility.

Goal(s): To develop a non-invasive model based on Three-dimensional (3D) MR elastography (3D-MRE) to detect portal hypertension.

Approach: Spearman correlation analysis between 3D-MRE parameters and HVPG; Multivariable linear regression analysis between mechanical parameters and HVPG; Logistic regression analysis and establish a model to diagnose portal hypertension.

Results: 3D-MRE is a non-invasive, rapid, and highly accurate tool for predicting portal hypertension. Especially Spleen stiffness at 60Hz was the independent parameters associating HVPG.

Impact: This indicates that the use of 3D-MRE can provide more personalized evaluation and better medical experience for patients with cirrhosis and provides a new method for non-invasive diagnosis of portal hypertension.

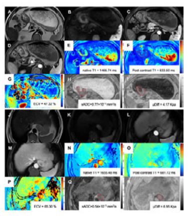
0195 Pitch: 13:45

Poster: 14:45

Screen 4

Baseline virtual MR elastography and extracellular volume fraction in the prediction of response to neoadjuvant chemotherapy in gastric cancer

Yongjian Zhu[1], Wei Cai[1], Yueluan Jiang[2], and Liming Jiang[1]



[1]Department of Diagnostic Radiology, National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China, [2]MR Research Collaboration, Siemens Healthineers, Beijing, China

Keywords: Digestive, Elastography, gastrointestinal; Cancer

Motivation: Although neoadjuvant chemotherapy (NAC) was recommended for gastric cancer (GC), only about 40% patients could achieve pathological response. Accurate prediction of the NAC response is crucial for patients' benefits.

Goal(s): To evaluate the predictive performance of virtual MR elastography (vMRE) and extracellular volume (ECV) for predicting the response to of NAC in GC patients.

Approach: Patients underwent DWI-based elastography, pre- and post-contrast T1 mapping before treatment. DWI-based virtual shear modulus (μDiff) and ECV were calculated from DWI and T1 mapping.

Results: Both μDiff (AUC: 0.833) and ECV (AUC: 0.794) were independent predictors for NAC response, their combination could improve the AUC to 0.968.

Impact: Our result revealed that DWI-based virtual shear modulus (μDiff) and ECV exhibited a promising predictive ability for predicting response to NAC. This would aid in identifying responders before treatment, reducing unnecessary toxicity and side effects, and guiding individualized treatment.

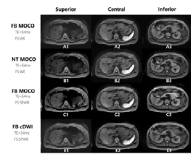
0196 Pitch: 13:45

Poster: 14:45

Screen 5

Free-breathing Motion-Corrected Liver DWI at 3T with Optimized Fat-suppression Scheme

Zhiyong Chen[1], Zhangli Xing[2], Enshuang Zheng[1], Mingcong Luo[2], Caixia Fu[3], Guijin Li[4], Thomas Benkert[5], Yunjing Xue[1], and Bin Sun[1]



[1]Radiology, Fujian Medical University Union Hospital, Fuzhou, China, [2]Fujian Medical University Union Hospital, Fuzhou, China, [3]MR Application Development, Siemens Shenzhen magnetic Resonance Ltd., Shenzhen, China, Shenzhen, China, [4]MR application, Siemens Healthineers Ltd , Guangzhou , China, Guangzhou, China, [5]MR Application Predevelopment, Siemens Healthineers AG, Erlangen, Germany, Erlangen, Germany

Keywords: Liver, Diffusion/other diffusion imaging techniques

Motivation: A free-breathing motion-insensitive and high-quality DWI is desired for abdominal DWI in clinical practice.

Goal(s): This study is to propose and evaluate a novel ss-EPI DWI sequence incorporating motion correction , complex averaging , and a combination of a reparametrized sinc fatsat pulse with an optimized water excitation pulse for abdominal DWI.

Approach: Four different DWI sequecnes were performed on volunteers. The overall image qualities and the SNR on the liver papernchyma were evaluated and compared.

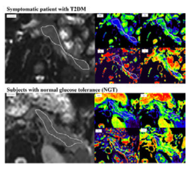
Results: The SNRs of the liver and the image qualities were significantly higher with the proposed Free-breathing motion-corrected DWI (MOCO-DWI) sequence compared to other EPI DWI sequences.

Impact: The free-breathing MOCO-DWI sequences with complex-averaging and new fat suppression scheme is recommended for high-quality liver DWI in clinical routine.

0197 Pitch: 13:45
Poster: 14:45
Screen 6

Intravoxel incoherent motion diffusion-weighted imaging (IVIM-DWI) of pancreas for assessment of β-cell dysfunction in hyperglycemia

Ping Liu[1], Yingying Song[2], Wanyi Zhen[1], and Guihua Jiang[1]



[1]Department of Medical Imaging,, Guangdong Second Provincial General Hospital, Guangzhou, China, [2]Department of Radiology, Affiliated Hospital of Jianghan University, Wuhan, China

Keywords: Endocrine, Pancreas, Type 2 diabetes mellitus

Motivation: Early detection of damaged β-cell function may help timely protect and stop the progression of hyperglycemia to type 2 diabetes mellitus (T2DM). The impaired β-cell function may be associated with damaged pancreatic microstructure.

Goal(s): The pancreatic microstructural changes may serve as the biomarker for β-cell dysfunction.

Approach: We evaluate the microstructural changes of the pancreas in patients with hyperglycemic employing intravoxel incoherent motion diffusion-weighted imaging (IVIM-DWI) and explore its correlation with the β-cell function.

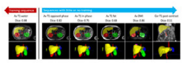
Results: IVIM-DWI can effectively distinguish T2DM from hyperglycemia, it has the potential for identifying damaged b-cell function for patients with early-stage hyperglycemia but without obvious clinical manifestation of DM.

Impact: IVIM-DWI of pancreases is a reliable and non-invasive tool with great potential in detecting the early damaged β-cell function when the DM is still in the insidious stage, and help for improving diabetes diagnosis and management.

0198 Pitch: 13:45
Poster: 14:45
Screen 7

Abdominal Foundation Model: Bootstrapping artificial intelligence for MRI organ volume biomarker analysis in ADPKD

Chenglin Zhu[1], Xinzi He[2], Zhongxiu Hu[1], Hreedi Dev[1], Dominick J. Romano[1], Arman Sharbatdaran[1], Anna Prince[1], Andrea Soto Figueroa[1], Sophie J. Wang[1], Hui Yi Ng He[1], Jon D. Blumenfeld[3], and Martin R. Prince[1,4]



[1]Weill Cornell Medicine, New York City, NY, United States, [2]Cornell University and Cornell Tech, New York City, NY, United States, [3]The Rogosin Institute, New York City, NY, United States, [4]Columbia University Vagelos Collage of Physicians and Surgeons, New York City, NY, United States

Keywords: Kidney, Segmentation, ADPKD

Motivation: Abdominal organ volumes are critical MRI biomarkers in many diseases including autosomal dominant polycystic kidney disease.

Goal(s): We aim to develop a segmentation model with an enhanced ability to generalize across various abdominal organs and MR pulse sequences.

Approach: We construct a multi-modality abdominal foundation model expanding upon our existing ADPKD kidney model which adapts to diverse organs and tissues with minimal new training data.

Results: The model was trained using a model-in-loop methodology and evaluated against radiologist benchmarks, yielding an impressive Dice score of 0.94 for in-distribution sequences and 0.73 for organ segmentations on out-of-distribution sequences.

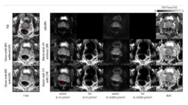
Impact: This foundational model can seamlessly integrate into clinical workflows, utilizing routine cases to enhance its performance and extending its application to additional organs and tissues. This advance also marks a significant step toward the automation of MRI reporting.

0199

Pitch: 13:45

Poster: 14:45

Screen 8



[Water/fat separated Prostate Diffusion-Weighted Imaging using Dixon-encoded multi-shot EPI with structured low-rank reconstruction]

Yiming Dong[1], David Atkinson[2], Kirsten Koolstra[3], Matthias J.P. van Osch[1], and Peter Börnert[1,4]

[1]C.J. Gorter MRI Center, Department of Radiology, LUMC, Leiden, Netherlands, [2]Centre for Medical Imaging, University College London, London, United Kingdom, [3]Philips, Best, Netherlands, [4]Philips Research Hamburg, Hamburg, Germany

Keywords: Prostate, Prostate

Motivation: Conventional single-shot EPI (ssh-EPI) is fast, but often causes geometric distortions, especially near the rectum.

Goal(s): In this research, a Dixon-msh-EPI technique is validated for prostate Diffusion-weighted Imaging (DWI).

Approach: Dixon-msh-EPI is proposed to reduce such distortions, while jointly separating water/fat components by a special structured low-rank reconstruction that also corrects shot-to-shot phase variations.

Results: Experiments were conducted on 7 healthy male volunteers using a 3T scanner comparing DW-ssh-EPI and Dixon-msh-EPI performance. The Dixon-msh showed significantly reduced geometric distortion and effective fat signal suppression, as scored by two readers. While both methods provided comparable image quality, Dixon-msh-EPI demonstrated improved motion-correction and geometric accuracy.

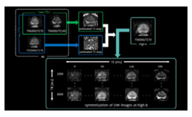
Impact: Dixon-msh-EPI offers improved prostate DWI by significantly reducing geometric distortions and enhancing across b-value registration. This technique could lead to more accurate diagnoses and has the potential to refine clinical MRI protocols, emphasizing precision in prostate diffusion imaging.

0200

Pitch: 13:45

Poster: 14:45

Screen 9



[Value of quantitative relaxation mapping calculated from Multiple-Repetition Multiple-Echo DWI acquisition in prostate cancer detection]

Tsutomu Tamada[1], Yu Ueda[2], Mitsuru Takeuchi[3], Atsushi Higaki[4], Yuichi Kojima[4], Yoshihiko Fukukura[4], and Akira Yamamoto[4]

[1]Radiology, Kawasaki Medical School, Kurashiki, Japan, [2]Philips Japan, Tokyo, Japan, [3]Radiolonet Tokai, Nagoya, Japan, [4]Kawasaki Medical School, Kurashiki, Japan

Keywords: Prostate, Prostate

Motivation: The detection rate of csPCa in PI-RADS 3 lesions is only 25-38%. This leads to unnecessary biopsies.

Goal(s): Can multiparametric quantitative maps based on estimated T1 and T2 help differentiate clinically significant prostate cancer (csPCa) from non-csPCa in PI-RADS 3 lesions?

Approach: We compare T1, T2, and ADC obtained from Multiple-Repetition time Multiple- Echo time (MRME) based DWI (MRME-DWI) between csPCas and non-csPCas in PI-RADS 3 lesion using MRI-ultrasound fusion targeted biopsy as the reference standard.

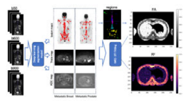
Results: The T1, T2, and ADC were significantly lower for csPCas than non-csPCas. Combining these indices yields an AUC of 0.82.

Impact: MRME-DWI can simultaneously obtain T1, T2, and ADC from a single region of interest in a single imaging session. Combining these quantitative measures is expected to improve the detection rate of clinically significant prostate cancer in PI-RADS 3 lesions.

0201 Pitch: 13:45

Poster: 14:45

Screen 10



Estimating diffusion fractional anisotropy of disease in patients with advanced prostate and breast cancers. A single-center study.

Sheng Yu[1], Antonio Candito[1], Konstantinos Zormpas-Petridis [1,2], Ana Ribeiro[1,3], Georgina Hopkinson[3], Jessica M Winfield[1,3], Nina Tunariu[1,3], Christina Messiou[1,3], Dow-Mu Koh[1,3], and Matthew David Blackledge[1]

[1]Institute of Cancer Research, London, United Kingdom, [2]Fondazione Policlinico Universitario Agostino Gemelli, Rome, Italy, [3]The Royal Marsden NHS Foundation Trust, London, United Kingdom

Keywords: Cancer, Whole Body, Metastasis, Fractional Anisotropy

Motivation: Whole-body diffusion-weighted imaging in oncology assumes isotropic diffusion therefore that data probing the directional dependence of diffusion in body cancer applications is scarce.

Goal(s): To report the distribution of fractional anisotropy (FA) values in metastatic bone disease for a cohort of patients who underwent multi-directional diffusion weighted imaging.

Approach: Deep learning was used to auto-segment metastatic lesions; FA values are calculated for each segmented region and the distributions reported.

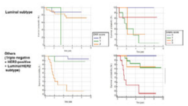
Results: FA distributions from 85 patients with metastatic disease (50 prostate, 33 breast) are reported and are deemed to be low (mean FA range breast group: 0.2179 - 0.3132; prostate group: 0.2866 - 0.3717).

Impact: We have conducted diffusion tensor imaging analysis for whole body DWI data and carried out the first bone lesion FA comparison study. This work provides a rationale for choice of diffusion-weighting gradient schemes in clinical imaging.

0202 Pitch: 13:45

Poster: 14:45

Screen 11



Predicting Disease-Free Survival by DWI and DCE MRI Scores for Breast Cancer Patients with Neoadjuvant Systemic Treatment

Rie Ota[1], Masako Kataoka[2], Mami Iima[2], Maya Honda[3], Aika Okazawa[2], Mizue Suzuki[1], Shotaro Kanao[1], Takeshi Kubo[1], Yosuke Yamada[4], Yasuhide Takeuchi[4], Masahiro Takada[5], and Yuji Nakamoto[2]

[1]Department of Radiology, Tenri Hospital, Nara, Japan, [2]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University graduate school of medicine, Kyoto, Japan, [3]Department of Diagnostic Radiology, Kansai Electric Power Hospital, Osaka, Japan, [4]Department of Diagnostic Pathology, Kyoto University Hospital, Kyoto, Japan, [5]Department of Breast Surgery, Kyoto University Hospital, Kyoto, Japan

Keywords: Breast, Breast

Motivation: MRI is expected to be a new surrogate marker of prognosis that can replace pathological complete response (pCR) for breast cancer patients who underwent neoadjuvant systemic treatment (NST).

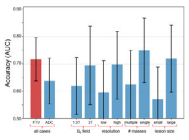
Goal(s): MRI is expected to be a new surrogate marker of prognosis that can replace pathological complete response (pCR) for breast cancer patients who underwent neoadjuvant systemic treatment (NST)

Approach: Survival analysis was performed for disease-free survival using Kaplan-Meier method.

Results: DWI score after NST of breast cancer was associated with DFS, in particular triple-negative, HER2-positive, and luminal-HER2 subtype.

Impact: The DWI / kinetic score obtained from MRI after neoadjuvant systemic treatment (NST) were associated with disease-free survival (DFS), especially among triple-negative, HER2-positive, and luminal/HER2 subtype. The DWI score may be a biomarker for prognosis of breast cancer patients.

0203 Pitch: 13:45 Poster: 14:45 Screen 12



Apparent diffusion coefficient as a non-contrast marker of residual disease after breast neoadjuvant treatment

Patrick J Bolan[1], Wen Li[2], Bonnie N Joe[2], Nu Le[2], Elissa Price[2], Jessica Gibbs[2], Lisa J Wilmes[2], Debsmita Biswas[3], Anum Kazerouni[3], An L Church[4], Elizabeth S McDonald[5], Stephane Loubrie[6], Rebecca Rakow-Penner[6], Hon J Yu[6], Dariya Malyarenko[7], Thomas L Chenervert[7], Beatriu Reig[8], Nola M Hylton[2], and Savannah Partridge[3]

[1]Center for MR Research / Radiology, University of Minnesota, MINNEAPOLIS, MN, United States, [2]Radiology, University of California San Francisco, San Francisco, CA, United States, [3]University of Washington, Seattle, WA, United States, [4]Radiology, University of Minnesota, MINNEAPOLIS, MN, United States, [5]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [6]Radiology, University of Californa San Diego, San Diego, CA, United States, [7]Radiology, University of Michigan, Ann Arbor, MI, United States, [8]Radiology, New York University, New York, NY, United States

Keywords: Breast, Treatment, Cancer, Treatment Response

Motivation: Accurate imaging markers to establish pathologic complete response (pCR) during neoadjuvant chemotherapy (NACT) could enable therapy de-escalation to avoid excessive systemic treatments

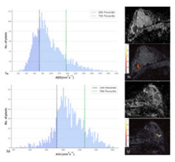
Goal(s): To determine if quantitative diffusion-weighted MRI (DWI) can accurately detect pCR following NACT.

Approach: In the ACRIN 6698/I-SPY 2 multicenter trial dataset, tumor region apparent diffusion coefficient (ADC) from DWI was measured on post-NACT/presurgical MRIs. The accuracy of ADC for predicting pCR, alone and in combination with functional tumor volume (FTV) from contrast-enhanced MRI, was assessed.

Results: In multivariate models ADC accurately predicts pCR, and is influenced by field strength, spatial resolution, and lesion morphology.

Impact: Apparent diffusion coefficient measured by DWI shows promise for determining absence of residual disease following chemotherapy and may provide a non-contrast option for tailoring therapies and enabling patients to avoid unnecessary prolongation of treatment.

0204 Pitch: 13:45 Poster: 14:45 Screen 13



Multiparametric MRI-based radiomics fusion combined with quantitative stratified ADC-defined tumor habitats for TNBC identification

Wanli Zhang[1,2], Fangrong Liang[1,2], Jiamin Li[1,2], Yongzhou Xu[3], Xin Zhen[4], Ruimeng Yang[1,2], and Xinqing Jiang[1,2]

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Keywords: Breast, Cancer, Breast cancer, MRI, Triple-negative breast cancer, Tumor habitat

Motivation: Investigated the role of quantitative stratified apparent diffusion coefficient (ADC)-defined tumor habitats in differentiating triple-negative breast cancer (TNBC) from non-TNBC using a multiparametric MRI (mpMRI)-based feature fusion radiomics (R_{FF}) approach.

Goal(s): To develop an R_{FF}-$Stratified_{ADC}$ model using an R_{FF} strategy and reveal distinct ADC map–based tumor habitats for distinguishing TNBC.

Approach: R_{FF} (predominant MRI sequence–based fused features), R_{ADC} (ADC radiomics features), $Stratified_{ADC}$ (stratified ADC–defined tumor habitat parameters), and combined R_{FF}-$Stratified_{ADC}$ models were constructed to identify TNBC.

Results: Stratified ADC parameters helped evaluate the underlying biological proliferation and cellularity within tumor habitats. The integrated R_{FF}-$Stratified_{ADC}$ model was effective and reliable for TNBC identification.

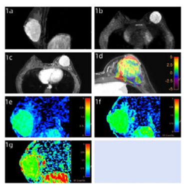
Impact: Stratified ADC–defined tumor habitat parameters derived from whole-tumor ADC maps, along with fused radiomics features from dominant mpMRI sequences (T2WI, DWI, ADC maps, and DCE_2), can serve as potential biomarkers for differentiating TNBC from non-TNBC.

0205

Pitch: 13:45

Poster: 14:45

Screen 14



Amide-proton transfer weighted imaging combined with time-dependent diffusion weighted imaging for evaluation of breast tumors

Xiaoyan Wang[1], Yan Zhang[1], Jingliang Cheng[1], Liangjie Lin[2], Zhigang Wu[2], Peng Sun[2], Ying Hu[1], Anfei Wang[1], Ruhua Wang[1], Yong Zhang[1], Ying Li[1], Kun Zhang[1], and Wenhua Zhang[1]

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Keywords: Breast, Breast

Motivation: Breast cancer is a complex and heterogeneous disease, and its different subtypes show very different biological characteristics, which will also affect the choice of treatment.

Goal(s): The objective of this study was to explore the value of APTWI combined with td-MRI in evalution of breast tumors.

Approach: The performance of APTWI was compared to conventional td-MRI in differentiation between benign and malignant breast tumors.

Results: APTWI overperform td-MRI in differentiation between benign and malignant breast tumors. And ADC values derived from td-MRI at different gradient oscillation frequencies show potential diagnostic values in predicting different risk factors in breast cancer.

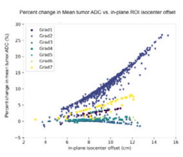
Impact: These may provide new ideals for the diagnosis, treatment and prognosis evaluation of breast cancer.

0206

Pitch: 13:45

Poster: 14:45

Screen 15



Effects of multi-vendor gradient non-linearity correction on breast tumor ADC measurements in the ACRIN 6698 trial

Lisa J Wilmes[1], Wen Li[1], Judith Zimmermann[1,2], David C Newitt[1], Dariya I Malyarenko[3], Jiachao Liang[1], Patrick J Bolan[4], Savannah C Partridge[5], I-SPY 2 Investigator Network[6], Thomas L Chenevert[7], and Nola M Hylton[1]

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Keywords: Breast, Diffusion/other diffusion imaging techniques, gradient nonlinearity correction, breast cancer, ADC

Motivation: MRI scanner gradient non-linearity (GNL) is a known source of variability and spatially-dependent bias in quantitative ADC measurements derived from diffusion-weighted imaging (DWI).

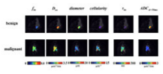
Goal(s): Evaluate the effects of GNL correction on DWI from the ACRIN 6698 multi-center trial, which investigated ADC as a marker breast cancer response in patients receiving neoadjuvant therapy**.**

Approach: Retrospective GNL correction was performed on the ACRIN 6698 DWI data

Results: Percent decrease in mean tumor ADC post-GNC ranged from 0.5%-11% for different MRI gradient sets, illustrating that GNL can confer significant bias to ADC measurements and should be corrected in multi-center clinical DWI trials**.**

Impact: Implementation of gradient non-linearity correction to reduce bias and variability of tumor ADC measurements from DWI data acquired in multi-center, multi-platform oncology trials may improve the quantitative utility of ADC for characterizing response to treatment.

0207 Pitch: 13:45 Poster: 14:45 Screen 16



The diagnostic performance of time-dependent diffusion MRI in differentiating benign and malignant breast tumors

Jie Lu[1], Xue Li[2,3], Haotian Li[1], Kuiyuan Liu[1], Chunmei Li[2,3], Min Chen[2,3], and Dan Wu[1]

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Keywords: Breast, Tumor, diffusion-time-dependence

Motivation: Diffusion-time-dependent diffusion MRI (td-dMRI) has potential in noninvasive mapping of breast tumor microstructure. However, its diagnostic value in differentiating benign and malignant tumors remains unclear, especially including transcytolemmal water exchange.

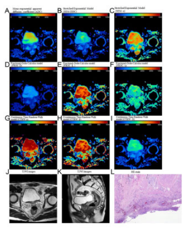
Goal(s): To investigate the clinical value of td-dMRI-based microstructural mapping for discriminating benign and malignant breast tumors.

Approach: Time-dependent dMRI data acquired with OGSE and PGSE sequences were estimated with the JOINT models.

Results: The td-dMRI-based f_{in}, cellularity and τ_{in} showed significant group differences between benign and malignant breast tumors. The combination of cellularity and τ_{in} indices achieved the highest diagnostic performance, with an accuracy of 94% and AUC of 0.958.

Impact: The diagnostic performance of cellularity-τ_{in} obtained from td-dMRI was comparable with or superior to previous studies. The 7.5-minute protocol is translatable to clinical diagnostics.

0208 Pitch: 13:45 Poster: 14:45 Screen 17



Predictive value of mono-exponential and mathematical models in rectal cancer responsiveness to neoadjuvant chemoradiotherapy

Mi Zhou[1], Meining Chen[2], Qin Zhang[3], and Longlin Yin[1]

[1]Department of Radiology, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [2]MR Research Collaboration, Siemens Healthineers, Chengdu, China, [3]MRI clinical application, Customer Service Department, Siemens Digital Medical Technology Co., LTD, Shanghai, China

Keywords: Treatment Response, Treatment

Motivation: Although it is challenging to predict LARC responsiveness to nCRT, the potential of emerging non-Gaussian DWI models for this purpose remains unexplored.

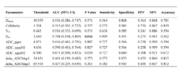
Goal(s): To assess the efficacies of mono-exponential ADC and various non-Gaussian DWI models, including SEM, FROC, and CTRW, in predicting LARC responsiveness to nCRT.

Approach: This prospective study included 103 LARC patients. Various DWI models were assessed, and post-surgery histopathology was utilized to classify patients based on responsiveness to nCRT.

Results: Non-Gaussian models, especially CTRW parameters, demonstrated robust capacity to predict both pCR and T-downstaging. The combination of CTRW parameters yielded the best diagnostic performance.

Impact: This study demonstrated the potential for novel non-Gaussian DWI models to enhance predictions of LARC responsiveness to nCRT, facilitating optimized treatment plans and encouraging further research in precision oncology.

0209 Pitch: 13:45 Poster: 14:45 Screen 18



Time-dependent Magnetic Resonance Imaging for Predicting Pathological Complete Response in Rectal Cancer with Neoadjuvant Therapy

Xiaoling Gong[1], Yu Shen[2], Xiaoxiao Zhang[3], Bing Wu[1], and Bin Song[1]

[1]Departments of Radiology, West China Hospital, Sichuan University, Guoxue Xiang No. 37, Chengdu, Sichuan, 610041, PR China, Chengdu, China, [2]Colorectal Cancer Center, Department of General Surgery, West China Hospital, Sichuan University, Chengdu, 610041, People's Republic of China, Chengdu, China, [3]Department of Clinical, Philips Healthcare, China, Wuhan, China

Keywords: Pelvis, Diffusion/other diffusion imaging techniques, rectal cancer； neoadjuvant treatment； pathological complete response； oscillatory gradient spin echo

Motivation: Time-dependent (TD) magnetic resonance imaging (MRI), an emerging imaging modality, offers insights into cellular microstructures, but its relevance to rectal cancer's neoadjuvant treatment response remains unknown.

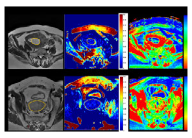
Goal(s): To determine the value of TD MRI-derived metrics for preoperatively predicting pathological complete response (pCR) in rectal cancer.

Approach: Univariate and multivariate logistic regression analyses were used to identify key predictors of pCR.

Results: Extracellular diffusivity independently predicted pCR, with a cutoff of 1.640 effectively distinguishing between pCR and non-pCR tumors.

Impact: Time-dependent magnetic resonance imaging emerges as a promising tool for detecting the pathological complete response in rectal cancer following neoadjuvant therapy, potentially facilitating the selection of patients who may benefit from a watch-and-wait approach.

0210 Pitch: 13:45 Poster: 14:45 Screen 19



Evaluation of Amide Proton Transfer-Weighted Imaging and T2 mapping for preoperative risk stratification of endometrioid adenocarcinoma

Fang Wang[1], Lianhua Cheng[1], Lingyu Chang[1], Dmytro Pylypenko[2], Weiqiang Dou[2], Dexin Yu[1], and Qing Wang[1]

[1]Qilu Hospital of Shandong University, Jinan city, Shandong province, China, [2]GE Healthcare, Beijing, China, Beijing, China

Keywords: Uterus, Cancer, Amide proton transfer-weighted imaging; T2 mapping ; endometrioid adenocarcinoma; risk stratification

Motivation: Preoperative risk stratification of endometrioid adenocarcinoma (EA) impacts the choice of operative modality and prognosis of patients.

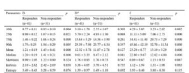
Goal(s): We aimed to perform an accurate and non-invasive preoperative risk stratification method for EA by MRI sequences.

Approach: APTw imaging as well as T2 mapping were included in this study.

Results: The APTw and T2 values showed significant differences between the low- and non-low-risk groups. Combining APTw with T2 mapping achieved the highest diagnostic efficacy in the preoperative risk stratification.

Impact: This suggested that the integrated use of APTw and T2 mapping can be an effective method for the preoperative risk assessment of EA.

0211 Pitch: 13:45 Poster: 14:45 Screen 20



Pre-treatment multiparametric MRI for prediction of chemo-immunotherapy response in advanced non-small cell lung cancer

Yu Zheng[1] and Jing Zhang[1]

[1]Lanzhou University Second Hospital, Lanzhou, China

Keywords: Lung, Cancer

Motivation: Early detection in poor responders to chemo-immunotherapy for non-small cell lung cancer (NSCLC) facilitates timely adjustment of treatment strategies.

Goal(s): To explore the value of histogram analysis based on intravoxel incoherent motion (IVIM) and difusion kurtosis imaging (DKI) in predicting chemo-immunotherapy response in advanced NSCLC.

Approach: 72 NSCLC patients underwent pre-treatment MRI examination. Histogram parameters of IVIM and DKI were calculated and compared.

Results: Compared with non-responders, ADC, D, Dapp were significantly lower and f was higher in responders (all p <0.05). The multivariate logistic regression model performed the best with an AUC of 0.954.

Impact: IVIM and DKI imaging would predict chemo-immunotherapy response in advanced NSCLC at initial state, which could help make clinical individualized treatment strategies.

Power Pitch

Pitch: Metabolic & Hyperpolarized MR

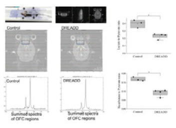
Power Pitch Theatre 2

Monday
Pitches: 13:45 - 14:45
Posters: 14:45 - 15:45

Moderators: Maximilian Fuetterer & Jeanine Prompers

(no CME credit)

0212 Pitch: 13:45 Poster: 14:45 Screen 21



Astrocytes contribute to signals of Hyperpolarized 13C pyruvate in the brain

Maiko Ono[1], Bolati Wulaer[2], Tomoteru Yamasaki[3], Toshihiro Sakamoto[1], Rikita Araki[4], Kosei Hirata[5], Keita Saito[1], Yoichi Takakusagi[1], Ming-Ron Zhan[3], Jun Nagai[2], and Yuhei Takado[1]

[1]Institute for Quantum Life Science, National Institutes for Quantum Science and Technology, Chiba, Japan, [2]RIKEN Center for Brain Science, Wako, Japan, [3]Department of Advanced Nuclear Medicine Sciences, Institute for Quantum Medical Science, National Institutes for Quantum Science and Technology, Chiba, Japan, [4]Bruker Japan K.K., Yokohama, Japan, [5]National Institutes for Quantum Science and Technology, Chiba, Japan

Keywords: Hyperpolarized MR (Non-Gas), Hyperpolarized MR (Non-Gas)

Motivation: Hyperpolarized MR (HP-MR) ^{13}C pyruvate is a valuable probe for evaluating glycolytic flux, but it remains unknown which cells contribute to the HP-MR signals in the brain.

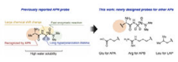
Goal(s): To verify whether astrocyte metabolism is involved in the signal of HP-MR ^{13}C pyruvate in the brain.

Approach: We perturbed Gq-GPCR/calcium (Ca^{2+}) signaling in astrocytes using the hM3Dq DREADD system and examined the fluctuations of the HP-MR pyruvate signals in awake mice.

Results: In HP-MR experiments conducted 30 minutes after the elevation of astrocyte Ca^{2+}, the lactate/pyruvate ratio decreased compared to the control, and the bicarbonate/pyruvate ratio also decreased.

Impact: Investigating the involvement of astrocyte metabolism in brain hyperpolarized MR(HP-MR) ^{13}C pyruvate signals, astrocyte GPCR/Ca^{2+} signaling was perturbed using DREADD, revealing a decrease in lactate/pyruvate and bicarbonate/pyruvate ratios in HP-MR experiments, suggesting metabolic alterations in response to astrocyte GPCR/Ca^{2+} modulation.

0213 Pitch: 13:45 Poster: 14:45 Screen 22



In vivo detection and imaging of aminopeptidase activities related to renin-angiotensin system using newly designed hyperpolarized MR probes

Hiroyuki Yatabe[1], Yutaro Saito[1], Yoichi Takakusagi[2], Keita Saito[2], Kazutoshi Yamamoto[3], Murali Cherukuri Krishna[3], and Shinsuke Sando[1]

[1]Chemistry and biotechnology, The University of Tokyo, Tokyo, Japan, [2]National Institutes for Quantum Science and Technology, Chiba, Japan, [3]National Institutes of Health, Bethesda, MD, United States

Keywords: Hyperpolarized MR (Non-Gas), Molecular Imaging, Molecular design

Motivation: Detection of aminopeptidase (AP) activities related to renin-angiotensin system (RAS) can lead to diagnosis of various diseases. Magnetic resonance imaging utilizing suitable hyperpolarized molecular probes can non-invasively detect *in vivo* AP activities. However, there have been no hyperpolarized molecular probes for APA, APB, and leucine AP.

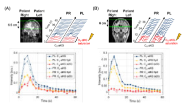
Goal(s): We aimed to design and develop new hyperpolarized molecular probes for the detection and imaging of RAS related AP activities *in vivo*.

Approach: Based on the previously reported APN probe scaffold, three new hyperpolarized probes were designed.

Results: Using the developed probes, target AP activities were successfully detected and visualized *in vivo*.

Impact: This study exhibits a framework that artificially designed hyperpolarized molecular probes can detect *in vivo* aminopeptidase activities, which is assumed impossible with isotope labeled natural substrates and broadens the possibility of hyperpolarized MR diagnosis based on AP activities.

0214 Pitch: 13:45
Poster: 14:45
Screen 23



[First in-human MR Metabolic Imaging of the Brain Using Hyperpolarized [1-13C]alpha-ketoglutarate]

Yaewon Kim[1], Duy Dang[1], James Slater[1], Andrew Riselli[1], Jeremy W. Gordon[1], Susan M. Chang[2], Yan Li[1], Adam W. Autry[1], Marisa Lafontaine[1], Evelyn Escobar[1], Hsin-Yu Chen[1], Chou T. Tan[3], Chris Suszczynski[3], Robert A. Bok[1], and Daniel B. Vigneron[1,2]

[1]Department of Radiology and Biomedical Imaging, University of California, San Francisco, CA, United States, [2]Department of Neurological Surgery, University of California, San Francisco, CA, United States, [3]ISOTEC Stable Isotope Division, MilliporeSigma, Merck KGaA, Miamisburg, OH, United States

Keywords: Hyperpolarized MR (Non-Gas), Contrast Agent

Motivation: Isocitrate dehydrogenase (IDH) mutational status is crucial for accurate diagnosis and prognosis of malignant gliomas. However, the current clinical assessment of IDH mutation requires an invasive brain biopsy for pathological testing.

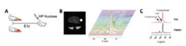
Goal(s): We aimed to perform first in-human MR studies using hyperpolarized [1-^{13}C]alpha-ketoglutarate as a new probe of IDH mutational status via cancer metabolic reprogramming, along with cerebral bioenergetics.

Approach: We acquired ^{13}C MRS data from healthy brain volunteers (N=6) and glioma patients (N=6) who received hyperpolarized aKG.

Results: Feasibility and safety were demonstrated in these 12 studies, with signals observed from [1-^{13}C]alpha-ketoglutarate and its metabolite glutamate in the obtained ^{13}C MRS data.

Impact: MR molecular imaging with the new probe hyperpolarized [1-^{13}C]alpha-ketoglutarate provided novel measurements of aKG metabolism and can investigate glioma IDH mutational status by detecting glutamate or the oncometabolite, 2-hydroxyglutarate.

0215 Pitch: 13:45
Poster: 14:45
Screen 24



[Hyperpolarize imaging of fructolysis in fed vs fasted mice liver]

Celia Martinez de la Torre[1], Quinlan Cullen[1,2], Thomas Ruan[1,2], Grace Figlioli[1], and Kayvan Rahimi Keshari[1,2]

[1]Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Weill Cornell Medicine, New York, NY, United States

Keywords: Hyperpolarized MR (Non-Gas), Metabolism

Motivation: Fructose intake has increased 80-times over the past century, although the effect of this increase in the body remains unclear.

Goal(s): To assess the metabolic flux of fructose at different metabolic states (fed vs fasted) for future human studies.

Approach: Fed or fasted mice were injected with hyperpolarized fructose to observe metabolic flux.

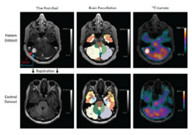
Results: Fed mice showed the formation of glucose (gluconeogenesis) by F1P, while fasted mice metabolized the fructose to obtain energy.

Impact: The results pressented have significant implications for the understanding of fructoylsis and provides a translational metabolic imaging strategy for future human studies.

0216 Pitch: 13:45

Poster: 14:45

Screen 25



[Imaging the metabolic profile of the normal appearing brain in patients with brain metastases using hyperpolarized [1-13C]-pyruvate MRI]

Nicole I.C. Cappelletto[1,2], Hany Soliman[3], Nadia D. Bragagnolo[2], Biranavan Uthayakumar[1,2], Arjun Sahgal[3], Albert P. Chen[4], Ruby Endre[2], Nathan Ma[5], William J. Perks[5], Jay S. Detsky[3], Chris Heyn[6], and Charles H. Cunningham[1,2]

[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [3]Department of Radiation Oncology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [4]GE Healthcare, Toronto, ON, Canada, [5]Pharmacy, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [6]Department of Medical Imaging, Sunnybrook Health Sciences Centre, Toronto, ON, Canada

Keywords: Hyperpolarized MR (Non-Gas), Metabolism, Cancer, Brain

Motivation: The metabolic profile of normal appearing brain tissue in patients with brain metastases may be related to the course of disease.

Goal(s): To test whether patients with brain metastases exhibit differential metabolism in normal appearing brain parenchyma compared to healthy control participants.

Approach: Hyperpolarized [1-^{13}C]-pyruvate and T1w MRI were used to compare the metabolism and volumes of normal appearing brain regions in patients and healthy control participants.

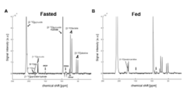
Results: The lactate-to-bicarbonate (p=0.0004) and lactate-to-pyruvate (p=0.04) ratios were significantly increased in the normal appearing brain parenchyma of patients compared to controls.

Impact: The metabolic profile of normal appearing brain parenchyma in patients with brain metastases exhibits significantly increased glycolytic metabolism compared to healthy control brains when imaged using hyperpolarized [1-^{13}C]-pyruvate MRI and may be related to the course of disease.

0217 Pitch: 13:45

Poster: 14:45

Screen 26



[Hyperpolarized [2-13C]pyruvate-d3 detects hepatic gluconeogenesis in vivo]

Mai Huynh[1], Zohreh Erfani[1], Zoltan Kovacs[1], and Jae Mo Park[1,2,3]

[1]Advanced Imaging Research Center, UTSW Medical Center, Dallas, TX, United States, [2]2. Department of Biomedical Engineering, UTSW Medical Center, Dallas, TX, United States, [3]Department of Radiology, UTSW Medical Center, Dallas, TX, United States

Keywords: Probes & Targets, Hyperpolarized MR (Non-Gas), pyruvate, hyperpolarization, hepatic gluconeogenesis, liver

Motivation: Assessing gluconeogenesis using hyperpolarized [1-^{13}C]pyruvate is technically challenging because [^{13}C]bicarbonate can be produced from both oxidative and gluconeogenic pathways and spectrally resolving the gluconeogenic products from large, neighboring peaks is non-trivial at 3T.

Goal(s): This study examines the utility of deuterated hyperpolarized [2-^{13}C]pyruvate in assessing gluconeogenesis.

Approach: Sodium [2-^{13}C]pyruvate-d_3 was synthesized to prolong the T_1. Hepatic metabolism was investigated using hyperpolarized [2-^{13}C]pyruvate-$d_3$with D_2O dissolution under normal fed and fasted conditions.

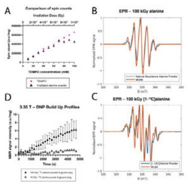
Results: The T_1 of [2-^{13}C]pyruvate-d_3 was ~80 s when dissolved with D_2O. Gluconeogenic products such as [2-^{13}C]oxaloacetate and [2-^{13}C]phosphoenolpyruvate were observed from fasted rats only, highlighting clear advantages over [1-^{13}C]pyruvate in investigating gluconeogenesis.

Impact: Hyperpolarization technology is rapidly being translated to humans. With the proven safety and feasibility, hyperpolarized [2-^{13}C]pyruvate-d_3 will facilitate its utilization in underexplored liver and kidney metabolism, illuminating mechanistic understanding for several disorders that are believed to depend on altered gluconeogenesis.

0218 Pitch: 13:45

Poster: 14:45

Screen 27



6 MeV electron irradiated 13C-alanine as a sterile, transportable probe with long-lived radicals for dissolution Dynamic Nuclear Polarization

Catriona H E Rooney[1], Justin Y C Lau[2], Brett W C Kennedy[3], Alice M Bowen[4], William K Myers[5], Iain Tullis[6], Kristoffer Petersson[6], Jarrod Lewis[7], Duy Anh Dang[8], Nichlas Vous Christensen[8], Esben Søvsø Szocska Hansen[8], Christoffer Laustsen[8], Damian Tyler[1,3], and Jack J. Miller[3,8,9]

[1]Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford, United Kingdom, [2]GE Healthcare, Schenectady, NY, United States, [3]Department of Cardiovascular Medicine, University of Oxford, Oxford, United Kingdom, [4]The National Research Facility for Electron Paramagnetic Resonance, The University of Manchester, Manchester, United Kingdom, [5]Department of Chemistry, University of Oxford, Oxford, United Kingdom, [6]Oxford Institute for Radiation Oncology, University of Oxford, Oxford, United Kingdom, [7]Department of Material Science, University of Oxford, Oxford, United Kingdom, [8]The MR Research Centre, Dept Clinical Medicine, Aarhus University, Aarhus, Denmark, [9]The PET Research Centre, Dept Clinical Medicine, Aarhus University, Aarhus, Denmark

Keywords: Hyperpolarized MR (Non-Gas), Hyperpolarized MR (Non-Gas)

Motivation: Human hyperpolarized metabolic imaging relies upon unstable exogenous radicals like the trityl radical EPA, necessitating clean rooms, pharmacy staff, and filters.

Goal(s): We wished to avoid EPA by using an ultrahigh-dose-rate 6 MeV electron accelerator, generating endogenous [1-^{13}C]alanine radicals for DNP.

Approach: We studied irradiated samples up to 100 kGy at two polariser field-strengths (3.35/6.7T), characterised radical species formed by EPR, X-ray diffraction, and numerical quantum-mechanical simulations.

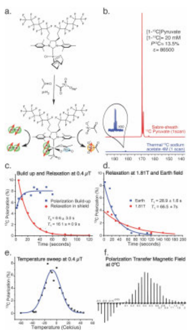
Results: Radicals from biologically sterilising doses were stable for months when stored anhydrously, quenching rapidly with dissolution. Comparable nuclear polarisation to pyruvate at 6.7T was observed in a partially-ordered glycerol/alanine mix, potentially via a cross-effect mechanism.

Impact: This has several novel impacts – it: (1) makes centralised manufacturing & storage possible with dual-purpose irradiation sterilising a sealed fluid-path; (2) demonstrates electron irradiation feasible for DNP; and (3) highlights how molecular environments could be partially controlled for polarisation optimisation.

0219 Pitch: 13:45

Poster: 14:45

Screen 28



Perfluorinated Iridium Catalyst for Signal Amplification by Reversible Exchange Provides Metal-Free Aqueous Hyperpolarized [13C1]-Pyruvate

Jessica H Ettedgui[1], Burchelle Blackman[2], Natarajan Raju[2], Samuel Kotler[3], Eduard Y Chekmenev[4], Boyd M Goodson[5], Christopher A LeClair[3], Murali Krishna[6], and Rolf Swenson[2]

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Keywords: Hyperpolarized MR (Non-Gas), Hyperpolarized MR (Non-Gas), NMR spectroscopy, imaging agents, parahydrogen, 13C pyruvate, SABRE, perfluorinated compounds

Motivation: Signal Amplification by Reversible Exchange (SABRE) recent progresses include hyperpolarizing [1-13C]pyruvate in aqueous solutions. However, overcoming the challenge of iridium toxicity in hyperpolarized mixtures is essential for broader biocompatible SABRE applications.

Goal(s): The removal of Ir metal from hyperpolarized SABRE mixtures is an unmet need with substantial clinical significance.

Approach: A perfluorinated SABRE catalyst was developed to counter iridium contamination in hyperpolarized aqueous solutions by exploiting its high hydrophobicity for straightforward separation.

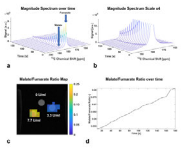
Results: The residual Ir was found to be only 177 ppb, representing a 8130-fold reduction in Ir concentration and the lowest and safest level reported to date for a SABRE-hyperpolarized solution.

Impact: Hyperpolarizing [1-13C]pyruvate using a perfluorinated SABRE catalyst reduced the residual iridium levels to safe levels for human injection. Future development along with solvent removal could make SABRE-SHEATH a faster and cost-effective alternative for biocompatible hyperpolarized agents in next-generation molecular imaging.

0220 Pitch: 13:45

Poster: 14:45

Screen 29



[Setting the stage for a clinical translation of hyperpolarized 13C-fumarate]

Pascal Wodtke[1,2], Jonathan R Birchall[1], Mary A McLean[1,3], Marta Wylot[1], Ashley Grimmer[1,2], Elizabeth Latimer[1], Otso Arponen[1], Maria Zamora[1], Evita Pappa[4], Johann Graggaber[5], Joseph Cheriyan[4,5], Ian B Wilkinson[4,5], Kevin M Brindle[3], and Ferdia A Gallagher[1,3]

[1]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [2]Cancer Research UK Cambridge Centre, Cambridge, United Kingdom, [3]Cancer Research UK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom, [4]Division of Experimental Medicine & Immunotherapeutics, Department of Medicine, University of Cambridge, Cambridge, United Kingdom, [5]Cambridge Clinical Trials Unit, Cambridge University Hospitals NHS Trust, Cambridge, United Kingdom

Keywords: Hyperpolarized MR (Non-Gas), Non-Proton, Fumarate, Necrosis, Treatment Response

Motivation: Clinical translation of hyperpolarized ^{13}C-fumarate has the potential to enable early, non-invasive assessment of treatment response in cancer.

Goal(s): To advance a novel hyperpolarized probe from the laboratory to the clinic.

Approach: Translation involved optimizing clinical scale hyperpolarization, establishing an imaging protocol at clinical field strength (3T), preclinical toxicology and first in-human injections.

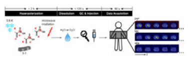
Results: ^{13}C-fumarate showed good hyperpolarization properties and the imaging protocol achieved sufficient spectral separation of peaks and spatial separation of phantoms respectively. Toxicological assessment demonstrated the safety of ^{13}C-fumarate, no adverse events observed in rodents and humans have so far been observed.

Impact: While promising preclinical molecules exist, clinical hyperpolarized ^{13}C MRI lacks probe versatility due to a complex, unclear translation process. This study on fumarate narrows the gap between preclinical and clinical utility and fosters transparent clinical translation pipelines for the field.

0221 Pitch: 13:45

Poster: 14:45

Screen 30



[First-in-Human Whole-Abdomen Metabolic Imaging with Hyperpolarized [1-13C]Pyruvate in D2O and Initial Application in Human Pancreatic Cancer]

Guannan Zhang[1], Kofi Deh[1], Hijin Park[2], Charles Cunningham[3,4], Nadia Bragagnolo[3], Serge Lyashchenko[2], Shake Ahmmed[2], Avigdor Leftin[5], Elizabeth Coffee[6], Hedvig Hricak[7], Vesselin Miloushev[7], Marius Mayerhoefer[1], and Kayvan Keshari[7]

[1]Department of Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Radiochemistry and Molecular Imaging Probes (RMIP) Core, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [3]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [4]Sunnybrook Research Institute, Toronto, ON, Canada, [5]GE HealthCare, New York, NY, United States, [6]Department of Neurology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [7]Department of Radiology & Molecular Pharmacology Program, Memorial Sloan Kettering Cancer Center, New York, NY, United States

Keywords: Hyperpolarized MR (Non-Gas), Hyperpolarized MR (Non-Gas), whole-abdomen imaging, hyperpolarized [1-13C]pyruvate, deuterium oxide (D2O), pancreatic ductal adenocarcinoma (PDAC)

Motivation: Whole-abdomen imaging with hyperpolarized [1-^{13}C]pyruvate holds promise to diagnose metabolic diseases. D_2O solvation could extend the ^{13}C T_1 lifetime, resulting in enhanced image SNR.

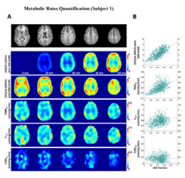
Goal(s): Establish the safety and feasibility of utilizing D_2O to administer hyperpolarized [1-^{13}C]pyruvate in whole-abdomen imaging, and present the first application of whole-abdomen hyperpolarized [1-^{13}C]pyruvate MRI in a PDAC patient.

Approach: We quantified the metabolic characteristics of organs in healthy and diseased subjects.

Results: The use of D_2O is safe and feasible. It has no significant impact on organ metabolism and delivery of the pyruvate bolus. This technique demonstrates potential for application in cancer patients.

Impact: The safety and feasibility of employing D_2O for hyperpolarized ^{13}C whole-abdomen MRI sets the stage for translational studies. The first application of hyperpolarized whole-abdomen [1-^{13}C]pyruvate MRI to a PDAC patient provides essential support for its future exploration in oncology.

0222 Pitch: 13:45 Poster: 14:45 Screen 31



[Mapping oxidative and non-oxidative glucose metabolic rates of entire human brain using quantitative dynamic deuterium MRS imaging at 7T]

Xin Li[1], Xiao-Hong Zhu[1], and Wei Chen[1]

[1]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States*

Keywords: Deuterium, Deuterium, Glucose Metabolic Rates

Motivation: Cerebral glucose metabolism *via* non-oxidative and oxidative pathways is critical for brain function, however, methods capable of quantitatively imaging metabolic rates are lacking.

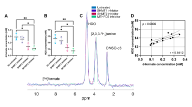
Goal(s): To develop a quantitative dynamic deuterium (^{2}H) MRSI (DMRSI) method capable of mapping human brain glucose metabolic rates.

Approach: Combining novel hardware and advanced post-processing method with kinetic models, we established a high-resolution, high-quality dynamic DMRSI capable of quantifying and imaging three metabolic rates of glucose consumption (CMR_{Glc}), lactate generation (CMR_{Lac}) and TCA cycle (V_{TCA}) in human brain at 7T.

Results: We demonstrate consistent whole-brain maps of CMR_{Glc}, CMR_{Lac}, V_{TCA} in health subjects.

Impact: We developed a novel DMRSI platform on an FDA-approved clinical 7T scanner that enables simultaneous high-resolution imaging of CMR_{Glc}, CMR_{Lac} and V_{TCA} of entire human brain for the first time. This novel technology has potential for brain research and translation.

0223 Pitch: 13:45 Poster: 14:45 Screen 32



2H imaging of [2,3,3-2H2]serine metabolism

Friederike Hesse[1], Jacob Low[1], Jianbo Cao[1], Flaviu Bulat[1], Felix Kreis[2], and Kevin Brindle[1]

[1]*CRUK CI, University of Cambridge, Cambridge, United Kingdom,* [2]*Bayer, Berlin, Germany*

Keywords: Deuterium, Deuterium

Motivation: Formate overflow linked to mitochondrial oxidative serine catabolism has been observed in various forms of cancer, and there is evidence that elevated formate concentrations promote cell infiltration.

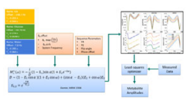
Goal(s): Our goal was to monitor serine catabolism using deuterium metabolic imaging.

Approach: Cell experiments were conducted using a 14.1 T high-resolution NMR spectrometer and ^{2}H experiments on tumors *in vivo* using a 7.0 T horizontal bore magnet.

Results: [2,3,3-$^2H_2$]serine catabolism can be monitored directly from measurements of ^{2}H-formate production and indirectly from ^{2}H-labeling of water.

Impact: Monitoring [2,3,3-$^2H_2$]serine metabolism holds huge potential when assessing novel cancer treatments that target the one-carbon pathway to inhibit tumor cell proliferation.

0224 Pitch: 13:45 Poster: 14:45 Screen 33



Combining multi-echo and phase cycling in bSSFP acquisition to improve whole-brain deuterium metabolic imaging at 9.4 T

Praveen Iyyappan Valsala[1,2], Rolf Pohmann[1], Rahel Heule[1,2,3], Nikolai Avdievich[1], Jörn Engelmann[1], Laura Kuebler[4,5], André F. Martins[4,5], and Klaus Scheffler[1,2]

[1]*High Field Magnetic Resonance, Max-Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*Department of Biomedical Magnetic Resonance, Eberhard Karls University Tübingen, Tübingen, Germany,* [3]*Center for MR Research, University Children's Hospital, Zurich, Switzerland,* [4]*Werner Siemens Imaging Center, Eberhard Karls University Tübingen, Tübingen, Germany,* [5]*Cluster of Excellence iFIT (EXC 2180) «Image-Guided and Functionally Instructed Tumor Therapies», Eberhard Karls University Tübingen, Tübingen, Germany*

Keywords: Deuterium, Deuterium, bSSFP, DMI, ultra high field, brain, metabolism, cancer

Motivation: Deuterium metabolic imaging could significantly impact the field of neuro-oncology by providing clinical quantitative metabolic information.

Goal(s): To improve the spatial resolution of human deuterium metabolic imaging at 9.4 T.

Approach: We performed phantom and in vivo experiments with oral intake of deuterated glucose using multi-echo phase-cycled bSSFP acquisitions. The results were compared with a standard 3D spectroscopy sequence.

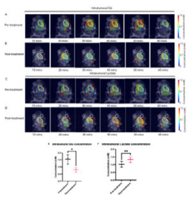
Results: We achieved higher spatial resolution compared to a 3D spectroscopy sequence. Phase cycling improved the reliability of the metabolite quantification especially in the large off-resonance and low SNR regimes.

Impact: We present an improved whole-brain dynamic deuterium metabolic imaging strategy at 9.4 T using bSSFP with multiple echoes and phase cycling. The efficacy of this method is validated with phantom and in vivo experiments along with standard spectroscopy measurements.

0225 Pitch: 13:45

Poster: 14:45

Screen 34



[Deuterium metabolic imaging detects early treatment response to mitochondrial complex 1 inhibition]

Jacob Chen Ming Low[1], Jianbo Cao[1], Friederike Hesse[1], Alan Wright[1], and Kevin Brindle[1]

[1]*Cancer Research UK, Cambridge Institute, Cambridge, United Kingdom*

Keywords: Tumors (Post-Treatment), Deuterium

Motivation: The oxidative subtype of glioblastoma (GB) has potential mitochondrial therapeutic vulnerabilities that can be targeted for treatment.

Goal(s): To detect early response to a mitochondrial complex 1 inhibitor, IACS-010759, using deuterium metabolic imaging (DMI).

Approach: Measurements of oxygen consumption, extracellular acidification rate and ^{2}H-labelled lactate production in GB cell suspensions *in vitro* and ^{2}H-labelled lactate and Glx production from [6,6'-$^{2}H_2$]glucose in GB xenografts *in vivo*, pre- and post-treatment.

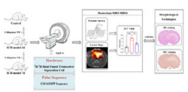
Results: DMI detects an *in vivo* response to treatment with IACS-010759 from measurements of decreased ^{2}H-labeled Glx production and increased ^{2}H-labeled lactate production.

Impact: Deuterium metabolic imaging can be used to detect the early response of a glioblastoma model to treatment with a mitochondrial complex 1 inhibitor.

0226 Pitch: 13:45

Poster: 14:45

Screen 35



[Optimized deuterium metabolic imaging (DMI) for quantitative analysis of lactate in intracerebral hemorrhages]

Xinjie Liu[1], Zhuang Liu[1], Martins Otikovs[2], Xin Cheng[1], Zhi Zhang[1], Peng Sun[3], Xin Zhou[1], Chaoyang Liu[1], and Qingjia Bao[1]

[1]*Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, Wuhan, China,* [2]*Weizmann Institute of Sciences, Rehovot, Israel,* [3]*Clinical & Technical Support, Philips Healthcare (Beijing), Beijing, China*

Keywords: Biology, Models, Methods, Deuterium, Deuterium metabolic imaging; Intracerebral hemorrhage; Lactate

Motivation: Lactate, as an important metabolism product after intracerebral hemorrhage (ICH), plays a crucial role in the pathophysiology and prognosis. Deuterium metabolic imaging (DMI), as a potentially transformative technique, can localize abnormal metabolism associated with lactate.

Goal(s): Optimize deuterium coils and sequences to improve the signal-to-noise ratio of DMI, and quantitatively analyze lactate changes after ICH with optimized techniques.

Approach: Propose the active decoupling 2H/1H dual-tuned transceiver coil and CSI-bSSFP sequence for DMI and measure the dynamical lactate metabolism in three groups of rats before and after ICH.

Results: DMI can measure the lactate metabolic changes at different time points after ICH.

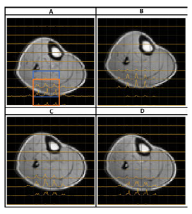
Impact: This study presents a non-invasive technique for monitoring the lactate metabolic changes after ICH, which holds clinical potential in determining the time of onset, treatment plan, and real-time response evaluation.

0227

Pitch: 13:45

Poster: 14:45

Screen 36



Measuring lipid turnover in human subjects using 2H magnetic resonance and heavy water loading

Daniel Cocking[1,2], Robin Damion[1,3,4], Matthew Brook[4,5,6], Dorothee Auer[1,3,4], and Richard Bowtell[1,2,4]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [3]Radiological Sciences, Mental Health and Clinical Neuroscience, School of Medicine, University of Nottingham, Nottingham, United Kingdom, [4]NIHR Nottingham Biomedical Research Centre/Nottingham Clinical Research Facilities, Queen's Medical Centre, Nottingham, United Kingdom, [5]MRC-Versus Arthritis Centre for Muscoskeletal Ageing Research, University of Nottingham, Nottingham, United Kingdom, [6]School of Life Sciences, University of Nottingham, Nottingham, United Kingdom

Keywords: Deuterium, Deuterium, Spectroscopy

Motivation: During heavy water loading, deuterium is incorporated into newly synthesised lipids; measurement of deuterium content thus provides a measure of lipid turnover. Currently this involves in vitro analysis of biopsy samples.

Goal(s): We investigated whether deuterium magnetic resonance can detect increased deuteration of subcutaneous fat following heavy water loading.

Approach: Deuterium signals from calf and abdomen from three participants were monitored during/after a 28-day period of loading with heavy water to ~100x natural abundance.

Results: Fat signal was increased relative to natural abundance in 5 of the 6 measurements (average at times > 50 days), reaching statistical significance (P<0.05) in three measurements.

Impact: A non-invasive technique for monitoring lipid turnover anywhere in the human body would be a powerful tool, allowing investigation of fat metabolism in health and disease. Deuterium magnetic resonance during heavy water loading could form this tool.

0228

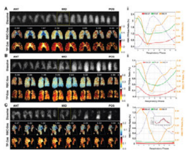
MERIT AWARD

MAGNA CUM LAUDE

Pitch: 13:45

Poster: 14:45

Screen 37



Revealing COPD Uneven Ventilation and Altered Gas Exchange with Dynamic Simultaneous Gas Exchange and Ventilation Imaging

Hooman Hamedani[1], Steve Kadlecek[1], Faraz Amzajerdian[1], Kai Ruppert[1], Luis Loza[1], Mostafa Ismail[1], Ian Duncan[1], and Rahim Rizi[1]

[1]University of Pennsylvania, Philadelphia, PA, United States

Keywords: Hyperpolarized MR (Gas), Contrast Agent, Dynamic Imaging of Respiratory Function

Motivation: The study aims to refine lung disease diagnosis through dynamic imaging, surpassing conventional breath-hold MRI limitations.

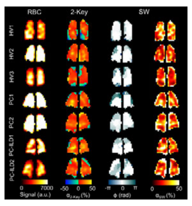
Goal(s): This research aims to confirm the efficacy of a new 4D dynamic HXe MRI method for real-time lung function imaging, enhancing our grasp of diseases like COPD.

Approach: Our method employs synchronized 4D dynamic MRI to differentiate lung function in healthy individuals, COPD sufferers, and a smoker, revealing subtle health variations.

Results: Dynamic imaging revealed consistent ventilation in healthy lungs but identified irregularities and a novel reversed RBC:Gas ratio pattern in COPD, indicating significant alterations in gas exchange dynamics.

Impact: This study enhances understanding of COPD and could shift diagnostic and treatment practices, paving the way for targeted therapies and improved patient outcomes.

0229 Pitch: 13:45 Poster: 14:45 Screen 38



Mapping the amplitude and phase of dissolved 129Xe red blood cell signal oscillations with keyhole spectroscopic lung imaging

Jemima H Pilgrim-Morris[1], Guilhem J Collier[1], Mika Takigawa[1], Graham Norquay[1], Neil J Stewart[1,2], and Jim M Wild[1,2]

[1]POLARIS, Division of Clinical Medicine, School of Medicine and Population Health, University of Sheffield, Sheffield, United Kingdom, [2]Insigneo Institute for in silico Medicine, University of Sheffield, Sheffield, United Kingdom

Keywords: Hyperpolarized MR (Gas), Image Reconstruction

Motivation: Cardiogenic oscillations in dissolved ^{129}Xe red blood cell (RBC) signal are sensitive to cardiopulmonary disease. Current methods to map the amplitude of these oscillations do not consider oscillation phase, leading to physiologically unrealistic amplitude values.

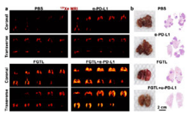
Goal(s): To map the amplitude and phase of ^{129}Xe RBC oscillations in the lung vasculature.

Approach: Multiple phases of the cardiac cycle were reconstructed from multi-echo dissolved ^{129}Xe spectroscopic imaging data using a sliding window keyhole method, to map both oscillation amplitude and phase in healthy volunteers and post-COVID-19 patients.

Results: Both oscillation amplitude and phase were mapped regionally. Phase-adjustment improved oscillation amplitude inter-scan repeatability in healthy volunteers.

Impact: Sliding-window keyhole ^{129}Xe RBC oscillation amplitude and phase mapping corrects for physiologically unrealistic negative amplitudes. This approach allows regional mapping of RBC oscillation phase, which may represent the cardiac pulse wave in the pulmonary microvasculature, and its alteration in disease.

0230 Pitch: 13:45 Poster: 14:45 Screen 39



Evaluating the Immunotherapy Efficacy of Lung Cancer by 129Xe MRI

Maosong Qiu[1], Ruifang Wang[1], Lei Zhang[1], shizhen Chen[1], and Xin Zhou[1]

[1]Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, Wuhan, China

Keywords: Visualization, Hyperpolarized MR (Gas), 129Xe MRI, Lung cancer, immunotherapy, ferroptosis

Motivation: The evaluation of lung cancer immunotherapy progress using non-invasive methods is challenging. Also, multiple scans of CT during the treatment period expose patients to more radiation.

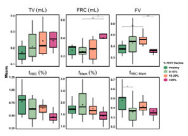
Goal(s): To confirm ^{129}Xe MRI is a potentially robust technology for monitoring immunotherapy effects.

Approach: Fe_3O_4-based nanoprobe that could induce ferroptosis of tumor cells was prepared for immunotherapy of lung metastatic cancer combined with α-PD-L1, finally the immunotherapy effect was evaluated via ^{129}Xe MRI.

Results: The ^{129}Xe MRI displayed a complete ventilatory image of the lung in the probe plus α-PD-L1 group while severe ventilation deficiency was observed in the control group.

Impact: The ^{129}Xe MRI results of the lung showed significant differences in ventilation defects among different treatment groups, revealing the excellent tumor immunotherapy efficiency of nanoprobe-mediated immunotherapy, which represents a potential protocol for the evaluation of immunotherapy against tumors.

0231 Pitch: 13:45 Poster: 14:45 Screen 40



Assessing Ventilation and Gas Exchange of Lung Transplant Recipients with Hyperpolarized Xenon-129

Faraz Amzajerdian[1], Hooman Hamedani[1], Andrew Courtwright[1], Luis Loza[1], Mostafa Ismail[1], Kai Ruppert[1], Stephen Kadlecek[1], and Rahim Rizi[1]

[1]University of Pennsylvania, Philadelphia, PA, United States

Keywords: Hyperpolarized MR (Gas), Hyperpolarized MR (Gas)

Motivation: Improving the diagnosis and monitoring of chronic lung allograft dysfunction (CLAD) post-lung transplantation may lead to improved long-term patient outcomes.

Goal(s): To identify hyperpolarized xenon-129 imaging markers for more comprehensively evaluating lung function in transplant recipients.

Approach: A multi-breath xenon-polarization transfer contrast (XTC) technique was used to quantify ventilation and gas exchange longitudinally in lung transplant patients.

Results: Correlations between the derived imaging metrics and current clinical standards for assessing lung function provided additional insight into the functional changes associated with post-transplant recovery or decline.

Impact: Hyperpolarized xenon-129 MRI enables more comprehensive assessments of the functional and physiological changes associated with recovery and/or deterioration after lung transplantation, potentially leading to earlier CLAD diagnosis and improved long-term outcomes.

Power Pitch

Pitch: Software Tools

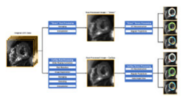
Power Pitch Theatre 3

Monday
Pitches: 13:45 - 14:45
Posters: 14:45 - 15:45

Moderators: Yamin Arefeen & Maxim Zaitsev

(no CME credit)

0232 Pitch: 13:45 Poster: 14:45 Screen 41



Cardiac Diffusion in Python (CarDpy): An Open-Source Toolbox for Cardiac Diffusion Tensor Data Processing

Tyler E. Cork[1,2,3,4], Ariel J. Hannum[1,2,3,4], Michael Loecher[1,3,4], and Daniel B. Ennis[1,3,4]

[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Bioengineering, Stanford University, Stanford, CA, United States, [3]Division of Radiology, Veterans Administration Health Care System, Palo Alto, CA, United States, [4]Cardiovascular Institute, Stanford University, Stanford, CA, United States

Keywords: Software Tools, Tissue Characterization, Cardiac Diffusion Tensor Imaging, cDTI, Heart, Data Processing

Motivation: cDTI provides several new and useful MRI biomarkers, but robust and reliable data processing pipelines are still needed to adequately handle cDTI data.

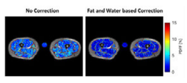
Goal(s): Goal: To demonstrate the benefits of an open-source Python cDTI data processing toolbox and its impact on measurement accuracy and precision.

Approach: A direct averaging and tensor-fitting data processing technique was compared to our open-source data processing pipeline. Data from healthy subjects was used to demonstrate improvements in the accuracy and uncertainty of cDTI metrics.

Results: Our open-source cDTI data processing toolbox provides smoother parametric maps that are more accurate with less uncertainty compared to direct averaging and tensor-fitting.

Impact: Development of Cardiac Diffusion in Python (CarDpy), an open-source python toolbox for cardiac diffusion tensor imaging (cDTI) data processing to facilitate reproducible cDTI research for new and established researchers. A strong foundation, plus software modularity encourages contributions from the community.

0233 Pitch: 13:45 Poster: 14:45 Screen 42



Reproducible Intramuscular Fat Quantification using Vendor-Independent Processing in a Multi-Site, Multi-Vendor Setting

Brendan L. Eck[1], Richard Lartey[1], Sibaji Gaj[1], Mei Li[1], Jeehun Kim[1], William Zaylor[1], Dongxing Xie[1], Carl S. Winalski[2], Kevin D. Harkins[3], Laura J. Huston[4], Ryan K. Robison[3,5], Nancy A. Obuchowski[6], Bruce M. Damon[3,7], Faysal Altahawi[2], Michael Knopp[8], Morgan H. Jones[9], Kurt P. Spindler[9], and Xiaojuan Li[1]

[1]Biomedical Engineering, Cleveland Clinic, Cleveland, OH, United States, [2]Diagnostic Radiology, Cleveland Clinic, Cleveland, OH, United States, [3]Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [4]Orthopaedic Surgery, Vanderbilt University Medical Center, Nashville, TN, United States, [5]Philips, Nashville, TN, United States, [6]Quantitative Health Sciences, Cleveland Clinic, Cleveland, OH, United States, [7]Carle, Urbana, IL, United States, [8]Ohio State University, Columbus, OH, United States, [9]Orthopaedic Surgery, Cleveland Clinic, Cleveland, OH, United States

Keywords: Muscle, Muscle, Reproducibility, fat, Dixon, post-processing, image processing, multi-site, multi-vendor, osteoarthritis, orthopaedics, ACL reconstruction

Motivation: Intramuscular fat is associated with muscle degeneration. Chemical shift-encoded MRI quantifies proton density fat fraction (PDFF), but multi-site, multi-vendor reproducibility for intramuscular assessment is scarcely reported.

Goal(s): To evaluate the reproducibility of a vendor-independent thigh muscle PDFF quantification approach using multi-site, multi-vendor data and then assess PDFF in patients 10 years post-anterior cruciate ligament reconstruction (ACLR).

Approach: Phantoms, traveling controls, and ACLR patients were scanned using five scanners (three sites, two vendors). A correction was developed to address image scaling variations.

Results: Average absolute PDFF standard deviation was below 1% after correction. The ACLR patient cohort had elevated PDFF in operated leg hamstrings.

Impact: Harmonized acquisition and vendor-independent processing with the proposed image scaling correction can provide reproducible thigh intramuscular proton density fat fraction across sites and vendors. This approach may characterize within-patient muscle changes, such as bilateral differences or potentially longitudinal assessment.

0234 Pitch: 13:45
Poster: 14:45
Screen 43

Smart-Uploader: an automatic tool for medical image classification and quality protocol adherence

Óscar Peña-Nogales[1], Evie Neylon[1], Tommy Boshkovski[1], Marc Ramos[1], Paulo Rodrigues[1], Vesna Prčkovska[1], and Kire Trivodaliev[1]

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Keywords: Software Tools, Software Tools

Motivation: Imaging biomarkers are becoming a cornerstone to increase throughput and efficiency of large clinical trials. However, the diversity of imaging modalities used to derive them creates complexity for both imaging protocols and image archiving systems.

Goal(s): To develop a tool to automatically classify imaging modalities and assess their adherence to the predefined acquisition protocol.

Approach: The combination of a few-shot learning classifier trained to classify image modalities according to their contrast characteristics and a deterministic heuristic approach based on the DICOM headers.

Results: The proposed approach displays potential for automatic online image classification and identification of protocol deviations, increasing clinical trial operational efficiency.

Impact: The proposed joint approach automatically classifies all medical imaging data and assesses its adherence to the predefined acquisition protocol. Consequently, it not only facilitates data management but also identifies protocol deviations increasing the operational efficiency of clinical trials.

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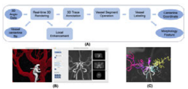

VesselVoyager: An Interactive 3D Intracranial Vessel Tracing Software

Kaiyu Zhang[1], Ted Guan[2], Xin Wang[3], William Kerwin[4], Yin Guo[1], Gador Canton[4], Thomas Hatsukami[5], Niranjan Balu[4], Mahmud Mossa-Basha[4], and Chun Yuan[4,6]

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Keywords: Software Tools, Software Tools, Vessel

Motivation: Aiming to unravel the complexities of intracranial arterial structures, we recognized the need for advanced 3D annotation capabilities to improve upon conventional 2D methodologies.

Goal(s): Our goal was to develop VesselVoyager, a tool that facilitates detailed 3D mapping and analysis of cerebral vasculature, filling a critical gap in neurovascular diagnostic technology.

Approach: We utilized real-time 3D rendering and a 3D virtual camera system in VesselVoyager, enabling precise, interactive annotation and analysis within a user-friendly, gamified environment.

Results: VesselVoyager not only improved accuracy but also created new approaches for analyzing understudied diseases, enhancing our understanding of complex neurovascular conditions.

Impact: VesselVoyager enhances centerline tracing precision and triples processing efficiency, thus lightening the workload for clinicians and researchers. This advancement broadens its applicability to intricate vascular pathologies, including moyamoya disease.

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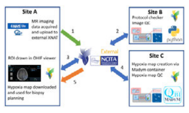

[A repository-integrated framework for rapid clinical analysis of MR-derived hypoxia maps.]

Penny L Hubbard Cristinacce[1], Andrew B Gill[2], Jonathan R Birchall[2], Sam Keaveney[3,4], Michael Berks[1], Mina Kim[5], Edith Gallagher[6], James T Grist[7,8], Julia Markus[9], Simon J Doran[4], Ross A Little[1], Daniel R McGowan[6,10], Geoff S Higgins[6,11], James PB O'Connor[1,4], Geoff JM Parker[5,12], and Joy R Roach[6,13]

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Keywords: Data Processing, Cancer, Clinical Translation

Motivation: Translation of quantitative biomarkers requires a reproducible and efficient analysis environment to underpin assessments of clinical utility.

Goal(s): This study aimed to provide a 24-hour turnaround of clinically relevant MR-derived hypoxia maps for use in biopsy planning.

Approach: The analysis framework was integrated into an XNAT imaging repository and applied to oxygen-enhanced and dynamic-contrast-enhanced images to quantify and map the extent of hypoxia within low-grade glioma.

Results: A group of geo-dispersed researchers consistently delivered MR-derived hypoxia maps to the clinical study team for use alongside ^{18}F-FDOPA PET in biopsy site definition prior to surgery.

Impact: A framework of repository-integrated analysis enabled rapid turnaround of quantitative MR imaging biomarkers for clinical decision-making. Specifically, biopsy-planning using MR-derived hypoxia mapping of low-grade glioma was delivered with standardised, reproducible, auditable results in under 24 hours.

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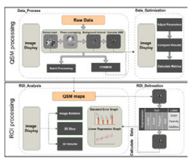

[SIPAS: A Comprehensive Susceptibility Imaging Process and Analysis Studio]

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Keywords: Software Tools, Software Tools, Quantitative Suceptibility Mapping

Motivation: Quantitative susceptibility mapping (QSM) presents great potential to monitor of neurodegenerative diseases.

Goal(s): Our goal is to provide comprehensive pipelines for QSM research including reconstruction and analysis.

Approach: This work elaborates on the Susceptibility Imaging Process and Analysis Studio (SIPAS) which offers multi-method options for each step with an abundant parameter tuning user-interface. Subsequent analysis of QSM maps is based on the statistical indicators of region-of-interest (ROI) which are delineated on SIPAS.

Results: SIPAS can achieve complete QSM procedures and precise results. Several hospitals have tested SIPAS for QSM research on different organs such as the brain, kidney, and liver.

Impact: Quantitative susceptibility mapping is a key means of neurodegenerative diagnosis. SIPAS may serve as a platform for obtaining and evaluating high-quality susceptibility maps, which can be an effective tool for doctors and institutions to conduct QSM studies.

0238

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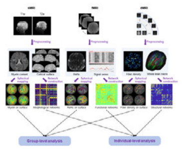
Screen 47



Harmonizing Multi-Modality Biases in Infant Development Analysis with an Integrated MRI Data Processing Pipeline

Feihong Liu[1,2], Jiawei Huang[1], Lianghu Guo[1], Haifeng Tang[1], Xinyi Cai[1], Yajuan Zhang[1], Jiameng Liu[1], Rui Hua[3], Jinchen Gu[1], Tianli Tao[1], Zhongrui Huang[1], Yichu He[3], Zehong Cao[3], Luoyu Wang[1], Xuyun Wen[4], Geng Chen[5], Fan Wang[6], Chunfeng Lian[7], Feng Shi[3], Qian Wang[1,8], Jun Feng[2], Han Zhang[1,8], and Dinggang Shen[1,3,8]

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Keywords: Data Processing, Brain, Neuroimage computing， pipeline

Motivation: Understanding infant neurodevelopment is pivotal for unraveling the anatomical underpinnings of psychomotor and cognitive functions, as well as pinpointing the origins of various disorders.

Goal(s): Introduce an integrated multi-modality MRI data processing pipeline tailored for infant development studies, with the goal of reliablly discerning relationship across brain anatomy and cognitive functions.

Approach: Incorporating precise deep learning tools specifically designed for infant brain, structural, functional, diffusion MRI data can be accurately analyzed, w.r.t. surface attributes for group-level study and network attributes for individual-level study.

Results: We introduce an integrated multi-modal infant MRI data processing pipeline toolkit with dedicated processing results.

Impact: We introduce the first infant multi-modal atlas and parcellation map

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0239

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Screen 48

NeuroLibre: Living MRI preprints with built-in support for code review

Agah Karakuzu[1], Elizabeth DuPre[2], Patrick Bermudez[3], Mathieu Boudreau[1], Rachel Harding[4], Jean-Baptiste Poline[3], Samir Das[3], Pierre Bellec[5], and Nikola Stikov[1]

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Keywords: Software Tools, Software Tools

Motivation: The ISMRM community is swiftly adopting data sharing and code review. While the advantages are clear, challenges persist in ensuring the quality and functionality of these shared resources.

Goal(s): To establish a platform for simplifying technical (or code) reviews and generating open-source living preprints with interactive data apps (e.g., dashboards).

Approach: We created NeuroLibre.org, offering dedicated cloud resources for hosting living preprints that combine narrative and executable content.

Results: NeuroLibre has published 8 living preprints, covering a variety of MRI applications. Each preprint is registered as citable and online-executable content with DOI links to archived reproducibility objects (code, runtime, data).

Impact: Our living preprints showcase how NeuroLibre helps reviewers interactively assess the quality and functionality of reproducibility objects effortlessly, bolstering the reproducibility of MRI publications. The ISMRM 2020 reproducibility challenge is our flagship example: https://doi.org/10.55458/neurolibre.00014

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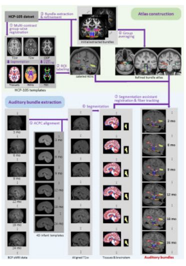
Screen 49



NeoAudi Tract: An Automated Tool for Identifying Auditory Fiber Bundles in Infants

Feihong Liu[1,2], Yaoxuan Wang[3,4,5], Jinchen Gu[2], Jiawei Huang[2], Jiameng Liu[2], Rui Hua[6], Yuting Zhu[3,4,5], Mengda Jiang[7], Feng Shi[6], Han Zhang[2,8], Zhaoyan Wang[3,4,5], Jun Feng[1], Hao Wu[3,4,5], and Dinggang Shen[2,6,8]

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Keywords: Data Processing, Pediatric, Neuroimage computing, Auditory pathway, Normal development

Motivation: Charting the development of infant auditory system is vital for understanding language acquisition and hearing disorders.

Goal(s): Extracting auditory fiber bundles from diffusion MRI data and overcoming the processing difficulties due to tiny and complex structures, as well as very low tissue contrast in the structural MRI data.

Approach: We propose an NAT framework with three core processes: 1) constructing a high-resolution atlas, 2) segmenting tissues and regions of interest (ROIs), and 3) applying a hierarchical registration framework.

Results: A high-resolution auditory fiber bundle template is constructed, and 12 auditory fiber bundles are successfully extracted.

Impact: Our approach is the first toolbox to identify individual auditory fiber bundles in infants, thus effectively mitigating the processing challenges caused by spatial-temporal asynchrony during the development of the first two postnatal years.

0241 Pitch: 13:45

Poster: 14:45

Screen 50

The Welsh Advanced Neuroimaging Database: an open-source state-of-the-art resource for brain research

Carolyn Beth McNabb[1], Ian D Driver[1], Vanessa Hyde[1], Garin Hughes[1], Hannah Louise Chandler[1], Hannah Thomas[1], Eirini Messaritaki[1], Carl Hodgetts[2], Craig Hedge[3], Christopher Allen[4], Maria Engel[1], Sophie Felicity Standen[1], Emma Morgan[1], Elena Stylianopoulou[1], Svetla Manolova[1], Lucie Reed[1], Mark Drakesmith[1], Michael Germuska[1], Alexander Shaw[5], Lars Mueller[6], Holly Rossiter[1], Christopher Davies-Jenkins[7], John Evans[1], David Owen[1], Gavin Perry[1], Slawomir Kusmir[1,8], Emily Lambe[1], Adam Partridge[1], Alison Cooper[1], Peter Hobden[1], Andrew Lawrence[1], Richard Wise[9], James Walters[10], Petroc Sumner[1], Krish Singh[1], and Derek K Jones[1]

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Keywords: Data Processing, Brain, data release

Motivation: Advances in MRI have increased our understanding of the human brain but are frequently limited by single modality study designs. Combining data from multiple modalities/MR contrasts can enhance our understanding of the complex multi-scale neural relationships that underpin human behaviour.

Goal(s): Our goal was to create an open-access multi-scale, multi-modal imaging database of the healthy human brain.

Approach: The Welsh Advanced Neuroimaging Database (WAND) includes micro and macro-structural, functional and spectroscopic MRI, MEG and cognitive data from over 150 healthy volunteers.

Results: WAND is free, open-source, organised using the Brain Imaging Data Structure (BIDS), and now available for download.

Impact: The Welsh Advanced Neuroimaging Database takes steps toward democratising magnetic resonance research by making multi-modal, multi-scale neuroimaging data freely and easily available, enhancing opportunities for collaboration and development of novel analysis techniques, further progressing the field of neuroimaging.

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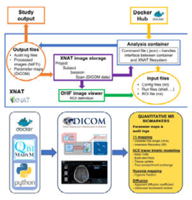
Screen 51



A Repository-Integrated Quantitative Imaging Data Analysis Pipeline for Enabling Multi-Centre Clinical Biomarker Studies

Jonathan R Birchall[1], Michael Berks[2], Sam Keaveney[3,4], Andrew Gill[1], Edith Gallagher[5], Julia E Markus[6], Simon Doran[3,4], Ross Little[2], Michael Dubec[2,7], James P B O'Connor[2,4,8], and Penny L Hubbard Cristinacce[2]

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Keywords: Software Tools, Data Processing, Data Analysis

Motivation: Robust evaluation of novel quantitative imaging biomarkers in multi-centre imaging trials requires harmonised workflow for storage, quality control and analysis of imaging data to facilitate clinical translation.

Goal(s): To establish a standardised, repository-integrated framework for quantitative MR data analysis to aid reproducibility.

Approach: A software container for quantitative MR data analysis was created using Docker, integrated with the XNAT imaging repository and demonstrated using example data.

Results: Repository-integrated software was used to generate quantitative maps of T_1, ADC and hypoxia, as well as DCE and IVIM modelling parameters in primary and nodal tumours from a patient with head-and-neck cancer.

Impact: Quantitative MR biomarker translation can be accelerated by standardisation of analysis protocols across multi-centre trials. Integration of containerised, user-configurable data analysis software within imaging repositories will improve repeatability and lower the barrier for entry to clinical trial involvement.

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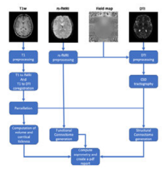
Screen 52



Brain Asymmetry Suite: a framework for the comprehensive examination of the brain's asymmetry

Tommy Boshkovski[1], Óscar Peña-Nogales[1], Evie Neylon[1], Marc Ramos[1], Paulo Rodrigues[1], Vesna Prchkovska[1], and Kire Trivodaliev[1]

[1]QMENTA, Boston, MA, United States

Keywords: Software Tools, Software Tools, brain asymmetry, rs-fMRI, DTI, connectome

Motivation: Hemispheric asymmetries have shown a great potential for early detection of a variety of neurological disorders such as traumatic brain injury. However, the lack of consistency in study outcomes is a common issue, largely stemming from the restricted sample sizes and methodological variations.

Goal(s): To develop a unified framework for the processing of multimodal imaging data for a comprehensive evaluation of brain asymmetry.

Approach: Combination of state-of-the-art algorithms for multimodal imaging data to estimate different metrics of brain asymmetry.

Results: By providing comprehensive measurements of brain asymmetry, this framework has the potential for early detection and monitoring of neurological disease.

Impact: The study aims to address inconsistencies in hemispheric asymmetry research by developing a unified framework for the estimation of brain asymmetry and offers a promising avenue for early detection and monitoring of neurological diseases.

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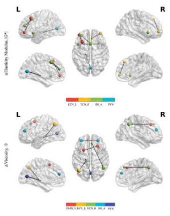

Evaluating MRE-Tract Integrity in HIV-CSVD Cohort: A Comprehensive Analysis with Functionally Defined Atlases and Neurocognitive Assessment

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Keywords: Data Processing, Elastography

Motivation: MR-Elastography and diffusion-MRI represents complementary modalities with mechanical-and-structural information of the brain. Structural-connectomes alone lack tract-integrity information. Tissue viscoelastic-measures can provide valuable insights for tract-integrity when combined with connectomes.

Goal(s): To aid the studies with neurodegeneration(HIV/CSVD), an analytical approach to combine viscoelastic-measures with diffusion-tractography is proposed which shows promise in targeted-analysis of functionally-defined-networks.

Approach: For 14 functionally-defined brain-networks, viscoelastic measures from MRE are mean-sampled with the dMRI derived tracts. Then, the significantly-affected viscoelastic alterations are studied in-accord with cognitive-changes.

Results: In a cohort of HIV-CSVD, by MRE-Tract-Integrity analysis, we reported significantly affected network connectivity that follows the cognitive decline($p<0.05$) in processing-speed and motor-skills.

Impact: The MRE-Tract-Integrity analysis enables us to study the missing mechanical properties of the structural connections from diffusion-tractography. This will help researchers performing targeted cognitive performance analysis with brain connectivity aided with mechanical basis which is a prominent marker for neural-change.

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MERIT AWARD MAGNA CUM LAUDE

The ISMRM Open Science Initiative for Perfusion Imaging (OSIPI): A Challenge for Reproducible DCE-MRI AI-based Analysis

Soudabeh Kargar[1], Lucy Kershaw[2,3], Anahita Fathi Kazerooni[4], Laura Bell[5], Rianne Van der Heijden[6], Henk-Jan Mutsaerts[7,8], Oliver Gurney-Champion[9,10], Eve Shalom[11], Andre Paschoal[12], Mu-Lan Jen[13], Safa Hoodeshenas[14], Natalie Serkova[15], Petra Van Houdt[16], Yuriko Suzuki[17], and Harrison Kim[18]

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Keywords: Data Processing, DSC & DCE Perfusion, Deep Learning

Motivation: There is a need for reproducibility, repeatability, and accuracy. Previously, OSIPI organized a challenge for benchmarking DCE software. As the use of artificial intelligence grows, we now set out to repeat the challenge, focusing on deep learning techniques.

Goal(s): To encourage researchers put their quantitative methods to test and stimulate collaboration and to charter the heterogeneity of DCE analysis software.

Approach: To use deep learning techniques to estimate perfusion parameters in DCE-MRI of the uterus. We share repeated in-vivo data to assess the algorithm's precision, and simulated DCE-data to test the accuracy.

Results: Top three winners may present their method at ISMRM 2025.

Impact: As quantitative perfusion MRI receives more importance and attention, the need for reproducibility, repeatability, and accuracy is inevitable. A public challenge within the MRI community is a great way to highlight the quantification of DCE-MRI.

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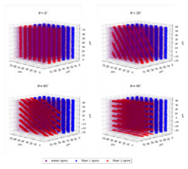

simDRIFT – An open-source software package for massively parallel simulation of DWI experiments on biophysically accurate tissue systems.

Jacob Samuel Blum[1], Kainen Utt[1], Donsub Rim[2], and Sheng-Kwei Song[1]

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Keywords: Simulation/Validation, Simulations, Monte Carlo Simulation, Massively Parallel Simulation

Motivation: The software encompassed by this abstract, which we call simDRIFT, fulfills a presently unmet need by allowing for mesh-free Monte Carlo simulations of DWI that unify researchers' needs for computational performance and biophysical realism with easy-to-use and configurable open-source software.

Goal(s): simDRIFT aims to provides for rapid and flexible Monte-Carlo simulations of Pulsed Gradient Spin Echo (PGSE) Diffusion-Weighted Magnetic Resonance Imaging (DWI) experiments.

Approach: We compared the performance of simDRIFT against other open-source DWI simulators on identical voxel geometries.

Results: Our results show that simDRIFT achieves orders of magnitude improved performance relative to other simulators, especially for large resident spin ensemble sizes.

Impact: The performance gains achieved by simDRIFT support its aim to provide a customizable tool for the rapid prototyping of diffusion models, ground-truth model validation, and in silico phantom production.

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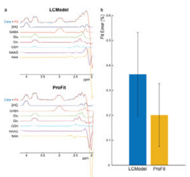
Screen 56



ProFit-1D for quantifying J-difference edited data at 3T

Kimberly L Chan[1], Tamas Borbath[2], Sydney Sherlock[3], Elizabeth A Maher[4,5], Toral R Patel[6], and Anke Henning[2,7]

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Keywords: Software Tools, Brain, MRS, fitting, editing, GABA, 2HG

Motivation: Reproducible and accurate fitting of the MR spectrum is critical in estimating metabolite concentrations. We have previously developed a fitting software called ProFit-1D which was shown to fit 9.4T sLASER data from the human brain with high accuracy and precision.

Goal(s): Here, ProFit-1D was optimized for fitting 3T J-difference edited data.

Approach: ProFit-1D was evaluated for accuracy and precision in simulated and in vivo 2HG-edited and GABA-edited data and compared to that of Gannet and LCModel

Results: ProFit-1D was found to be more accurate than LCModel in fitting the GABA-edited and 2HG-edited data and more precise than Gannet in fitting the GABA-edited spectra.

Impact: Here, we show that ProFit-1D produces more accurate measurements than LCModel and more precise measurements than Gannet in simulated and in vivo spectra from tumors and healthy participants. ProFit-1D is a promising fitting software with high clinical applicability.

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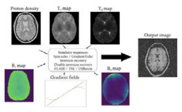


An open-source platform for image simulation, denoising, and super-resolution for point-of-care MRI devices

Mathieu Mach[1] and Andrew Webb[1]

[1]LUMC, Leiden, Netherlands

Keywords: Software Tools, Low-Field MRI, Simulation, denoising, super-resolution

Motivation: Low-field MRI is increasingly being applied in lower- and middle-income countries, but due to limited resources, training is scare.

Goal(s): Provide an open-source plateform for simulation, teaching, and a denoising and super-resolution pieline of low-field MRI images.

Approach: Using 3D maps of relaxation times, proton density, B0 and low-field system-specific parameters, such as limited gradient linearity, simulation of low-field images are created. Application of bm4d denoising and AI super-resolution on low-field images is additionally proposed.

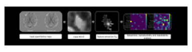
Results: We provide an open-source graphical interface that can simulate and generate multiple sequences of low-field MRI, and a denoised and super-resolution pipeline increasing low-field image enhancement.

Impact: This study provides a simple open-source python platform to simulate point-of-care low-field MRI images, reflecting specific system-specific parameters for teaching purposes, and a fast advanced denoising and AI-based super-resolution pipeline for low-field images.

0249 Pitch: 13:45

Poster: 14:45

Screen 58



QRadAR: A Toolbox for Quantitative Magnetic Resonance Radiomics Analysis and Reliability

Alexandra Grace Roberts[1], Jinwei Zhang[2], Dominick Romano[3], Sema Akkus[4], Brian Harris Kopell[4], Pascal Spincemaille[5], and Yi Wang[3,5]

[1]Electrical and Computer Engineering, Cornell University, New York, NY, United States, [2]Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, United States, [3]Biomedical Engineering, Cornell University, New York, NY, United States, [4]Neurosurgery, Mount Sinai Hospital, New York, NY, United States, [5]Radiology, Weill Cornell Medicine, New York, NY, United States

Keywords: Radiomics, Radiomics

Motivation: Radiomic feature robustness as an input to a downstream model is an important consideration for model reliability. Generating a subset of robust, reproducible, and repeatable features is an important step in determining predictive or indicative features.

Goal(s): To provide a framework for radiomics robustness, repeatability, and reproducibility.

Approach: A Python implementation using the pyradiomics, scikit-learn, numpy, and other open-source library is provided as tool to quickly summarize the radiomic features surviving differing sampling, time point, or field strength acquisitions.

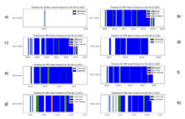
Results: The QRadAR Toolbox provides researchers and clinicians with a collection of reliable features for downstream model input.

Impact: The QRadAR Toolbox provides researchers and clinicians with a collection of reliable features for downstream model input by providing a providing Python a framework for radiomics robustness, repeatability, and reproducibility.

0250 Pitch: 13:45

Poster: 14:45

Screen 59



A Novel Pipeline to Automatically Harness Log File Data for Enhanced MRI Parameter Analysis, Patient Care and Radiology Utilisation

Oscar Lally[1], Molly Buckley[1], Elizabeth Gabriel[1], Laurence Jackson[1], Anthony Price[1], and Simon Shah[1]

[1]*Medical Physics, Guy's and St Thomas' NHS Trust, London, United Kingdom*

Keywords: Software Tools, MR Value

Motivation: A deeper understanding of how information in log files can contribute to service improvement, for example reducing patient backlog and improving patient safety.

Goal(s): To construct an automated data pipeline that analyses and processes log files, returning quantitative results and graphical visualisations that can be interpreted in a clinically useful way.

Approach: We obtained log files from our scanner fleet and constructed a Python codebase to read, analyse and interpret data pertaining to time utilisation and patient exposure.

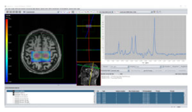
Results: We have demonstrated the code's capability to provide detailed exposure monitoring as well as insights into how productively we use time on our scanners.

Impact: Our work will help us to optimise the patient pathway, improve patient safety and investigate how more obscure parameters can affect our service delivery. Our code will be open source, enabling others to benefit and contribute, improving services more widely.

0251 Pitch: 13:45

Poster: 14:45

Screen 60



TensorFit: an open-source tool for fast MRS metabolite quantification.

Federico Turco[1] and Johannes Slotboom[1]

[1]*Institute for Diagnostic and Interventional Neuroradiology, Support Center for Advanced Neuroimaging (SCAN), University of Bern, Bern, Switzerland*

Keywords: Data Processing, Data Processing, Optimization, Torch, Auto-differentiation.

Motivation: Addressing the time constraints in Magnetic Resonance Spectroscopy (MRS) metabolite quantification, TensorFit aims to overcome processing delays hindering clinical use.

Goal(s): TensorFit seeks to accelerate MRS analysis with a strong focus in time efficiency, using GPU acceleration, and modeling capabilities within the Torch framework.

Approach: Implemented in Python, employs Torch for efficient forward- and back-propagation, allowing rapid quantification of large datasets. It supports GPU usage, and integration with Spectrlm-QMRS for clinical practices.

Results: TensorFit achieves speed-ups surpassing existing methods by up to 200x on GPU and 17x on CPU, making it a powerful tool for metabolite quantification in EPSI data.

Impact: TensorFit speed-up MRS metabolite quantification in clinical practices, enabling ultra-fast analysis. This tool could lead to enhance the use of high-resolution MRS adquisition for both research and clinical practices.

Study Group Business Meeting

MR Spectroscopy Business Meeting

Room 324 Monday 14:45 - 15:45

(no CME credit)

Other

Environmental Sustainability & MRI

Room 334-336 Monday 16:00 - 18:00 *Moderators:* Michael Atalay

(no CME credit)

16:00 Primer On Climate Change, Planetary Health & Human Health Impacts

Penny Hubbard Cristinacce

16:13 Environmental Sustainability & MRI: Use-Phase Energy & GHG Emissions

Jan Vosshenrich

16:26 Impact Of MR Field Strength On Energy & GHG Emissions

Adrienne Campbell-Washburn

16:39	Panel Discussion & Audience Q&A – Strategies to Reduce the Environmental Impact of MRI While Preserving Benefits Rajiv Ramasawmy[1], Meng Law[2] [1], [2]
16:55	Break & Meet the Teachers
17:05	Sustainability of MR Systems Throughout Their Life Cycle Including Production Phase (Materials, Power Electronics, Magnets, Computing) James Carr
17:18	Environmental Sustainability in MRI: Travel, Data Analysis/Storage & AI Christof Boehm
17:31	Environmental Sustainability in MRI Beyond Energy: Waste, Contrast & Helium Peter Barker
17:44	Panel Discussion & Audience Q&A – Strategies to Reduce the Environmental Impact of MRI Beyond Energy Hamidreza Saligheh Rad[1], Hersh Chandarana[2] [1], [2]

Study Group Business Meeting

Imaging Neurofluids Business Meeting

Room 303-304 — Monday 16:00 - 17:00

(no CME credit)

Study Group Business Meeting

Musculoskeletal MR Business Meeting

Room 324 — Monday 16:00 - 17:00

(no CME credit)

Oral

Good Old Proton Spectroscopy

Hall 606 — Monday 16:00 - 18:00 — *Moderators:* Malgorzata Marjanska & Ralph Noeske

16:00	Introduction Malgorzata Marjanska *University of Minnesota, United States*

0252 16:12

MERIT AWARD
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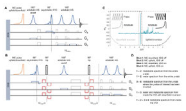

[Metabolite-cycling at 14.1T: sequence implementation and initial explorations using SPECIAL and diffusion-weighted SPECIAL]

Jessie Mosso[1,2], André Döring[1,2], Roland Kreis[3,4], Cristina Cudalbu[1,2], and Bernard Lanz[1,2]

[1]CIBM Center for Biomedical Imaging, Lausanne, Switzerland, [2]Animal Imaging and Technology, EPFL, Lausanne, Switzerland, [3]Magnetic Resonance Methodology, Institute of Diagnostic and Interventional Neuroradiology, University of Bern, Bern, Switzerland, [4]Translational Imaging Center, sitem-insel, Bern, Switzerland

Keywords: Spectroscopy, Brain, MRS, metabolite-cycling, sequence development, SPECIAL, diffusion, DW-MRS, downfield

Motivation: Water suppression leads to saturation of exchanging protons which biases metabolite concentration estimates and prevents the study of downfield resonances in the ^{1}H spectrum.

Goal(s): Apply metabolite-cycling (MC) to study these resonances with high sensitivity using the short-TE, full-intensity SPECIAL sequence at ultra-high field on an animal scanner.

Approach: The MC pulse was optimized for 14.1T. MC SPECIAL and MC diffusion-weighted SPECIAL were implemented and tested in vivo.

Results: Underestimation of specific upfield metabolite concentrations with water-suppressed SPECIAL compared to MC SPECIAL was observed. Downfield resonances attribution was further validated with diffusion-weighted acquisitions, uniquely showing the presence of macromolecules in the 6.5-7.5ppm region.

Impact: The introduction of metabolite-cycling in the short echo-time, full intensity SPECIAL and diffusion-weighted SPECIAL ^{1}H MRS sequences at 14.1T paves the way for in-depth exploration of the downfield resonances of the ^{1}H spectrum with high sensitivity on animal scanners.

0253 16:24

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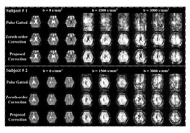

[Robust Volumetric Diffusion-Weighted MRSI via Time-Resolved Phase Reconstruction and Correction]

Zepeng Wang[1,2], Bradley P. Sutton[1,2,3], and Fan Lam[1,2,3]

[1]Department of Bioengineering, 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]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States

Keywords: Spectroscopy, Spectroscopy, Diffusion, Quantitative Imaging

Motivation: To address the long-standing phase correction challenge and enhance the robustness for diffusion-weighted MRSI.

Goal(s): To correct the significant phase variations due to macroscopic and microscopic motions in in vivo diffusion-weighted MRSI acquisition.

Approach: We developed a novel fast diffusion-weighted MRSI sequence integrating time-resolved, sparsely sampled, volumetric phase navigators, a subspace-based phase image reconstruction, and a sensitivity-encoded phase-corrected reconstruction. The corrected diffusion-weighted MRSI data were processed by state-of-the-art subspace-based spatiospectral processing methods.

Results: Improved data quality, diffusion-weighted spatiospectral reconstruction and metabolite-specific diffusion parameter estimation achieved by the proposed method are demonstrated using in vivo data.

Impact: A novel integrative acquisition and reconstruction solution for robust, phase-corrected 3D in vivo diffusion-weighted MRSI was presented, an important step towards developing diffusion-weighted MRSI for its translation to quantitative, molecule-specific microstructural imaging.

0254 16:36

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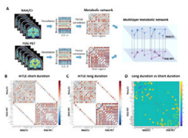


Multilayer Metabolic Networks of Mesial Temporal Lobe Epilepsy: Insights from Simultaneous PET/MRSI

Hui Huang[1], Miao Zhang[2], Yibo Zhao[3,4], Wen Jin[3,4], Yudu Li[3,5], Bingyang Cai[1], Jiwei Li[1], Zhi-Pei Liang[3,4], Biao Li[2], and Jie Luo[1]

[1]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [2]Department of Nuclear Medicine, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Department of Electrical and Computer Engineering, University of Illinois at Urbana Champaign, Urbana, IL, United States, [4]Beckman Institute for Advanced Sciences and Technology, University of Illinois at Urbana Champaign, Urbana, IL, United States, [5]National Center for Supercomputing Applications, University of Illinois at Urbana Champaign, Urbana, IL, United States

Keywords: Epilepsy, Metabolism, PET/MR

Motivation: How chronic epilepsy impacts the interplay between neuronal metabolites and inter-regional metabolic connectivity remains unclear.

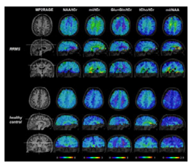
Goal(s): To identify neurometabolic imaging biomarkers for epilepsy progression using PET/MRSI.

Approach: Forty-eight patients with drug-resistant mesial temporal lobe epilepsy and fifteen patients with extratemporal epilepsy underwent simultaneous high-resolution MRSI and FDG PET. Moderation effects of disease duration were evaluated for multiple brain regions; multilayer metabolic networks were constructed to investigate metabolic changes of NAA, FDG and their interplay.

Results: We found disease duration moderated changes in the interplay between NAA and FDG. Metabolic networks form distinct modules in short duration and long duration groups.

Impact: This is the first simultaneous PET/MRSI study to investigate multilayer metabolic network associated with disease duration of mTLE, which could offer a comprehensive view of neurometabolic profile, facilitating the exploration of imaging markers in epileptic lesion detection and disease progression.

0255 16:48



Imaging brain metabolic alterations of multiple sclerosis using fast high-resolution 3D-CRT-MRSI at 7T

Eva Niess[1,2], Assunta Dal-Bianco[3], Lukas Hingerl[1], Bernhard Strasser[1], Alexandra Lipka[1], Fabian Niess[1], Stanislav Motyka[1,2], Anna Petrova[1,3], Gilbert Hangel[1,4], Paulus Rommer[3], Siegfried Trattnig[1], and Wolfgang Bogner[1,2]

[1]High Field MR Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [2]Christian Doppler Laboratory for MR Imaging Biomarkers (BIOMAK), Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [3]Department of Neurology, Medical University of Vienna, Vienna, Austria, [4]Department of Neurosurgery, Medical University of Vienna, Vienna, Austria

Keywords: Multiple Sclerosis, Brain, MR Spectroscopic Imaging

Motivation: MR spectroscopy offers biomarkers like myo-inositol and N-acetylasparate that can better predict disability progression and clinical status in multiple sclerosis. However, traditional MR spectroscopic imaging faces challenges like limited resolution and lengthy acquisition times, hampering its clinical utility.

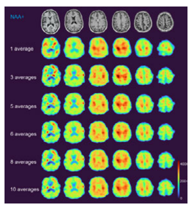
Goal(s): This study aimed to assess a novel 7T 3D-concentric-ring-trajectory-readout MRSI, addressing these limitations, for reliable metabolic marker imaging in MS.

Approach: Metabolic images were obtained from 26 MS patients and compared with 13 healthy controls.

Results: Altered brain metabolism in MS was effectively visualized across a large brain volume, revealing significant differences in metabolite levels within normal-appearing white matter.

Impact: We showcase extensive, high-resolution brain metabolic mapping of multiple sclerosis within a clinically viable timeframe. This can enhance disease monitoring and improve the assessment of treatment effectiveness.

0256 17:00



CHEAP and SLOW: a comprehensive acquisition protocol for downfield, upfield, and spectral editing 1H-MRSI at 7T

Guodong Weng[1,2], Piotr Radojewski[1,2], and Johannes Slotboom[1,2]

[1]Institute for Diagnostic and Interventional Neuroradiology, Support Center for Advanced Neuroimaging (SCAN), University of Bern, Bern, Switzerland, [2]Translational Imaging Center, sitem-insel, Bern, Switzerland, Bern, Switzerland

Keywords: Spectroscopy, High-Field MRI, downfield, Spectral editing, MRSI

Motivation: Integration of downfield, upfield, and spectral editing MRSI in clinical studies

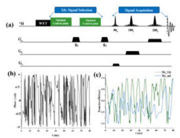
Goal(s): Generate high resolution downfield (0.37 ml) and upfield (0.2 ml) in vivo MRSI at 7T

Approach: CHEAP-ESPI and SLOW-EPSI were used for downfield and upfield (spectral editing) MRSI, respectively, in two healthy volunteers and one glioma patient.

Results: A 4-minute acquisition with CHEAP-EPSI suffices for downfield MRSI (ATP/GSH+ and NAA+), while a 9-minute acquisition with SLOW-EPSI is adequate for upfield (NAA) and spectral editing (2HG, GABA, and Glx) MRSI.

Impact: The combination of CHEAP-EPSI and SLOW-EPSI enables the measurement of downfield, upfield, and edited 3D MRSI within approximately 13 minutes, making it readily integrable into clinical routine examinations or scientific studies.

0257 17:12



Selective measurement of glycine in human brain by optimal control method at 7 T

Ying Liu[1], Jiaxiang Xin[2], Yifan Yuan[3], Caixia Fu[4], Ying-Hua Chu[2], Da-Xiu Wei[5], Ye-Feng Yao[5], and He Wang[1]

[1]Institute of Science and Technology for Brain-Inspired Intelligence, Fudan University, Shanghai, China, [2]MR Research Collaboration Team, Siemens Healthineers Ltd, Shanghai, China, [3]Huashan Hospital, Fudan University, Shanghai, China, [4]MR Application Development, Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China, [5]Physics Department and Shanghai Key Laboratory of Magnetic Resonance, School of Physics and Electronic Science, East China Normal University, Shanghai, China

Keywords: Pulse Sequence Design, Spectroscopy

Motivation: Glycine is key neurotransmitter associated with the the pathogenesis and imaging of gliomas, yet the non-invasive quantification of it remains a challenge.

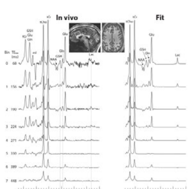
Goal(s): To selectively measure glycine in human brain.

Approach: A new pulse sequence was developed, utilizing optimal control techniques to selectively detect glycine signals while effectively suppressing myo-inositol signals.

Results: Experimental results from both phantom models and glioma patient studies confirm the selective detection of glycine. Preliminary data indicate a relationship between glycine signal intensities and glioma distributions.

Impact: The use of the developed pulse sequence for the selective measurement of glycine in the human brain may provide possibility for more accurate assessment of glioma aggressiveness.

0258 17:24



In Vivo Detection of Lactate and its T2 in the Resting Human Brain by Transverse Relaxation Encoding with Narrowband Decoupling

Li An[1], Maria Ferraris Araneta[1], Tara Turon[1], Christopher S Johnson[1], Sungtak Hong[1], John A Derbyshire[1], and Jun Shen[1]

[1]National Institute of Mental Health, National Institutes of Health, Bethesda, MD, United States

Keywords: Spectroscopy, Spectroscopy, MRS; lactate; glutamate

Motivation: The published T_2 relaxation times in healthy brains are highly inconsistent.

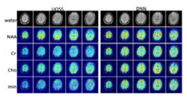
Goal(s): To reliably measure T_2 relaxation times of lactate and glutamate.

Approach: A new editing pulse was crafted and incorporated into the TREND technique for simultaneous homonuclear decoupling of lactate and glutamate at 7 Tesla.

Results: The concentrations and T_2 relaxation times of lactate and glutamate were measured in vivo with low CVs and CRLBs.

Impact: As lactate and glutamate are the markers of glycolysis and oxidative metabolism, respectively, this technique can be used for clinical MRS studies of the biophysical aspects of cerebral metabolic alterations or abnormalities.

0259 17:36 [A deep learning-based approach to nuisance signal removal from MRSI data aqcuired without suppression]



Wonil Lee[1,2], Yue Zhuo[1,2], Thibault Marin[1,2], Paul Kyu Han[1,2], Didi Chi[1,2], Georges El Fakhri[3], and Chao Ma[1,2]

[1]Radiology, Massachusetts General Hospital, Boston, MA, United States, [2]Radiology, Harvard Medical School, Boston, MA, United States, [3]School of Medicine, Yale University, Boston, MA, United States

Keywords: Spectroscopy, Data Processing, MRSI nuisance signal removal

Motivation: Unsuppressed water and lipid signals are several orders of magnitude stronger than the metabolite signals in MRSI, imposing significant challenges in MRSI data processing and image reconstruction.

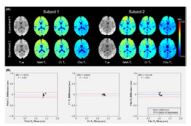
Goal(s): To develop a novel deep learning-based method for nuisance signal removal from MRSI data acquired without suppression.

Approach: A neural network with a U-net structure was designed to remove nuisance signals in MRSI, where the input of the network was the Hankel matrix formed by the time-domain MRSI signal.

Results: The proposed method was validated using in vivo MRSI data, showing superior performance over the conventional method.

Impact: A deep learning-based method is proposed for nuisance signal removal in MRSI. It could enable MRSI without water or lipid suppression with robust performance in practical settings.

0260 17:48 [Accelerated 3D Metabolite T1 Mapping Using Variable-Flip-Angle FID MRSI]



Yibo Zhao[1,2], Rong Guo[1,3], Yudu Li[1,4], Wen Jin[1,2], Brad Sutton[1,4,5], Chao Ma[6], Georges El Fakhri[7], Yao Li[8], Jie Luo[8], and Zhi-Pei Liang[1,2]

[1]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]Siemens Medical Solutions USA, Inc., Urbana, IL, United States, [4]National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [5]Department of Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [6]Gordon Center for Medical Imaging, Department of Radiology, Massachusetts General Hospital, Boston, MA, United States, [7]Yale School of Medicine, New Haven, CT, United States, [8]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China

Keywords: Spectroscopy, Spectroscopy

Motivation: Metabolite T1 values are needed for T1 correction in short-TR MRSI data. Due to the prolonged scan time, metabolite T1 measurement has been limited to single-voxel or single-slice experiments so far.

Goal(s): To develop a novel method for 3D metabolite T1 mapping in a practically feasible scan time.

Approach: We used a variable-flip-angle short-TR MRSI to achieve rapid metabolite T1 mapping. The high-dimensional data space was undersampled in a variable-density manner. Associated data processing challenges were solved by generalized-series and low-rank-tensor modelling.

Results: Simulation, phantom and healthy subject results demonstrated the feasibility of accelerated 3D metabolite T1 mapping.

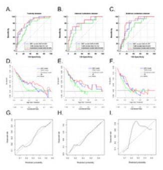
Impact: The proposed method enables 3D metabolite T1 mapping within a clinically feasible scan time (15 min). This method can be used to correct T1 weighting effects in accelerated short-TR MRSI experiments, producing more quantitative results.

Oral

New Perspectives in Prostate Cancer Imaging

Nicoll 1 Monday 16:00 - 18:00 *Moderators:* Andreas Loening & Rolf Reiter

0261 16:00



Predicting Pathogenic DNA Damage Repair Gene Mutations in Prostate Cancer Patients: A Multi-Center MRI Radiomics Study

Enyu Yuan[1], Yuntian Chen[1], Lei Ye[1], Jin Yao[1], and Bin Song[1]

[1]*Department of Radiology, West China hospital, Chengdu, China*

Keywords: Prostate, Prostate

Motivation: Pathogenic DDR gene alterations are associated with aggressive disease and poor outcomes among prostate cancer (PCa) patients.

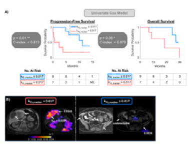
Goal(s): To develop a radiomics-based pre-testing model for identifying DDR mutation carriers among PCa patients.

Approach: A total of 225 patients from three centers with both multiparameter MRI and genetic DDR mutations testing were included. Radiomic models were established based on T2WI and ADC sequences of MRI images. The predictive values were validated in both internal and external validation cohorts.

Results: The radiomics-based model exhibited an AUC of 0.835 in the training dataset, 0.824 in the internal validation dataset, and 0.836 in the external validation dataset.

Impact: In the current study, we introduced a noninvasive radiomics feature-based tool designed to predict pDDRg mutations in prostate cancer patients. External validation of the novel tool by datasets from other medical centers revealed a high predictive accuracy for pDDRg mutations.

0262 16:12



Assessment of Radiomic Features of Metabolism in Advanced Prostate Cancer using Hyperpolarized 13C MRI with Whole Abdominopelvic Coverage

Hsin-Yu Chen[1], Ivan de Kouchkovsky[2], Robert A. Bok[1,2], Michael A. Ohliger[1], Zhen J. Wang[1], Daniel Gebrezgiabhier[1], Tanner Nickles[1], Lucas Carvajal[1], Jeremy W. Gordon[1], Peder E.Z. Larson[1], John Kurhanewicz[1,2], Rahul Aggarwal[2], and Daniel B. Vigneron[1,2]

[1]*Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States,* [2]*Helen Diller Family Comprehensive Cancer Center, University of California, San Francisco, San Francisco, CA, United States*

Keywords: Prostate, Prostate, Hyperpolarized 13C MRI

Motivation: Hyperpolarized (HP) ^{13}C-pyruvate MRI can address limitations of PSMA-PET for monitoring therapy and evaluating treatment-emergent, lethal subtypes of prostate cancer.

Goal(s): To establish and characterize a novel radiomics framework of tumor metabolism in advanced prostate cancer based on whole abdominopelvic HP MRI.

Approach: We extracted 316 metabolic features from 16 patients. Following feature selection and classification, their prognostic values were evaluated using uni- and multivariate survival analyses.

Results: Metabolic feature $k_{PL,median}$ (pyruvate-to-lactate conversion rate) significantly predicted both progression-free ($p<0.01$) and overall ($p<0.05$) survivals with longer median PFS (11.2 vs 0.5 months) and OS (NR vs 18.4 months) in the lower- vs higher-k_{PL} subgroups.

Impact: A novel radiomics framework based on whole abdominopelvic hyperpolarized ^{13}C-pyruvate MRI extracted and evaluated 316 metabolic features of advanced prostate cancer. Selected features significantly predicted clinical outcome measures (PFS and OS), strongly supporting further investigation of their prognostic values.

0263 16:24

MERIT AWARD

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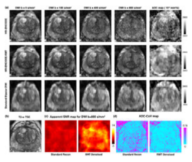


[Rapid High-Resolution Prostate Diffusion MRI using Eddy Current-Nulled Convex Optimized Diffusion Encoding and Random Matrix Theory Denoising]

Elif Aygun[1,2], Zhaohuan Zhang[1,2], Shu-Fu Shih[1,2], Steven S. Raman[1], Kyunghyun Sung[1,2], and Holden H. Wu[1,2]

[1]Department of Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States, [2]Department of Bioengineering, University of California Los Angeles, Los Angeles, CA, United States

Keywords: Prostate, Diffusion/other diffusion imaging techniques, Prostate, Diffusion Denoising

Motivation: High-resolution (HR) DWI, although beneficial for prostate tissue characterization and cancer diagnosis, suffers from low signal-to-noise ratio (SNR). The common strategy of averaging to increase SNR prolongs the acquisition time (TA).

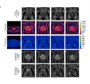
Goal(s): Decreasing the number of repetitions for averaging while maintaining the SNR for HR prostate DWI.

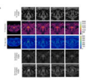
Approach: Eddy Current-Nulled Convex Optimized Diffusion Encoding (ENCODE) combined with random matrix theory (RMT)-based denoising to reduce the repetitions while maintaining SNR.

Results: HR-ENCODE-RMT (TA=2 min 30 sec) improved SNR for rapid prostate HR-DWI, and achieved consistent and precise apparent diffusion coefficient (ADC) mapping compared to standard-resolution bipolar DWI (TA=5 min 50 sec).

Impact: Eddy Current-Nulled Convex Optimized Diffusion Encoding combined with Random Matrix Theory-based denoising enables rapid high-resolution prostate DWI using fewer repetitions while maintaining the signal-to-noise ratio and robustness of apparent diffusion coefficient maps. This method could improve characterization of prostate cancer.

0264 16:36





[3D MR Fingerprinting for Prostate at 0.55 T]

Jesus Ernesto Fajardo Freites[1], Tejinder Kaur[1], Gastao Cruz[1], Nicole Seiberlich[1,2], Vikas Gulani[1], and Yun Jiang[1,2]

[1]Department of Radiology, University of Michigan, Ann Arbor, MI, United States, [2]Department of Biomedical Engineering, Univeristy of Michigan, Ann Arbor, MI, United States

Keywords: Prostate, Prostate, prostate cancer, 0.55 T, low field, MRF, fingerprinting, synthesized contrast

Motivation: 0.55 T MRI scanners have lower fields inhomogeneities and bigger bore size when compared to higher fields, allowing to scan larger body habitus patients, and to perform MRI-guided biopsies.

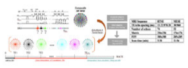
Goal(s): To generate 1x1x3 mm^3 T_1 and T_2 maps of the prostate and T_1 and T_2 weighted images with improved contrast from MRF at 0.55 T.

Approach: We use a 3D MRF-FISP sequence with Stack of Spirals acquisition and a low-rank denoising method.

Results: We show T_1 and T_2 maps and T_1 and T_2 weighted images and report on values for the prostate NPZ and NTZ of 5 subjects and for a biopsy-confirmed lesion.

Impact: Implementing prostate MR Fingerprinting at 0.55 T, allows multiparametric quantitative assessment of the gland while gaining advantages that 0.55 T scanners offer respect to higher field ones. This includes lower fields inhomogeneities, bigger bore size and a lower equipment cost.

0265 16:48



[Advancements in Prostate Luminal Water Imaging: Radial Turbo Spin-Echo Acquisition and Spatial Regularization]

Parsa Razmara[1], Fei Han[2], Qingle Kong[1], Jiayu Xiao[1], Junzhou Chen[1], Monish Aron[1], Justin Haldar[1], and Zhaoyang Fan[1]

[1]University of Southern California, Los Angeles, CA, United States, [2]Siemens Healthineers, Los Angeles, CA, United States

Keywords: Prostate, Cancer

Motivation: Non-invasive and efficient diagnostic methods for prostate cancer are urgently needed to enhance patient experience and improve diagnostic accuracy.

Goal(s): To develop and validate a novel radial turbo spin-echo (rTSE) sequence for luminal water imaging (LWI) that reduces MRI scan times while maintaining image quality.

Approach: Employed a radial k-space trajectory for the rTSE sequence, optimized on volunteers, followed by paired comparison with the MESE sequence. Implemented spatial regularization to stabilize the T2 decay curve fitting.

Results: The rTSE sequence halved scan times without compromising image quality or diagnostic precision. Spatial regularization significantly improved the homogeneity and smoothness of LWF, demonstrating better outcomes.

Impact: The rTSE sequence enhances prostate MRI by cutting scan times and discomfort without losing diagnostic accuracy. Spatial regularization refines tissue analysis for earlier cancer detection and reduces noise for clearer luminal water fraction maps.

0266 17:00

[Clinically Significant Prostate Cancer Following Negative Biopsies for PIRADS 4 and 5 Lesions: A Multicenter Study]

Evie Nguyen[1], Imon Banerjee[1,2], Meghana Nadella[1], Jacob Varner[3], Naoki Takashashi[4], Jordan LeGout[5], Melissa Stanton[1], Daniel Frendl[1], Haider Abdul-Mush[1], and Nelly Tan[1]

[1]Mayo Clinic AZ, Phoenix, AZ, United States, [2]Arizona State University, Phoenix, AZ, United States, [3]Mayo Clinic AZ, Phenix, AZ, United States, [4]Mayo Clinic Rochester, Rochester, MN, United States, [5]Mayo Clinic FL, Jacksonville, FL, United States

Keywords: Prostate, Cancer, prostate cancer, discordant radiology pathology

Motivation: To understand the risk of clinically significant prostate cancer (csPCa) in patients with negative biopsies for PIRADS categories 4 and 5 lesions, addressing a critical gap in clinical decision-making following discordant prostate MRI-biopsy findings.

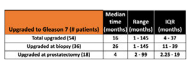
Goal(s): To determine the prevalence of csPCa among patients with negative biopsy for PIRADS 4 or 5 lesions.

Approach: A multicenter retrospective study, utilizing Natural Language Processing (NLP) to analyze patient demographics, clinical, imaging and pathologic outcomes, followed by statistical analyses.

Results: In 44% patients was found to have csPCa after initial discordant prostate MRI- biopsy.

Impact: This study underscores the high risk of csPCa in patients with initial negative biopsies for PIRADS 4 or 5 lesions, potentially guiding clinicians in patient management and informing follow-up strategies.

0267 17:12



[Is MR-visible Gleason 6 prostate cancer clinically insignificant?]

Alexandra Besser[1], Surbhi Raichandani[1], Tie Liang[2], Zachary Franks[1], Richard E Fan[3], Geoffrey A Sonn[3], and Pejman Ghanouni[2]

[1]Body MRI, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Urology, Stanford University, Stanford, CA, United States

Keywords: Prostate, Prostate

Motivation: The clinical course of MR-visible Gleason 6 prostate cancer is unclear.

Goal(s): We studied patients with MR-visible prostate lesions scored as Gleason 6 after MR-guided and systematic biopsy.

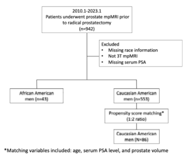
Approach: We retrospectively analyzed the rate of Gleason grade upgrading in 95 men initially diagnosed with Gleason 6 prostate cancer in an MR-visible lesion who later underwent a second biopsy or prostatectomy.

Results: Over half of MR-visible Gleason 6 lesions were upgraded to Gleason 7 with a median time to upgrade of ~2 years. Neither PSA density nor ADC value predicted subsequent upgrade.

Impact: Gleason 6 prostate cancer that is MR-visible often harbors higher grade cancer. This argues for more aggressive monitoring or earlier intervention in these patients.

0268 17:24

Investigating Quantitative Perfusion Characteristics of Prostate Cancer for African American and White Men



Sohaib Naim[1], Raymi Ramirez[1], Fatemeh Zabihollahy[1], Qi Miao[2], Harrison Kim[3], Robert E Reiter[4], Steven Raman[1], and Kyunghyun Sung[1]

[1]Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Radiology, The First Affiliated Hospital of China Medical University, Shenyang City, China, [3]Radiology, University of Alabama at Birmingham, Birmingham, AL, United States, [4]Urology, University of California, Los Angeles, CA, United States

Keywords: Prostate, Prostate, Health disparity, perfusion analysis

Motivation: Race and ethnicity strongly impact the risk of prostate cancer, and understanding the impact of biological heterogeneity in patients from different racial/ethnic backgrounds is crucial for reducing the observed gaps in clinical outcomes.

Goal(s): To investigate potential differences in quantitative perfusion characteristics of prostate cancer between African American and White men.

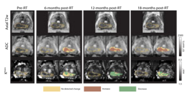
Approach: After matching commonly known clinical risk factors, the quantitative DCE-MRI analysis was performed to assess differences in perfusion parameters of the pathology- and MRI-based lesions African American and White men.

Results: Notable differences between the two cohorts were observed in the K^{trans} of tumors with csPCa.

Impact: Considering race-specific perfusion characteristics can help in understanding biological factors of health disparity in prostate cancer.

0269 17:36

Longitudinal quantitative MRI detects heterogeneity in response to radiation therapy within prostate cancer



Yu-Feng Wang[1,2,3], Sirisha Tadimalla[1,2], Lois Holloway[1,3,4], Niluja Thiruthaneeswaran[2], Sandra Turner[2], Mark Sidhom[4], Amy Hayden[2], Jarad Martin[5], and Annette Haworth[1,2]

[1]Institute of Medical Physics, The University of Sydney, Camperdown, NSW, Australia, [2]Sydney West Radiation Oncology, Westmead & Blacktown Hospital, Wentworthville, NSW, Australia, [3]Ingham Institute for Applied Medical Research, Liverpool, NSW, Australia, [4]Liverpool and Macarthur Cancer Therapy Centre, Liverpool Hospital, Liverpool, NSW, Australia, [5]Department of Radiation Oncology, Calvary Mater Newcastle, Newcastle, NSW, Australia

Keywords: Prostate, Quantitative Imaging, Treatment response, tumors, radiotherapy, prostate

Motivation: Tumour heterogeneity can result in a spatial variation in response to radiation. While quantitative MRI (qMRI) shows promise in monitoring treatment response in prostate cancer (PCa), there remains an untapped potential for spatial response mapping to detect radioresistant tumour sub-regions suitable for early salvage therapy.

Goal(s): To assess the feasibility of treatment response mapping in a post-radiation therapy longitudinal qMRI PCa dataset.

Approach: Longitudinal qMRI parameter maps of 16 PCa patients were analysed using voxel-wise and region of interest (ROI) approaches.

Results: Voxel-wise analysis identified heterogeneity in treatment-related changes within PCa that would otherwise be concealed in ROI-based assessments.

Impact: Voxel-wise analysis of longitudinal qMRI parameter maps can detect radiation treatment response in sub-volumes of prostate cancer. Reliable detection and localisation of early treatment response provides an opportunity for adaptive or salvage therapies of treatment-resistant tumours.

17:48

Discussion

Andreas Loening

Stanford University, Stanford, CA, United States

Oral

Applications of Advanced Acquisition & Reconstruction

Nicoll 2 | Monday 16:00 - 18:00 | *Moderators:* Redha Boubertakh & Megan Poorman

0270 16:00

MERIT AWARD
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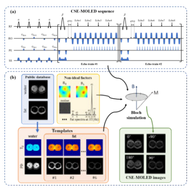


Fast water/fat T2 and PDFF mapping via multiple overlapping-echo acquisition and deep learning reconstruction

Qing Lin[1], Weikun Chen[1], Taishan Kang[2], Xinran Chen[1], Liangjie Lin[3], Zhong Chen[1], Shuhui Cai[1], and Congbo Cai[1]

[1]Xiamen University, Xiamen, China, [2]Magnetic Resonance Center, Zhongshan Hospital Afflicated to Xiamen University, Xiamen, China, [3]Clinical & Technical Support, Philips Healthcare, Beijing, China

Keywords: Quantitative Imaging, Fat, T2 mapping

Motivation: Skeletal muscle inflammation/necrosis and fat infiltration are strong indicators of disease activity and progression in many neuromuscular disorders. They can be assessed by muscle T_2 relaxometry and water-fat separation techniques, respectively.

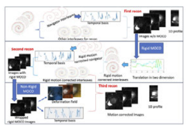
Goal(s): Develop a method for simultaneous water-fat separation and T_2 quantification.

Approach: The chemical-shift encoding multiple overlapping-echo detachment (CSE-MOLED) sequence was designed for MRI data acquisition, and synthetic data and deep learning were used for image reconstruction.

Results: The experiments showed that accurate T_2 maps of water and fat and proton density fat fraction maps (PDFF) can be fast and simultaneously acquired by CSE-MOLED.

Impact: A new MRI method is proposed for fast and simultaneous T_2 and PDFF mapping, which may help improve the clinical diagnosis of neuromuscular diseases.

0271 16:12



Motion-Corrected Subspace Navigator Reconstruction for High Resolution Spiral First-pass Myocardial Perfusion Imaging at 3 Tesla

Quan Chen[1], Junyu Wang[1], Xitong Wang[1], Shen Zhao[1], Sizhuo Liu[1], and Michael Salerno[1]

[1]Cardiovascular medicine, Stanford University, Palo Alto, CA, United States

Keywords: Myocardium, Cardiovascular, Myocardial Perfusion Imaging

Motivation: As perfusion images are typically acquired over 60 heart beats, respiratory motion is unavoidable. Motion compromises spatio-temporal reconstructions.

Goal(s): Residual undersampling artifacts and contrast variation make deformation field estimation challenging. This work aims to get an accurate deformation field from the auxiliary reconstruction and incorporate it into the forward reconstruction model to improve perfusion images.

Approach: To obtain high-quality images for motion estimation, the fixed-angle spiral navigator is used to extract temporal basis. The rigid and non-rigid motion corrections are jointly incorporated into the subspace reconstruction.

Results: Motion-corrected whole-heart first-pass spiral myocardial perfusion imaging with a high resolution of 1.3 mm^2 is achieved.

Impact: The proposed navigator-guided subspace motion correction reconstruction pipeline substantially improves the image quality, sharpness, and alignment of the 1.3mm² high-resolution spiral myocardial perfusion imaging, benefiting voxel-wise perfusion quantification crucial for assessing ischemic heart disease.

0272 16:24

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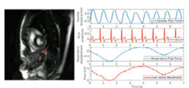

Cardiac and respiratory motion extraction at 0.55T with high-amplitude Pilot Tone

Bilal Tasdelen[1], Ecrin Yagiz[1], Ye Tian[1], and Krishna S Nayak[1]

[1]Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States

Keywords: Motion Correction, New Devices, Pilot Tone, Low Field

Motivation: With Pilot Tone, it is challenging to extract weak modulations, specifically those related to cardiac motion, at lower B0 field strengths (<1.5T).

Goal(s): To enable the use of cardiac Pilot Tone at low-fields (0.55T).

Approach: We utilize high-amplitude pilot tone transmission in conjunction with interference mitigation to eliminate ensuing image artifacts.

Results: We demonstrate robust extraction of cardiac pilot-tone signals at 0.55T. We demonstrate ability to track motion with real-time MRI, and demonstrate the ability to separate cardiac and respiratory phases with retrospective binning. Compared to ECG, the measured timing standard deviation was 36ms for Cartesian and 47ms for spiral acquisitions.

Impact: This work makes it possible to extract cardiac motion from Pilot Tone at 0.55T, which was not possible before. Pilot Tone could potentially replace ECG gating, simplify the clinical workflow, and serve for scanners that do not employ ECG.

0273 16:36

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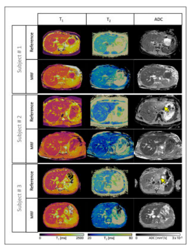


Liver T1, T2 and ADC Magnetic Resonance Fingerprinting in a single breath-hold

Carlos Velasco[1], Carlos Castillo-Passi[1,2,3], Nadia Chaher[1], Alkystis Phinikaridou[1], René M. Botnar[1,2,3,4], and Claudia Prieto[1,3,4]

[1]*School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom,* [2]*Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile,* [3]*Millennium Institute for Intelligent Healthcare Engineering (iHEALTH), Pontificia Universidad Católica de Chile, Santiago, Chile,* [4]*School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile*

Keywords: MR Fingerprinting, MR Fingerprinting

Motivation: Single breath-hold simultaneous T1, T2 and ADC abdominal Magnetic Resonance Fingerprinting (MRF) in liver would allow for fast and comprehensive liver tissue characterization.

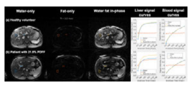
Goal(s): To develop a fast MRF sequence for T1, T2 and ADC quantification on liver tissue in a single breath-hold at 3T

Approach: Radial spoiled-GRE ~16-second acquisition with magnetization preparation modules for T1, T2 and ADC encoding was proposed, with an optimized diffusion-preparation module. Sequence was evaluated in phantoms and in 11 healthy subjects.

Results: T1, T2 and ADC quantification shows good correlation with reference maps in phantoms and good agreement in vivo against clinical scans.

Impact: Simultaneous quantification of T1, T2 and ADC in liver tissue in a single-scan is now possible with this proposed MRF sequence, allowing for a more comprehensive evaluation of hepatic disease through co-registered multiparametric imaging.

0274 16:48



Robust water-only liver T1 mapping with Look-Locker spiral out-in-out-in imaging at 0.55T

Ye Tian[1], Bilal Tasdelen[1], Liyun Yuan[2], and Krishna S. Nayak[1]

[1]*Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States,* [2]*Clinical Medicine, University of Southern California, Los Angeles, CA, United States*

Keywords: Quantitative Imaging, Low-Field MRI, liver

Motivation: Evaluation of patients with fatty liver disease can benefit from low-field scanners due to their larger bore size and reduced cost. However, fat is a cofounding factor for liver T1 mapping, and there is currently no reliable water-only T1 mapping method for low B0 field strengths.

Goal(s): To develop a practical water-only liver T1 mapping method at 0.55T.

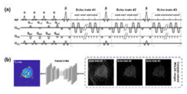
Approach: Inversion recovery preparation combined with a 3-echo bSSFP spiral out-in-out-in (**OIOI**) readout was used to obtain water/fat separated images and quantify water-only T1.

Results: The proposed water-only T1 mapping method is insensitive to liver PDFF, compared to Cartesian MOLLI and water-fat in-phase T1 values.

Impact: For patients with fatty liver disease, this new method provides reliable water-only T1 mapping at low field strength (0.55T). This method may be incorporated into clinical protocols as an indicator of liver inflammation, fibrosis, and stiffness.

0275 MERIT AWARD MAGNA CUM LAUDE

17:00



Robust measurement of T2 relaxation time in the developing fetal brain using ultrafast MOLED technique

Nuowei Ge[1], Qinqin Yang[1], Jianfeng Bao[2], Zhigang Wu[3], Jianhui Zhong[4], Congbo Cai[1], and Shuhui Cai[1]

[1]Department of Electronic Science, Xiamen University, Xiamen, China, [2]Department of Magnetic Resonance Imaging, The First Affiliated Hospital of Zhengzhou University, Zhengzhou University, Zhengzhou, China, [3]Clinical & Technical Solutions, Philips Healthcare, Shenzhen, China, [4]Department of Imaging Sciences, University of Rochester, Rochester, NY, United States

Keywords: Quantitative Imaging, Relaxometry, Fetal Brain, T2 mapping

Motivation: Unpredictable and intense motion poses serious challenges to quantitative imaging of the fetal brain.

Goal(s): To evaluate the value of single-shot multiple overlapping-echo detachment acquisition (MOLED) imaging technique in accurately T_2 mapping the developing fetal brain.

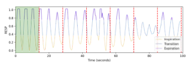
Approach: Single-shot MOLED imaging was utilized for motion-robust T_2 mapping in the developing fetal brain. The method was tested on phantom and in vivo, and a scan-rescan assessment was performed on nine fetuses.

Results: MOLED T_2 mapping strongly agreed with single-echo spin echo T_2 (r = 0.996 in phantom). The median intra-subject coefficient of variation of T_2 values between scan-rescan tests across the nine subjects is 1.385%.

Impact: MOLED is a motion-robust, accurate, and repeatable method for T_2 mapping of the whole developing fetal brain in only a few seconds. This method makes it feasible to use T_2 maps to quantify early myelination in the fetal brain.

0276 MERIT AWARD MAGNA CUM LAUDE

17:12



Adaptive Real-time Control and Online Reconstruction of Free-Breathing Abdominal MRF

Andrew Dupuis[1], Yong Chen[2], Madison E Kretzler[2], Kelvin Chow[3], Xinzhou Li[4], Mark A Griswold[1,2], and Rasim Boyacioglu[2]

[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, School of Medicine, Case Western Reserve University, Cleveland, OH, United States, [3]Siemens Healthcare Ltd, Calgary, AB, Canada, [4]Siemens Medical Solution, USA, St. Louis, MO, United States

Keywords: MR Fingerprinting, MR Fingerprinting, Liver, Respiratory Motion, Scanner Feedback

Motivation: Abdominal MRF can require long breath-holds. Free-breathing MRF with retrospective binning and offline reconstruction does not guarantee adequate map quality.

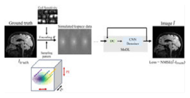
Goal(s): Develop a self-binning, self-terminating MRF sequence for free-breathing abdominal imaging, providing real-time adjustments to the acquisition for improved image quality.

Approach: The proposed MRF sequence monitors respiratory states in real-time, adapts or extends the acquisition based on reconstruction feedback, and performs iterative conjugate gradient reconstruction online.

Results: The free-breathing approach shows promising results mitigating motion artifacts, producing similar maps to conventional breath-hold results. Sequence termination commands are processed within 0.55 seconds, while reconstruction is completed within 22 seconds.

Impact: This work enables free-breathing abdominal MRF scans with real-time control and online reconstruction. This approach potentially allows for shorter scans with improved map quality without breath-holds. New strategies for real-time control and adaptive MRF imaging can now be investigated.

0277 17:24



Fast 3D Neuro T2-FLAIR with Learned Sampling and fully 3D Model Based Deep learning

Chenwei Tang[1], Leonardo A Rivera-Rivera[1,2], Laura B Eisenmenger[3], and Kevin M Johnson[1,3]

[1]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Medicine, University of Wisconsin-Madison, Madison, WI, United States, [3]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States

Keywords: White Matter, Brain

Motivation: T2-FLAIR is an essential contrast for clinical neuroimaging. However, the inherently long scan time limits its application in screening.

Goal(s): We aim to accelerate 3D T2-FLAIR scan while maintaining sufficient image quality.

Approach: We developed a framework that simultaneously learns a sampling pattern and a fully 3D deep learning reconstruction neural network. This allows exploiting the optimization space in both sampling and reconstruction.

Results: Learned sampling pattern with MoDL reconstruction trained with added Gaussian noise was able to provide high quality T2-FLAIR scan with 1x1x1.6mm resolution in 1 min 39s.

Impact: This work confirms the feasibility of a short 3D T2-FLAIR scan, provides insights for optimization strategies, and could lead to clinical implementation.

0278 17:36

Navigator-gated Simultaneous Multi-Slice STEAM Diffusion Tensor Cardiac Magnetic Resonance

Ke Wen[1,2], Pedro Ferreira[1,2], Eun Ji Lim[1,2], Camila Munoz-Escobar[1,2], Radhouene Neji[3], Karl Kunze[4], Dudley Pennell[1,2], Andrew Scott[1,2], and Sonia Nielles-Vallespin[1,2]

[1]National Heart and Lung Institute, Imperial College London, London, United Kingdom, [2]CMR Unit, The Royal Brompton Hospital, London, United Kingdom, [3]Biomedical Engineering, King's College London, London, United Kingdom, [4]Siemens Healthineers, London, United Kingdom

Keywords: Data Acquisition, Diffusion Tensor Imaging, Simultaneous Multi-Slice; Navigator-gated Acqusition

Motivation: Low scanning efficiency of stimulated echo acquisition mode (STEAM) diffusion tensor cardiac magnetic resonance images (DT-CMR) limits its clinical translation.

Goal(s): We aimed to improve the slice coverage efficiency of DT-CMR utilizing simultaneous multi-slice (SMS) techniques.

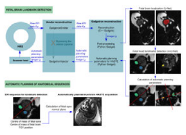
Approach: The navigator-gated (Nav) SMS STEAM acquisition, integrated with a biofeedback system, was introduced, enabling controlled breathing and respiratory motion compensation.

Results: Nav SMS STEAM acquisition reduced scanning time by 46±6% compared to single-band (SB) acquisition. No significant difference in global mean MD and FA was observed, but a lower median |E2A| was noted for the SMS basal slice.

Impact: Our proposed Nav SMS STEAM acquisition would reduce the total breath-hold duration of STEAM DT-CMR acquisitions, enhancing clinical feasibility. Improved efficiency could also lead to whole heart coverage in DT-CMR scans, essential for example, in myocardial infarction.

0279 17:48

Automatic planning of T2-weighted fetal scans at 0.55T using fetal brain landmark detection



Sara Neves Silva[1,2], Jordina Aviles Verdera[1,2], Sarah McElroy[1,3], Kathleen Colford[1,2], Michela Cleri[2,4], Valéry Ozenne[5], Megan Hall[1,6], Lisa Story[1,6], Mary Rutherford[1,2], Kuberan Pushparajah[2], Jo Hajnal[1,2], and Jana Hutter[1,2]

[1]Centre for the Developing Brain, School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom, [2]Biomedical Engineering Department, School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom, [3]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [4]London Collaborative Ultra High Field System (LoCUS), King's College London, London, United Kingdom, [5]CNRS, CRMSB, UMR 5536, IHU Liryc, Université de Bordeaux, Bordeaux, France, [6]Department of Women & Children's Health, King's College London, London, United Kingdom

Keywords: Data Acquisition, Data Acquisition, Fetal

Motivation: Fetal MRI plays an important role in clinical and research settings. The variability of the fetal position and extensive fetal motion, however, create challenges limiting the use of fetal MRI mainly to specialist centres.

Goal(s): Real-time fully automatic planning of true radiological fetal brain planes for anatomical TSE scans.

Approach: Deep-learning based detection of key landmarks in the fetal brain on a whole-uterus EPI scan enables the subsequent automatic calculation of the radiological plane for the TSE scan.

Results: Prospective results on three fetal MRI scans on a clinical low-field 0.55T MRI scanner illustrate the ability of the framework to perform diagnostic planning.

Impact: Fully automated planning of radiological planes for low-field fetal MRI demonstrates time efficiency and carries the potential to significantly widen accessibility to fetal MRI beyond specialist centres.

Oral

New Horizons in Cardiac MRI for Structural, Valvular & Congenital Heart Disease

Nicoll 3 Monday 16:00 - 18:00 *Moderators:* Jeremy Collins

16:00

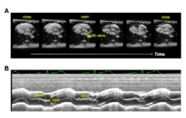
Introduction

Jeremy Collins

Mayo Clinic, Rochester, MN, United States

0280 16:12

Accuracy of Measuring Opening and Closing Characteristics of the Aortic Valve with SPEEDI MRI



Qingfei Luo[1], Yosman Dhar[1,2], Alessandro Scotti[1], and Xiaohong Joe Zhou[1,3]

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Keywords: Valves, Valves, SPEEDI, sub-millisecond, high temporal resolution

Motivation: get-SPEEDI, a recently published pulse sequence, offers a promising MRI technique for imaging the rapid dynamics of the aortic valve (AV) opening and closing with sub-millisecond temporal resolution.

Goal(s): This study aims to assess the accuracy of measuring the AV dynamics with get-SPEEDI by comparing its performance with transthoracic ultrasound, which is the gold standard clinically.

Approach: Ultrasound echocardiograms and get-SPEEDI MR images of AV were acquired in healthy human subjects with 0.6- and 0.8-ms temporal resolution, respectively.

Results: There were no statistically significant differences between get-SPEEDI and ultrasound in the measurements of AV opening and closing dynamics and the maximum AV area.

Impact: The dynamic characteristics of the aortic valve measured with get-SPEEDI MRI agree well with the ultrasound measurements. get-SPEEDI MRI provides a new imaging tool for diagnosis of aortic valve diseases.

0281 16:24

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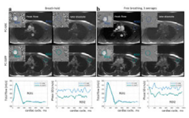

<u>bSSFP Phase Contrast (PC-SSFP) at 0.55T for Aortic Flow</u>

Jie Xiang[1], Rajiv Ramasawmy[2], Felicia Seemann[2], Dana C. Peters[1,3], and Adrienne E. Campbell-Washburn[2]

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Keywords: Flow, Low-Field MRI

Motivation: Aortic flow imaging at 0.55T has limited SNR, especially in diastolic phases, which can limit the accuracy of flow and regurgitant fraction measurements.

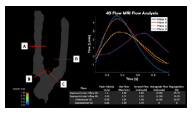
Goal(s): Our goal was to improve the SNR of phase contrast images at 0.55T using a bSSFP readout and maintain accurate flow quantification.

Approach: We developed a through-plane phase contrast sequence with bSSFP readout and tested it in phantoms and healthy volunteers.

Results: Significantly improved SNR (25.5±9.6 vs 8.2±2.9, p<0.001) and accuracy of velocities measurement were demonstrated in phantom. Accurate flow and constant high SNR were measured using our method in 8 subjects, for both breath-hold and free-breathing cases.

Impact: Our proposed phase contrast with bSSFP readout can reliably evaluate aortic flow at 0.55T with higher SNR and VNR leading to more accurate quantification compared to conventional GRE based phase contrast method.

0282 16:36



<u>Ex-vivo 4D Flow MRI for Evaluation of Aortic Valve Pathologies in a Mock Circulatory System</u>

Leah M Gober[1], James Rice[2], Michael Stellon[1], and Alejandro Roldán-Alzate [2,3]

[1]Surgery, University of Wisconsin-Madison, Madison, WI, United States, [2]Mechanical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States

Keywords: Valves, Velocity & Flow

Motivation: The Ross Procedure is a complex cardiac surgery that utilizes the pulmonary valve to replace a diseased aortic valve. More work is needed to improve preoperative candidacy.

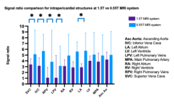
Goal(s): To develop and validate an ex-vivo model of the aortic valve in combination with a mock circulatory system.

Approach: The left ventricle was mounted on a circulatory loop with preservation of aortic valve anatomy and application of hemodynamic flow to assess valve characteristics.

Results: A successful system was built and 4D Flow MRI performed with resultant functional quantification and representative curves mimicking ventricular inflow and aortic outflow.

Impact: 4D Flow MRI, in combination with an ex-vivo left ventricular mock circulatory system, provides a method to study aortic flow and assess valvular abnormalities or preoperative candidacy in cardiac surgery.

0283 16:48



[Accelerated free-breathing 3D simultaneous Bright and black-blood Whole-Heart Imaging at 0.55T: Comparison to 1.5T.]

Anastasia Fotaki[1,2], Carlos Castillo-Passi[1,3,4], Michael G. Crabb[1], Karl K Kunze[1,5], Kuberan Pushparajah[1], and Rene Botnar[1,3,6,7,8]

[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, UK, London, United Kingdom, [2]Royal Brompton Hospital, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, [3]Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, Santiago, Chile, [4]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, Santiago, Chile, [5]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, Camberley, United Kingdom, [6]Escuela de Ingeniería, Pontificia Universidad Católica de Chile, Santiago, Chile, Santiago, Chile, [7]Millennium Institute for Intelligent Healthcare Engineering, Chile, Santiago, Chile, [8]Technical University of Munich, Germany; Institute of Advanced Study, Munich, Germany, Santiago, Chile

Keywords: Vessel Wall, Low-Field MRI, bright- and black-blood whole heart, vessel lumen,vessel wall

Motivation: Bright-blood and black-blood MRI is fundamental for the comprehensive assessment of cardiac disease.Low field MRI promises high quality imaging at lower cost and improved patient accessibility.3D bright-blood and black-blood whole-heart imaging applications at low-field are limited.

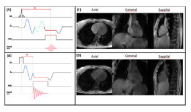
Goal(s): To implement and evaluate the diagnostic quality of a novel framework for simultaneous 3D whole-heart bright-and black-blood(BOOST) imaging at 0.55T.

Approach: 3D whole-heart BOOST including image-based navigation, motion corrected reconstruction and patch-based denoising was evaluated at 0.55T.Diagnostic capabilities of 3D BOOST was evaluated versus its counterpart at 1.5T.

Results: 3D whole-heart BOOST at 0.55T offers good quality imaging, that is comparable to its counterpart at 1.5T.

Impact: This study demonstrates that high-quality bright- and black-blood 3D whole-heart imaging can be achieved at 0.55T CMR, showing comparable image and diagnostic quality to the current clinical standard in both healthy subjects and clinical patients.

0284 17:00



[Initial demonstration of free-running whole-heart radial 4D flow using ultra-short echo times (UTE)]

Efena Akporeha[1], Robin Ferincz[1], Tobias Rutz[2], Giulia M.C. Rossi[1], Mariana B.L. Falcao[1], Isabel Montón Quesada[1], Jérôme Yerly[1], Ruud B. van Heeswijk[1], Milan Prsa[3], Michael Markl[4,5], Matthias Stuber[1,6], and Christopher W Roy[1]

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Keywords: Flow, Heart, Whole-heart, UTE, Congenital Heart Disease

Motivation: Free-running phase-contrast whole-heart MRI, despite its ease of use and efficiency may suffer from artifacts and inaccuracy in the presence of non-laminar flow and high velocities due to prolonged echo times.

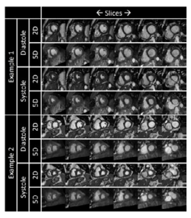
Goal(s): Our goal was to reduce the echo time in free-running radial 4D flow (radial 4D flow).

Approach: We incorporated ultra-short echo time (UTE) imaging techniques into our radial 4D flow framework.

Results: Net flow and peak flow measurements that correlate well with reference values were obtained in a cohort of healthy volunteers with the modified sequence and enabled qualitative evaluation of turbulent flow in patients with congenital heart disease.

Impact: The combination of UTE and radial 4D flow MRI marks a step towards a more precise and robust quantification of hemodynamics under complex conditions, in an effort to improve both diagnosis and patient outcomes.

0285 17:12 [Free-running 5D whole-heart MRI using a Gadolinium enhanced Fast-Interrupted Steady-State sequence to evaluate congenital heart disease]



Christopher W Roy[1], Tobias Rutz[2], Milan Prša[3], Ludovica Romanin[1,4], Jerome Yerly[1,5], Juerg Schwitter[2,6], Jessica AM Bastiaansen[7,8], and Matthias Stuber[1,5]

[1]Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Service of Cardiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [3]Division of Pediatric Cardiology, Mother-Woman-Child Department, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [4]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland, [5]Center for Bio-medical Imaging (CIBM), Lausanne, Switzerland, [6]Cardiac MR Center, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [7]Diagnostic, Interventional and Pediatric Radiology (DIPR), Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland, [8]Translational Imaging Center (TIC), Swiss Institute for Translational and Entrepreneurial Medicine, Bern, Switzerland

Keywords: Myocardium, Cardiovascular, Congenital heart disease, Free-running, whole-heart

Motivation: There is a need for simplified and time-efficient dynamic whole-heart imaging in the evaluation of congenital heart disease patients.

Goal(s): To demonstrate the feasibility of Gadolinium enhanced 5D FISS CMR and compare it to established 2D and 3D CMR methods in a cohort of congenital heart disease patients.

Approach: Ejection fraction and vessel sharpness measurements derived from established 2D and 3D CMR are quantitatively compared to those obtained from the proposed 5D sequence.

Results: 5D FISS CMR is feasible for the evaluation of cardiac function and anatomy building towards an easy-to-use and time-efficient method for evaluating congenital heart disease.

Impact: Free-running 5D whole-heart MRI using a Gadolinium enhanced FISS sequence enables both measurements of cardiac function and evaluation of morphology in patients with congenital heart disease with a fixed six-minute scan time.

0286 17:24 [Cardiovascular MRI study of the relationship between right ventricular function and biventricular shape in repaired tetralogy of Fallot]

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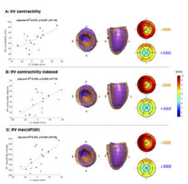


Maria Gusseva[1], Tarique Hussain[1], Thomas Pickardt[2], Philipp Beerbaum[2,3], Samir Sarikouch[2,4], Heiner Latus[5], Gerald Greil[1], Radomir Chabiniok[1], Dominque Chapelle[6,7], and Pablo Lamata[8]

[1]Pediatrics, University of Texas Southwestern Medical Center, Dallas, TX, United States, [2]German Competence Network for Congenital Heart Defects, Berlin, Germany, [3]Department for Paediatric Cardiology and Paediatric Intensive Care Medicine, Hannover Medical School, Hannover, Germany, [4]Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, Hannover, Germany, [5]Department of Paediatric Cardiology and Congenital Heart Defects, German Heart Centre Munich, Munich, Germany, [6]Inria, Palaiseau, France, [7]Ecole Polytechnique, CNRS, Palaiseau, France, [8]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom

Keywords: Myocardium, Cardiovascular, Statistical shape modeling, biomechanical modeling, myocardial contractility, biventricular interaction, biomarkers

Motivation: In patients with repaired tetralogy of Fallot prolonged exposure to the right ventricular (RV) pressure and/or volume overload can affect the function of both RV and left ventricle (LV).

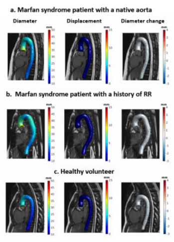
Goal(s): We aimed to investigate the link between RV function and RV and LV shape variation.

Approach: We combined biomechanical modeling (i.e., provides RV contractility) with statistical shape modeling to quantify function and shape interaction.

Results: Higher values of RV contractility were associated with a compressed LV cavity with associated septal flattening. No meaningful relationship was identified between RV function and RV endocardial shape.

Impact: The link between anatomy and function can be studied with unprecedented detail in rTOF by combining biomechanical and statistical modeling frameworks from MRI. Such an approach facilitates the discovery of new disease mechanisms.

0287 17:36



[Differences in 4D aortic motion derived from 3T bSSFP CMR between Marfan syndrome patients and healthy volunteers]

Daan Bosshardt[1,2,3], Renske Merton[1,2], Aart Nederveen[1,2], Danielle Robbers-Visser[3], Roland van Kimmenade[4], Moniek Cox[5], Eric Schrauben[1], Maarten Groenink[3], and Pim van Ooij[1,2]

[1]Radiology and Nuclear medicine, Amsterdam University Medical Centers, Amsterdam, Netherlands, [2]Amsterdam Cardiovascular Sciences, Amsterdam, Netherlands, [3]Cardiology, Amsterdam University Medical Centers, Amsterdam, Netherlands, [4]Cardiology, Radboud University Medical Center, Nijmegen, Netherlands, [5]University Medical Center Groningen, Groningen, Netherlands

Keywords: Vascular, Blood vessels, Marfan

Motivation: New biomarkers are needed to guide aortic surgery to prevent aortic dissection in Marfan syndrome (MFS).

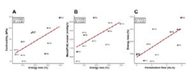
Goal(s): To investigate differences in aortic motion between healthy volunteers and (subgroups of) MFS patients.

Approach: We apply a recently published novel non-contrast enhanced, free breathing, time-resolved 3D balanced steady free precession CMR scan with a machine learning based algorithm for automatic aortic segmentations to evaluate 4D aortic motion.

Results: We found significant differences in aortic motion between patients with- and without a history of aortic root surgery and healthy volunteers. Thus, aortic motion might be a novel marker for aortic disease severity in MFS.

Impact: The differences in 4D aortic motion measured using 3D CINE balanced steady state free precession CMR between healthy volunteers and (subgroups of) Marfan syndrome patients might provide a new marker for disease severity in Marfan syndrome.

0288 17:48



[Interventional Cardiac MR (iCMR)-based Myocardial Mechanics and Circulatory Flow Dynamics in Patients with Fontan Circulation]

Hamza Dahshi[1], Surendranath Veeram Reddy[1], Abhay Divekar[1], Mohammad Tarique Hussain[1], and Maria Gusseva[1]

[1]Pediatrics, UT Southwestern Medical Center, Dallas, TX, United States

Keywords: Heart Failure, Modelling, Congenital Heart Disease

Motivation: The complexity of Fontan palliation in single-ventricle physiology prompts the need to understand the associated cardiovascular adaptations and their impact on ventricular function.

Goal(s): The research aims to quantify the relationship between single-ventricle contractile function and flow dynamic efficiency within the total cavopulmonary connection.

Approach: Utilizing Interventional Cardiac MR and a biomechanical heart model, this study analysed hemodynamic data from 11 post-Fontan procedure patients, correlating myocardial contractility with energy loss (EL) and clinical metrics.

Results: The analysis showed that EL significantly predicts myocardial contractility and the max(dP/dt), offering insights into the mechanical implications of Fontan circulation, with potential applications in patient-specific intervention strategies.

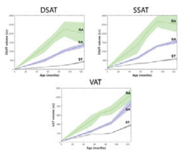
Impact: This study exemplifies the integration of patient-specific biomechanical modelling with clinical cardiac MRI and hemodynamic data to understand Fontan circulation, potentially providing a quantitative framework for personalized treatment strategies and improving the cardiovascular health of patients with congenital heart disease.

Oral

Pediatric Body & Lung Imaging

Room 331-332 | Monday 16:00 - 18:00 | *Moderators:* Jonathan Dyke & Mary-Louise Greer

0289 16:00



Trajectories of abdominal subcutaneous and visceral adipose tissue accumulation and cardiometabolic health in children: The GUSTO study

Suresh Anand Sadananthan[1], Varsha Gupta[1,2], Yeshe Manuel Kway[1,3], Kashthuri Thirumurugan[1], Mya Thway Tint[1], Navin Michael[1], Fabian Kok Peng Yap[4,5,6], Kok Hian Tan[5,7], Keith M Godfrey[8], Peter D Gluckman[1,9], Yap Seng Chong[1,10], Dennis Wang[1,11,12,13], Yung Seng Lee[1,14,15], Marielle V Fortier[1,16], Johan G Eriksson[1,10,17,18,19], and S. Sendhil Velan[1,3,17,20]

*[1]Singapore Institute for Clinical Sciences, A*STAR, Singapore, Singapore, [2]Bioinformatics Institute, A*STAR, Singapore, Singapore, [3]Department of Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [4]Department of Pediatric Endocrinology, KK Women's and Children's Hospital, Singapore, Singapore, [5]Duke-National University of Singapore Graduate Medical School, Singapore, Singapore, [6]Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, Singapore, [7]Department of Maternal Fetal Medicine, KK Women's and Children's Hospital, Singapore, Singapore, [8]MRC Lifecourse Epidemiology Centre & NIHR Southampton Biomedical Research Centre, University of Southampton & University Hospital Southampton NHS Foundation Trust, Southampton, United Kingdom, [9]Centre for Human Evolution, Adaptation and Disease, Liggins Institute, University of Auckland, Auckland, New Zealand, [10]Department of Obstetrics and Gynaecology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [11]Sheffield Institute for Translational Neuroscience, University of Sheffield, Sheffield, United Kingdom, [12]Department of Computer Science, University of Sheffield, Sheffield, United Kingdom, [13]National Heart and Lung Institute, Imperial College London, London, United Kingdom, [14]Department of Paediatrics, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, Singapore, [15]Department of Paediatrics, Khoo Teck Puat-National University Children's Medical Institute, National University Health System, Singapore, Singapore, [16]Department of Diagnostic and Interventional Imaging, KK Women's and Children's Hospital, Singapore, Singapore, [17]Human Potential Translational Research Programme, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [18]Department of General Practice and Primary Health Care, University of Helsinki and Helsinki University Hospital, Helsinki, Finland, [19]Folkhälsan Research Center, Helsinki, Finland, [20]Department of Physiology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore*

Keywords: Body, Body, Pediatrics, abdominal adipose tissue, subcutaneous and visceral fat, insulin resistance

Motivation: Unravel the links between childhood abdominal fat distribution patterns and subsequent cardiometabolic risks aiming to provide effective strategies for preventing childhood obesity.

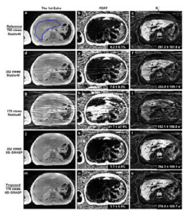
Goal(s): To investigate the presence of distinct abdominal fat accumulation patterns during infancy and childhood in a multi-ethnic cohort, and their associations with cardiometabolic risk.

Approach: Latent class growth mixture modeling was used to identify three trajectories (stable, slow acceleration, rapid acceleration) for deep subcutaneous (DSAT), superficial subcutaneous (SSAT), and visceral adipose tissues (VAT).

Results: Compared to Chinese children, Indian children had higher odds of being in the rapid acceleration trajectory. All accelerated trajectories were associated with inflammatory marker, hsCRP.

Impact: This research has the potential to impact public health by providing evidence-based insights into the relationships between abdominal fat distribution patterns and cardiometabolic health. Our findings may aid development of targeted interventions and strategies to mitigate long-term adverse cardiometabolic consequences.

0290 16:12 [Accelerated Free-Breathing Liver Fat/R2* Quantification in Pediatrics Using XD-GRASP Multi-Echo Stack-of-Radial MRI: A Retrospective Study]



Xiaodong Zhong[1], Aaryani Tipirneni-Sajja[2], Marcel Nickel[3], Cara Morin[4], Zachary Abramson[5], Fei Han[6], Vibhas Deshpande[7], and Stephan Kannengiesser[3]

[1]Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States, [2]Biomedical Engineering, University of Memphis, Memphis, TN, United States, [3]MR Application Predevelopment, Siemens Healthineers AG, Erlangen, Germany, [4]Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [5]Diagnostic Imaging, St. Jude Children's Research Hospital, Memphis, TN, United States, [6]MR R&D Collaborations, Siemens Medical Solutions USA, Inc, Los Angeles, CA, United States, [7]MR R&D Collaborations, Siemens Medical Solutions USA, Inc, Austin, TX, United States

Keywords: Body, Liver, Fat and iron quantification

Motivation: Free-breathing liver fat and iron quantification is of growing interest in pediatric patients. However, motion compensation is necessary for quantification accuracy, resulting in prolonged acquisition times.

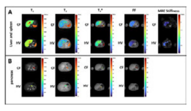
Goal(s): This study was to retrospectively evaluate a newly developed technique with XD-GRASP reconstruction in pediatric patients.

Approach: Data with oversampled k-space radial views were undersampled to fewer radial views. All data were reconstructed and compared between a self-gating method and the proposed XD-GRASP method.

Results: When applied to data with undersampled radial views, the proposed XD-GRASP method reduced image artifacts and improved PDFF and R_2^* results compared to the self-gating method.

Impact: The proposed multi-echo stack-of-radial MRI method using motion-resolved reconstruction and multi-dimensional regularization may allow accelerated free-breathing liver PDFF and R_2^* mapping in pediatric patients.

0291 16:24 [Multiorgan quantitative abdominal MRI in paediatric patients with Cystic Fibrosis]



Chris R Bradley[1,2], Alex Yule[2,3], Nayan Dey[2,3], Christabella Ng[2,3], Naaventhan Palaniyappan[2,4], Zachary Peggs[1,2], Jonathan Brooke[2,4], Neele Dellschaft[1,2], Luca Marciani[1,2], Robin Spiller[2,4], Guruprasad Aithal[2,3], Caroline Hoad[1,2], Penny A Gowland[1,2], Ian Hall[2,3], Alan Smyth[2,3], Susan T Francis[1,2], and Andrew Prayle[2,3]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Nottingham Biomedical Research Centre, Nottingham, United Kingdom, [3]Population and Lifespan Sciences, University of Nottingham, Nottingham, United Kingdom, [4]Translational Medical Sciences, University of Nottingham, Nottingham, United Kingdom

Keywords: Body, Pediatric, liver, pancreas, spleen

Motivation: Cystic fibrosis (CF) is a multi-system, life-limiting genetic disorder. There is a need for multiorgan assessment in children with CF and the response to modulator therapies.

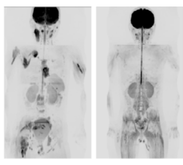
Goal(s): To perform multiorgan MRI in children to quantify lung, liver, pancreas, spleen, and gut function.

Approach: 8 children with CF and 3 healthy volunteers (HV) performed the protocol including quantitative assessment (T_1, T_2, T_2*, fat fraction (FF), stiffness) of liver, pancreas and spleen.

Results: Increased pancreas FF, T_1 and T_2, spleen T_1 and hepatic arterial velocity in CF compared to HVs. Increased liver T_1, T_2 and stiffness in a CF child independently diagnosed with liver disease.

Impact: This protocol will be used to study the effect of the Cystic Fibrosis Transmembrane Regulator Modulator therapy in children on liver toxicity, pancreas and gut function, and lung health, by performing MRI before and 12 months after commencement of Kaftrio.

0292 16:36



Abbreviated Whole-Body MRI as a Novel Imaging Modality for Pediatric Lymphoma Follow-Up: A Multicenter study

Dongqiu Shan[1], Bingjie Zheng[1], and Yue Wu[1]

[1]*The Affiliated Hospital of Zhengzhou University, Zhengzhou, China*

Keywords: Adolescents, Whole Body

Motivation: Our study is motivated by the need to assess abbreviated whole-body MR for evaluating treatment response in pediatric patients with lymphoma.

Goal(s): To evaluate the diagnostic efficacy and reproducibility of a novel abbreviated whole-body MRI (WB-MRI) for response assessment in pediatric patients with lymphoma.

Approach: We conducted a multicenter prospective study included pediatric patients underwent both PET/CT and abbreviated WB-MRI at baseline and during follow-up.

Results: The image quality of abbreviated WB-MRI was rated good or excellent, with high sensitivity and accuracy.

Impact: Abbreviated WB-MRI has the advantage of being non-invasive and without radiation exposure, making it an alternative to PET/CT for response surveillance in pediatric patients.

0293 16:48

Comparison of diagnostic image quality of a 24-channel pediatric screen-printed coil to commercially available coils in clinical body MR exams

Yingzhen Zhang[1], Surbhi Raichandani [1], and Ali B Syed[1]

[1]*Stanford University Department of Radiology, Palo Alto, CA, United States*

Keywords: Body, Pediatric

Motivation: To evaluate diagnostic image quality of novel 24-channel screen-printed flexible coil array in pediatric body MR at 3T

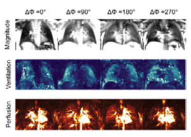
Goal(s): Whether the diagnostic image quality of novel 24-channel screen-printed flexible coil array in pediatric body MR at 3T is comparable to commercially available coils

Approach: Retrospective case-control study with pediatric patients who underwent clinical body MR exams using either screen-printed coils or commercial coils. A single radiologist reviewed image quality using anonymized randomized image stacks.

Results: A flexible screen-printed pediatric MRI receive coil yielded similar diagnostic image quality to commercial coils on body MRI exams performed in the clinical setting.

Impact: Screen-printed pediatric MRI receive coil yielded comparable diagnostic image quality to commercial coils on body MRI exams performed in the clinical setting on 3T scanners while offering the advantages of comfort, flexibility, and ease of use.

0294 17:00



Investigating Phase-Cycled bSSFP Imaging for Functional Lung Imaging in 2-Year-Olds After Congenital Diaphragmatic Hernia Repair

Efe Ilıcak[1,2], Safa Özdemir[1,2], and Frank Gerrit Zöllner[1,2]

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Keywords: Lung, Lung, Functional, Pulmonary, non-contrast-enhanced

Motivation: bSSFP-based non-contrast-enhanced imaging is a promising alternative for functional lung imaging in pediatric patients. However, bSSFP acquisitions suffer from magnetic field inhomogeneities.

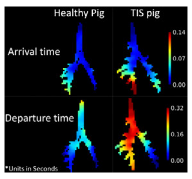
Goal(s): Our goal is to investigate phase-cycled bSSFP acquisitions as a robust alternative in pediatric functional lung imaging.

Approach: We acquired dynamic images using conventional and phase-cycled bSSFP acquisitions at 1.5T, from five 2-year-old patients after congenital diaphragmatic hernia repair. The images were non-rigid registered to a reference frame and functional maps were obtained using dynamic mode decomposition technique.

Results: We have successfully obtained functional maps in all patients and observed a trend toward improved ventilation map homogeneity using phase-cycled acquisitions.

Impact: Pulmonary functional maps obtained via non-contrast-enhanced bSSFP acquisitions may suffer from field inhomogeneity artifacts. Here, we investigate phase-cycled bSSFP imaging in 2-year-old congenital diaphragmatic hernia patients, and show improved robustness, which may be beneficial for lung function assessments.

0295 17:12 [Ventilation and Gas Exchange Delay maps in Pre-clinical Thoracic Insufficiency Syndrome Models using Dynamic Hyperpolarized-Xenon MRI]



Mostafa K. Ismail[1], Hooman Hamedani[1], Faraz Amzajerdian[1], Luis Loza[1], Madeleine Boyes[2], Klaus Hopster[2], Benjamin Sinder[2], Patrick Cahill[2], Brian Snyder[3], Thomas P. Schaer[2], Stephen Kadlecek[1], Kai Ruppert[1], and Rahim Rizi[1]

[1]University of Pennsylvania, Philadelphia, PA, United States, [2]Children's Hospital of Philadelphia, Philadelphia, PA, United States, [3]Boston Children's Hospital, Boston, MA, United States

Keywords: Hyperpolarized MR (Gas), MSK, Hyperpolarized MR (Gas), Dynamic Imaging, Pediatric, Signal Modeling, Skeletal, Preclinical, Lung, Flow, Analysis/Processing

Motivation: The pressing need to develop and evaluate novel treatments of thoracic insufficiency syndrome (TIS), a condition with significant implications for compromised pulmonary growth and function.

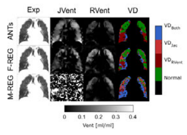
Goal(s): To gain deeper insights into the altered lung function associated with TIS, ultimately improving patient care and outcomes.

Approach: Dynamic hyperpolarized-xenon-129 MRI was used to assess ventilation and gas exchange dynamics in pre-clinical models of TIS.

Results: Significant ventilation and gas exchange delays were found in the TIS animals compared to the healthy ones.

Impact: Our findings hold the promise to improve TIS assessment and treatment monitoring by providing crucial insights into altered lung function. This study offers a valuable tool for clinicians/researchers, fostering improved patient care and stimulating further TIS management and intervention research.

0296 17:24 [Comparison of MR-Signal-based and Deformation-based Ventilation Measurement in Pediatric Patients with non-CF Bronchiectasis]



Andreas Voskrebenzev[1,2], Marcel Gutberlet[1,2], Filip Klimeš[1,2], Robin Müller[1,2], Marius Wernz[1,2], Martha Dohna[1], Diane Renz[1], Frank Wacker[1,2], and Jens Vogel-Claussen[1,2]

[1]Institute for Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Biomedical Research in Endstage and Obstructive Lung Disease Hannover (BREATH), Member of the German Center for Lung Research, Hannover, Germany

Keywords: Lung, Lung, Registration, Ventilation, Free-Breathing

Motivation: A previous study showed that MR-signal-based (RVent) and deformation-based approaches (JVent) for ventilation are theoretically equivalent, but result in different defects in a digital lung model. A verification of this finding using real data is pending.

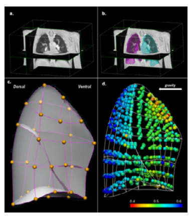
Goal(s): Test if both ventilation parameters result in significant differences on a global and regional level.

Approach: A retrospective analysis of 32 patients with non-CF Bronchiectasis was performed, calculating RVent, JVent and corresponding ventilation defects for three registration variants.

Results: There were significant differences and patterns on a global and regional level, which are consistent with the findings in the lung model study.

Impact: Inferior-superior gradient in deformation-based ventilation measurements might lead to a biased defect detection. Therefore, use of such parameters might require further correction and/or diligent registration optimization. Thus, signal-based ventilation with more stable performance across different registration variants might be benefical.

0297 17:36



[Feasibility of MRI-based lung tissue mechanics computational models of the paediatric lung]

Megan Soo[1], Haribalan Kumar[1,2,3], Daniel Cornfeld[3], Paul Condron[3,4], Taylor Emsden[3,4], Leigh Potter[3,5], Samantha Holdsworth[3,4], Merryn H. Tawhai[1], and Ho-Fung Chan[1,3]

[1]Auckland Bioengineering Institute, University of Auckland, Auckland, New Zealand, [2]GE Healthcare Australia and New Zealand, Auckland, New Zealand, [3]Mātai Medical Research Institute, Gisborne, New Zealand, [4]Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand, [5]Ngāti Porou, Ngāti Kahungungu, Rongomaiwahine, Rongowhakaata; Tūranganui-a-Kiwa, Tairāwhiti, New Zealand

Keywords: Lung, Lung

Motivation: There is a scarcity of personalised computational physiology models of the paediatric lung because most models have previously been derived for the adult lung from CT images.

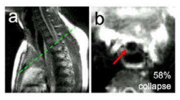
Goal(s): We aim to derive personalised computational models of the paediatric lung from novel structure-function lung MRI techniques.

Approach: In this feasibility study, lung ZTE MR images from healthy children were used to create finite element soft tissue deformation mechanics models.

Results: Simulations of regional supine lung tissue densities were shown to be similar to lung ZTE MRI densities, demonstrating the strong potential for developing computational paediatric lung models from MR images.

Impact: A computational physiology model of soft tissue deformation was created from lung ZTE MR images of healthy children, demonstrating the potential of using novel regional lung structure-function information for personalised paediatric computational models.

0298 17:48



[Real-Time Imaging of Lower Airway Collapse at 0.55T]

Sarina Kapai[1], Prakash Kumar[1], Ecrin Yagiz[1], Ye Tian[1], Roberta Kato[2], Marcus Chen[3], Marcela Ferrada[3], Adrienne Campbell-Washburn[3], and Krishna S Nayak[1]

[1]Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States, [2]Children's Hospital Los Angeles, Los Angeles, CA, United States, [3]National Institutes of Health, Bethesda, MD, United States

Keywords: Rare Disease, Low-Field MRI, Acquisition Methods, Data Acquisition, Pulse Sequence Design, Lower Airway, Tracheomalacia, Lung

Motivation: Tracheomalacia involves intermittent collapse of the lower airway and is difficult to diagnose. Currently, this condition is evaluated with invasive procedures like bronchoscopy or dynamic computer tomography (CT) which utilizes ionizing radiation.

Goal(s): To develop and optimize a high spatial and temporal resolution pulse sequence for evaluating tracheomalacia at 0.55T.

Approach: We optimize contrast (sequence, flip angle) for dynamic imaging in the lower airway for both 2D and SMS real-time imaging.

Results: Spiral acquisition achieves sufficient temporal resolution and the TrueFISP sequence (flip angle=32°) offers optimal contrast for imaging lower airway collapse.

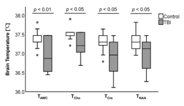
Impact: We demonstrate the feasibility of capturing lower airway collapse with 2D and SMS real-time imaging (at 0.55T) in a way that is informative to the diagnosis and longitudinal monitoring of tracheomalacia.

Oral

Advanced MRI Methods in CNS Trauma

Summit 1 | Monday 16:00 - 18:00 | *Moderators:* Yu-Chien Wu

0299 16:00



Brain temperature and its relation to cognitive status in traumatic brain injury: a whole-brain magnetic resonance spectroscopic imaging study

Maho Kitagawa[1], Kagari Abiko[2,3], Sulaiman Sheriff[4], Andrew A Maudsley[4], Daisuke Sawamura[5], and Khin Khin Tha[1,6]

[1]Department of Biomarker imaging Science, Graduate School of Biomedical Science and Engineering, Hokkaido University, Sapporo, Japan, [2]Department of Rehabilitation, Hokkaido University Hospital, Sapporo, Japan, [3]Department of Rehabilitation, Sapporo Azabu Neurosurgical Hospital, Sapporo, Japan, [4]Department of Radiology, University of Miami School of Medicine, Miami, FL, United States, [5]Department of Rehabilitation Science, Hokkaido University Faculty of Health Sciences, Sapporo, Japan, [6]Global Center for Biomedical Science and Engineering, Faculty of Medicine, Hokkaido University, Sapporo, Japan

Keywords: Traumatic Brain Injury, Thermometry, Brain temperature

Motivation: The long-term outcome, i.e., the impact of injury on life, may be underestimated in patients with mild-to-moderate TBI. Cognitive deficit, a sequela of TBI and a significant social burden, is difficult to assess in uncooperative patients.

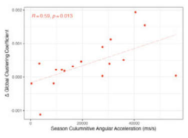
Goal(s): To compare brain temperature between control and TBI groups, and to assess the relationship between brain temperature and cognitive status in TBI group.

Approach: Brain temperature of patients was estimated noninvasively by WB-MRSI and compared to controls; the association between brain temperature and cognitive status was also assessed in the TBI group.

Results: Significant brain temperature reductions in the TBI group were associated with cognitive decline.

Impact: The strong correlation between brain temperature and cognitive performance in the TBI group indicates that attention decreases as brain temperature decreases. Brain temperature may become as a quantitative indicator of cognitive status in patients with subacute to chronic TBI.

0300 16:12



The Rugby Connectome: A Longitudinal Analysis of Structural Connectivity in an Adolescent Cohort with Repeated Head Impacts

Edward John Clarkson[1,2], Maryam Tayebi[1,2], William S. Schierding[2,3,4], Paul Condron[2], Leigh Potter[2], Jerome Maller[5], Miao Qiao[6], Justin Fernandez[1], Samantha Holdsworth[2,7], Eryn E. Kwon[1,2,7], Joshua P. McGeown[2,7], and Vickie Shim[1,2]

[1]Auckland Bioengineering Institute, University of Auckland, Auckland, New Zealand, [2]Mātai Medical Research Institute, Tairāwhiti-Gisborne, New Zealand, [3]Department of Ophthalmology, University of Auckland, Auckland, New Zealand, [4]Vision Research Foundation, Auckland, New Zealand, [5]General Electric Healthcare, Victoria, Australia, [6]School of Computer Science, Faculty of Science, University of Auckland, Auckland, New Zealand, [7]Faculty of Medical and Health Sciences & Centre for Brain Research, University of Auckland, Auckland, New Zealand

Keywords: Structural Connectivity, Adolescents

Motivation: Evidence suggests that repeated head impacts which do not produce conscious changes in cognition, may have detrimental effects on neurological function and brain micro-structure.

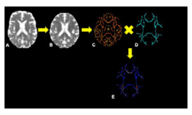
Goal(s): Our study aims to quantify longitudinal changes in structural connectivity within a cohort of young rugby players throughout a rugby season.

Approach: Using head impact data and advanced MRI techniques including whole brain tractography from multi-shell diffusion MRI, structural connectivity adjacency matrices were derived from tractograms and analyzed using graph theory.

Results: Global clustering coefficient increased significantly from preseason to mid-season and post-season. These changes correlated with measures of cumulative head impact exposure.

Impact: Data from our adolescent rugby cohort offers a rare opportunity to document the longitudinal effect of repeated head impact exposure on structural connectivity. The structural connectivity changes we observed may not be indicative of clinically relevant brain injury.

0301 16:24



Association of white matter brain diffusivity properties with football exposure in former professional American-style football players

Ona Wu[1], Rachel Grashow[2], Marc Weisskopf[2], Karen Miller[3], Grant Iverson[4], Jacob A Dodelson[1], Annelise M Kulpanowski[1], Brandon L Hancock[1], Michael Doyle[5], William A Copen[6], Aaron Baggish[7], and Ross Zafonte[5]

[1]Athinoula A Martinos Center for Medical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard T. H. Chan School of Public Health, Boston, MA, United States, [3]Neuroendocrine Unit, Massachusetts General Hospital, Boston, MA, United States, [4]Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital, Charlestown, MA, United States, [5]Football Players Health Study, Harvard Medical School, Boston, MA, United States, [6]Department of Radiology, Massachusetts General Hospital, Boston, MA, United States, [7]Cardiology Division, Massachusetts General Hospital, Boston, MA, United States

Keywords: Traumatic Brain Injury, Traumatic brain injury

Motivation: The possible long-term effects of repetitive head impacts experienced by American-style professional football players are poorly understood. White matter injury is a known sequela of head trauma. Peak-width skeletonized mean diffusivity measurements have been associated with cerebrovascular disease.

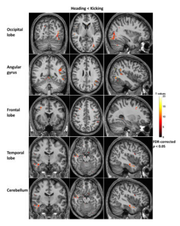
Goal(s): Our goal is to evaluate the association of peak-width skeletonized diffusion values with football exposure.

Approach: We measured peak-width skeletonized diffusion values in 103 retired professional football players who underwent multi-shell diffusion imaging.

Results: Age, hypertension, body-mass index, concussion signs and symptom history score, total years of non-professional play, and episodes of loss of consciousness were significantly associated with peak-width skeletonized diffusion values.

Impact: Measured peak-width skeletonized diffusion values in white matter may provide an improved understanding of the association between football exposure and later-in-life brain microstructural integrity.

0302 16:36



Acute impact of soccer ball heading on brain tissue electrical conductivity

Jun Cao[1], Nathan Delang[2,3,4,5], Luke Henderson[5], Rebecca Robertson[5], Fernando Tinoco Mendoza[5], Ben Desbrow[2], Christopher Irwin[2,6], Elizabeth Cairns[4,7], Paul Austin[5], Shane Ball[4], Michael Buckland[4], Iain McGregor[4,7], Danielle McCartney[1,4,7], and Caroline Rae[1,8]

[1]Neuroscience Research Australia, Sydney, Australia, [2]School of Health Sciences and Social Work, Griffith University, Gold Coast, Australia, [3]Queensland Academy of Sport, Queensland, Australia, [4]School of Psychology, Faculty of Science, The University of Sydney, Sydney, Australia, [5]School of Medical Sciences (Neuroscience), Faculty of Medicine and Health, The University of Sydney, Sydney, Australia, [6]Menzies Health Institute Queensland, Griffith University, Gold Coast, Australia, [7]Lambert Initiative for Cannabinoid Therapeutics, The University of Sydney, Sydney, Australia, [8]School of Psychology, The University of New South Wales, Sydney, Australia

Keywords: Traumatic Brain Injury, Brain

Motivation: The effects of sub-concussive head impacts are not well understood. New biomarkers are needed to detect sub-concussion.

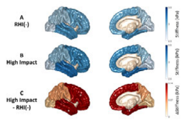
Goal(s): Our goal was to investigate the acute effects of sub-concussive impacts using MREPT.

Approach: Fourteen soccer players were scanned with MREPT in two separate sessions after performing the task of either heading or kicking soccer balls for 20 minutes.

Results: Electrical conductivity measured in multiple brain regions such as inferior fronto-occipital fasciculus after the heading session was significantly less than that measured following kicking, indicating that MREPT could be a useful tool for detecting sub-concussive injury.

Impact: The finding that heading soccer balls for a short period can cause significant acute decreases in brain electrical conductivity suggests that this activity may have detrimental short term effects on brain function.

0303 16:48 [Evaluation of MR Elastography-Based Biomarkers for Detecting Skull-Brain Interface Decoupling Changes in Response to Repetitive Head Impacts]



Xiang Shan[1], Matthew Murphy[1], Yi Sui[1], Keni Zheng[1], Emi Hojo[1], Armando Manduca[2], Richard Ehman[1], John Huston III[1], and Ziying Yin[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States, [2]Physiology and Biomedical Engineering, Mayo Clinic, Rochester, MN, United States

Keywords: Traumatic Brain Injury, Traumatic brain injury, Repetitive head impacts, Magnetic resonance elastography

Motivation: The growing concern about subconcussive, repetitive head impacts (RHI) has prompted the need for non-invasive RHI detection methods.

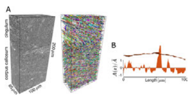
Goal(s): To understand if there are alterations of the skull-brain interface due to RHI exposure and explore potential imaging biomarkers for characterizing RHI.

Approach: Four MR Elastography (MRE)-based parameters were compared between RHI(-) and RHI(+) groups, encompassing assessment of cortical stiffness, capabilities of motion dampening, and strain mediation at the skull-brain interface.

Results: Our findings revealed increased cortical stiffness, rotational transmission ratio, and adjusted NOSS in individuals with high RHI exposure, suggesting a degeneration of the skull-brain interface decoupling performance.

Impact: This study sheds light on RHI-induced changes at the skull-brain interface, proposing three potential non-invasive biomarkers for monitoring such alterations. These findings hold promise for aiding medical professionals in identifying individuals at high RHI exposure risk.

0304 17:00 [Quantifying changes of axonal shape in traumatic brain injury with time-dependent diffusion]



Ali Abdollahzadeh[1,2], Ricardo Coronado-Leija[1,2], Hong-Hsi Lee[3], Alejandra Sierra[4], Els Fieremans[1,2], and Dmitry S. Novikov[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research, New York University Grossman School of Medicine, New York, NY, United States, [3]Department of Radiology, Harvard Medical School, Boston, MA, United States, [4]A.I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland

Keywords: Microstructure, Modelling, Axons, Diffusion, Validation, TBI, Segmentation, Electron microscopy

Motivation: Interpreting diffusion MRI (dMRI) in terms of brain tissue micro-geometry.

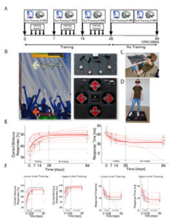
Goal(s): To identify cellular features that govern diffusion measurements among myriads of parameters specifying tissue microstructure.

Approach: We found how axonal micro-geometry is manifested in a dMRI measurement by analytically solving the diffusion equation in a tube with a randomly varying cross-section.

Results: We identify a specific power-law approach of the time-dependent diffusion coefficient along the axon to its long-time limit. The average inverse cross-section and the variance of long-range cross-sectional fluctuations govern the diffusive dynamics. We quantify changes in these non-trivial geometrical features, associated with axonal beading, in a rat TBI model.

Impact: Beading is a characteristic feature of numerous neurodegenerative diseases triggered by different pathological conditions and injuries. Here, we detect geometrical changes in the axonal micro-geometry, accessible via the along-tract diffusivity from the diffusion tensor using clinically feasible diffusion weightings.

0305 17:12



Spinal cord injury and the patterns of neuronal plasticityduring motor-rehabilitation training

Tim Max Emmenegger[1], Gergely David[1], Tim Killeen[1], and Patrick Freund[1,2,3]

[1]Spinal Cord Injury Center Balgrist University Hospital, Zurich, Switzerland, [2]Wellcome Centre for Human Neuroimaging, UCL Queen Square Institute of Neurology, London, United Kingdom, [3]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Keywords: Other Neurodegeneration, Brain, Myelin plasticity; Multiparametric mapping; Magnetisation transfer; Motor learning; Quantitative MRI; Corticospinal tract; Hippocampus

Motivation: Rehabilitation following spinal cord injury is currently the only means to improve motor function. How macro-and microstructural changes in the CNS promote such recovery is understudied.

Goal(s): Investigate training-induced plasticity during motor skill training and explore associations between neuroplasticity and performance.

Approach: We compared healthy and SCI trainees and healthy non-trainees using quantitative and diffusion MRI, and associated changes in MRI parameters with performance improvement.

Results: SCI patients showed training-induced changes in cortical and subcortical areas, which were akin to those in healthy controls and were linked to specific aspects of motor skill learning.

Impact: Motor skill learning in SCI induces neuroplasticity in similar areas as seen in healthy controls. These findings open the possibility to monitor progress in neurorehabilitation.

0306 17:24

Automatic segmentation of T2-weighted hyperintense lesions in spinal cord injury

Jan Valosek[1,2,3,4], Naga Karthik Enamundram[1,2], Maxime Bouthillier[1,5], Simon Schading-Sassenhausen[6], Lynn Farner[6], Dario Pfyffer[6,7], Andrew C. Smith[8], Kenneth A. Weber II[7], Patrick Freund[6,9], and Julien Cohen-Adad[1,2,10,11]

[1]NeuroPoly Lab, Institute of Biomedical Engineering, Polytechnique Montreal, Montreal, QC, Canada, [2]Mila - Quebec AI Institute, Montreal, QC, Canada, [3]Department of Neurosurgery, Faculty of Medicine and Dentistry, Palacký University Olomouc, Olomouc, Czech Republic, [4]Department of Neurology, Faculty of Medicine and Dentistry, Palacký University Olomouc, Olomouc, Czech Republic, [5]Centre Hospitalier de l'Université de Montréal, University of Montreal, Montreal, QC, Canada, [6]Spinal Cord Injury Center, Balgrist University Hospital, University of Zürich, Zürich, Switzerland, [7]Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Standford, CA, United States, [8]Department of Physical Medicine and Rehabilitation Physical Therapy Program, University of Colorado School of Medicine, Aurora, CO, United States, [9]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [10]Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montreal, QC, Canada, [11]Centre de Recherche du CHU Sainte-Justine, Université de Montréal, Montreal, QC, Canada

Keywords: Analysis/Processing, Spinal Cord, Deep Learning; Spinal Cord Injury; Segmentation

Motivation: Morphometric analysis of the intramedullary lesion following spinal cord injury will assist in understanding the extent of the injury and choosing the best therapeutic strategy for rehabilitation.

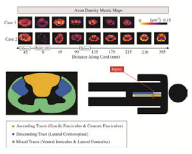
Goal(s): Our objective was to develop a deep learning-based tool for the segmentation of T2-weighted hyperintense spinal cord injury lesions.

Approach: A nnUNet model was trained to segment both the spinal cord and lesions from two different datasets.

Results: Compared to existing methods, our model achieved the best segmentation performance for both cord and lesions. The code/model is available on GitHub and will soon be part of the Spinal Cord Toolbox.

Impact: Automatic segmentation of spinal cord injury lesions replaces the tedious process of manual annotation and enables the extraction of relevant lesion morphometrics in large cohorts. The proposed model generalizes across lesion etiologies (traumatic/ischemic), scanner manufacturers and heterogeneous image resolutions.

0307 17:36



Whole cord diffusion imaging of post-mortem human spinal cord injury reveals extent and potential timeline of axonal swelling and degeneration

Nikolai Lesack[1,2,3], Sarah Rosemary Morris[1,2,3], Taylor Swift-LaPointe[2], Andrew Yung[1,3,4], Valentin Prevost[1,3,4], Shana George[5], Andrew Bauman[4], Piotr Kozlowski[1,2,3,4], Farah Samadi[1,5], Caron Fournier[1,5], Lisa Parker[6], Kevin Dong[1], Femke Streijger[1], G.R. Wayne Moore[1,5,6], Adam Velenosi[1], Veronica Hirsch-Reinshagen[1,5,6], Brian Kwon[1,7], and Cornelia Laule[1,2,3,5]

[1]International Collaboration on Repair Discoveries, Vancouver, BC, Canada, [2]Physics and Astronomy, The University of British Columbia, Vancouver, BC, Canada, [3]Radiology, The University of British Columbia, Vancouver, BC, Canada, [4]Faculty of Medicine, UBC MRI Research Centre, Vancouver, BC, Canada, [5]Pathology & Laboratory Medicine, The University of British Columbia, Vancouver, BC, Canada, [6]Vancouver General Hospital, Vancouver, BC, Canada, [7]Orthopaedics, The University of British Columbia, Vancouver, BC, Canada

Keywords: Microstructure, Spinal Cord, White Matter, Traumatic Injury, ActiveAx, Spinal Cord Injury, DTI, Myelin, Axons

Motivation: Following spinal cord injury (SCI) changes in tissue microstructure occur throughout the length of the cord which are not detectable with conventional MRI.

Goal(s): To characterize whole cord diffusion MRI metrics in human SCI post-mortem tissue, including the effect of injury-to-death interval on diffusion MRI metrics.

Approach: Two full-length spinal cords were imaged at 7T. DTI and ActiveAx metrics were extracted from white matter tracts.

Results: Changes in fractional anisotropy, axon density, and axon diameter were observed downstream of the injury epicentre in the case with a longer injury-to-death interval. Transience in diffusion metrics may indicate the extent of axonal degeneration and swelling.

Impact: Diffusion MRI may be a useful tool in understanding the extent and progression of spinal cord injury. Insight into axonal swelling and degeneration following spinal cord injury could aid clinicians in predicting patient prognosis.

17:48 Discussion

Thomas Talavage

University of Cincinnati, United States

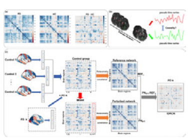
Oral

Imaging for Deeper Insight into Early Parkinsonism

Summit 2 | Monday 16:00 - 18:00 | *Moderators:* Septian Hartono & Rahul Gaurav

0308 16:00

MERIT AWARD
MAGNA CUM LAUDE



Brain iron accumulation kinetics in Parkinson’s disease revealed by relaxometry network and susceptibility-weighted imaging

Weizhao Lu[1], Tianbin Song[1], and Jie Lu[2]

[1]Xuanwu Hospital, Capital Medical University, Beijing, China, [2]Xuanwu Hospital Capital Medical University, Beijing, China

Keywords: Parkinson's Disease, Parkinson's Disease, susceptibility-weighted imaging; kinetics; iron accumulation; relaxometry covariance network; substantia nigra

Motivation: Iron deposition is implicated in the pathogenesis of Parkinson's disease (PD). However, most of the previous studies failed to report progressive iron accumulation with disease progression.

Goal(s): This study aimed to explore the kinetics of iron accumulation in the PD brain using a novel relaxometry covariance network (RCN) approach.

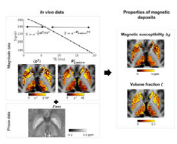
Approach: The RCN approach consisted of three steps, the identification of brain regions as propagators of iron, construction of causal RCN and individual differential RCN.

Results: The left substantia nigra pars reticulata, left substantia nigra pars compacta, and lobule VII of cerebellum vermis were identified as propagators of iron.

Impact: The application of our novel relaxometry covariance network on susceptibility-weighted imaging revealed iron accumulation kinetics in Parkinson's disease, which were closely related to the pathophysiological aspects of the disease. The current findings deserved further exploration to elucidate the underlying mechanisms.

0309 16:12

MERIT AWARD MAGNA CUM LAUDE



Characterizing iron deposits in subcortical grey matter from in vivo gradient-echo data

Rita Oliveira[1], Quentin Raynaud[1], Valerij Kiselev[2], Ileana Jelescu[3], and Antoine Lutti[1]

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Keywords: Gray Matter, Brain

Motivation: Transverse relaxation rate and magnetic susceptibility are MRI measures of iron concentration in subcortical grey matter. However, their relation to the microscopic distribution of iron deposits within the tissue remains elusive.

Goal(s): Our goal is to characterize the distribution of iron deposits in subcortical grey matter from *in vivo* gradient-echo data.

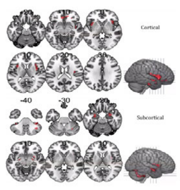
Approach: We characterize iron-rich deposits from the combination of transverse relaxation parameters of the magnitude and phase of gradient-echo data, under two limiting regimes.

Results: The estimates of iron distribution are consistent with *ex vivo* studies. Data suggest that an intermediate regime might be applicable in subcortical tissue.

Impact: The characterization of the microscopic distribution of iron deposits in subcortical grey matter, from in vivo gradient-echo data, brings the opportunity to study iron-related brain changes in neurodegenerative diseases with improved specificity.

0310 16:24

MERIT AWARD MAGNA CUM LAUDE



Multiparametric imaging of dopaminergic, cholinergic and noradrenergic contribution in olfactory dysfunction in Parkinson’s disease

Jean-Baptiste Perot[1], Audrey Fraysse[1], Salim Ouarab[2], Sana Rebbah[3], François-Xavier Lejeune[3], Emma Massy[1], Rahul Gaurav[1], Isabelle Arnulf[1], Jean-Christophe Corvol[4], Marie Vidailhet[1], Nadya Pyatigorskaya[1], Cécile Gallea[1], and Stéphane Lehéricy[1,2]

[1]Paris Brain Institute – ICM, MOVIT team, Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, Paris, France, [2]Paris Brain Institute – ICM, Centre de NeuroImagerie de Recherche – CENIR, Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, Paris, France, [3]Paris Brain Institute – ICM, Data Analysis Core, Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, Paris, France, [4]Paris Brain Institute – ICM, Centre d'Investigation Clinique (CIC), Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, Paris, France

Keywords: Parkinson's Disease, Parkinson's Disease

Motivation: Olfactory dysfunction is an early symptom of Parkinson’s disease (PD), involving impairments of cholinergic, dopaminergic, and noradrenergic networks. Patients with idiopathic REM sleep behavior disorder (iRBD), a prodromal phase of PD, are associated with anosmia and severe noradrenergic defects.

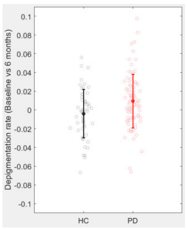
Goal(s): This study aimed to decipher the contribution of cholinergic, dopaminergic, and noradrenergic alterations in olfactory impairments in the presence or absence of RBD.

Approach: Multiparametric imaging highlighted specific alterations of the Locus Coeruleus (LC) and Nucleus Basalis of Meynert that correlated with olfactory score

Results: Alterations were modulated by the presence of RBD, suggesting specific progression pattern.

Impact: Our results show that olfactory dysfunction originates from different altered subcortical nodes in Parkinson’s disease patients depending on the presence of sleep disorder. This suggests that patients with sleep disorder display different progression pattern of Parkinson’s disease.

0311 16:36 Serial neuromelanin MRI detects progression of depigmentation over 6 months in early Parkinson's



Yue Xing[1,2,3], Stefan Pszczolkowski[1,2,3], Tayyib Hayat[1,4], Paul Morgan[1,2,3], Jonathan Evans[5], Chris Tench[1,2,3], and Dorothee P. Auer[1,2,3]

[1]School of Medicine, Mental Health & Clinical Neurosciences, University of Nottingham, Nottingham, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [3]National Institute for Health Research, Nottingham Biomedical Research Centre, Nottingham, United Kingdom, [4]Neurology, Queen's medial Centre, Nottingham, United Kingdom, [5]Neurology, Queen's medical Centre, Nottingham, United Kingdom

Keywords: Parkinson's Disease, Parkinson's Disease, Neuromelanin MRI

Motivation: The potential of neuromelanin-MRI in tracking disease progression is underexplored.

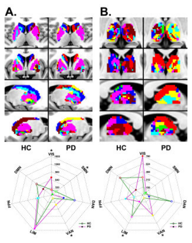
Goal(s): We investigated the detectability of changes of contrast in substructures of the substantia nigra over 6 months.

Approach: We compared changes of contrast between healthy controls and subjects with early PD.

Results: Depigmentation progresses over 6 months in early PD, but not in healthy controls, advancing the use of neuromelanin-MRI as a potential marker of PD.

Impact: Our study addresses the knowledge gap of neuromelanin-MRI as a potential progression marker of early PD, which will be particularly helpful in the context of future disease-modifying trials.

0312 16:48 Characterizing microstructural patterns within the cortico-striato-thalamo-cortical circuit in Parkinson's disease



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Keywords: Parkinson's Disease, Diffusion/other diffusion imaging techniques

Motivation: Parkinson's disease (PD) pathologically involves regional impairments and network disturbances. However, its microstructural abnormalities remain to be further elucidated via an appropriate neuroimaging approach.

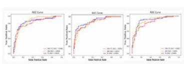
Goal(s): We thus aimed to investigate the microstructural patterns of PD as mapped by diffusion kurtosis imaging (DKI).

Approach: The intergroup difference and classification performance of global microstructural complexity were analyzed, respectively. The network disruptions were explored in terms of structural connectivity, network covariance and modular connectivity.

Results: Our findings indicated that PD encountered globally impaired microstructural complexity, disturbed structural connectivity between basal ganglia and cortices, aberrant network covariance within the striatum and thalamus and altered modular connectivity.

Impact: These findings verified the potential clinical application of DKI for the exploration of microstructural patterns in PD, contributing complementary imaging features that offer insights into the neurodegenerative process.

0313 17:00 Multi-parametric radiomics of T1and susceptibility-weighted imaging for differentiating Parkinson's disease and multiple system atrophy.



Shuting Bu[1], Yueluan Jiang[2], and Guoguang Fan[3]

[1]the First hospital of China Medical University, Shenyang,Liaoning, China, [2]MR Research Collaboration, Siemens Healthineers, Beijing China, Beijing, China, [3]the First hospital of China Medical University, Shenyang, China

Keywords: Radiomics, Neurodegeneration

Motivation: Aim to differentiate PD from MSA in the early stage.

Goal(s): To build a radiomic model based on features derived from basal ganglia regions by using commonly applied sequences in clinical settings, to distinguish between PD and MSA.

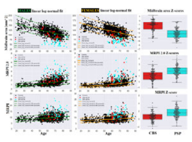
Approach: This study constructed three machine learning models- logistic regression, support vector machine and light gradient boosting method to differentiate PD motor subtypes.

Results: The light gradient boosting machine trained by features extracted from SWI and T1 sequences achieved a great classification performance between PD and MSA (AUC=0.881).

Impact: This study has developed an effective classification model using commonly utilized clinical MRI sequences, which provides a valuable tool for distinguishing between PD and MSA in clinical practice.

0314 17:12

MERIT AWARD MAGNA CUM LAUDE



Establishing Magnetic Resonance Parkinsonism Index reference ranges to distinguish Progressive Supranuclear Palsy and Corticobasal Syndrome

Tommaso Di Noto[1,2,3], Punith B Venkategowda[4,5], Ricardo Corredor-Jerez[1,2,3], Tobias Raffael Bodenmann[1], Madappa Shadakshari Swamy[4], Vincent Dunet[3], Stephane Lehericy[6], Neelam Sinha[5], and Bénédicte Maréchal[1,2,3]

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Keywords: Parkinson's Disease, Neurodegeneration, MRPI; Brain; Reference ranges; Corticobasal syndrome; Progressive supranuclear palsy

Motivation: distinguishing Parkinsonian syndromes can be challenging since these diseases exhibit overlapping clinical manifestation.

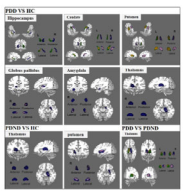
Goal(s): provide extended reference ranges of established biomarkers to distinguish Progressive Supranuclear Palsy (PSP) from Corticobasal Syndrome (CBS) in a fast, automated way.

Approach: we build reference ranges of relevant brain measurements from a large cohort of healthy subjects; then, we compute corresponding Z-scores of these measurements to distinguish PSP and CBS patients.

Results: the midbrain area is the most informative measurement to discern PSP and CBS. A logistic regressor that combines Z-scores of multiple brain measurements achieves mean AUC of .87 in 5-fold-cross-validation when distinguishing PSP and CBS.

Impact: We release extended age-/sex-specific reference ranges built from healthy controls for several biomarkers used to differentiate Parkinsonian disorders. Our ranges show notable variation with age/sex and could be used by radiologists as benchmark to better differentiate Parkinsonian subtypes.

0315 17:24



Subcortical structures alterations in Parkinson's disease patients with depression by Vertex-based morphological analysis

Mingrui Qu[1], Bingbing Gao[1], Yuhan Jiang[1], Yuan Li[1], Qingwei Song[1], and Yanwei Miao[1]

[1]The First Affiliated Hospital of Dalian Medical University, Dalian, China

Keywords: Parkinson's Disease, Neurodegeneration

Motivation: Subcortical structure is critical to the pathogenesis of Parkinson's disease (PD) and depression.

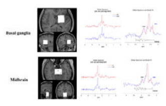
Goal(s): shape analysis can precisely localise regional shape deformations in the subcortical gray matter and detect changes that are not found in VBM and volumetric analyses.

Approach: This study explored the shape change of subcortical gray matter nuclei in Parkinson's disease patients with depression (PDD).

Results: PDD patients have multiple subcortical morphological atrophy, and local expansion areas were also found in several nuclei. The shape change of left nucleus accumbens was negatively correlated with Hamilton depression scale (HAMD) scores, and the shape change of right caudate nucleus was negatively correlated with disease duration.

Impact: This study suggested that PDD patients have multiple subcortical morphological atrophy, and local expansion areas were also found in several nuclei. Partial correlation analysis showed that the shape change of left nucleus accumbens was negatively correlated with HAMD scores.

0316	17:36	[Effect of iron content on GSH levels in the basal ganglia and midbrain in young healthy controls]



Youmin Zhang[1,2], Naying He[1], Peng Wu[3], Qiurong Yu[1,2], Yefeng Yao[4], Ewart Mark Haacke[1,5], and Fuhua Yan[1,2]

[1]Department of Radiology, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, Shanghai, China, [2]Faculty of Medical Imaging Technology, College of Health Science and Technology, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [3]Philips Healthcare, Shanghai, China, Shanghai, China, [4]Shanghai Key Laboratory of Magnetic Resonance, College of Physics and Electronic Science, East China Normal University, Shanghai, China, [5]Department of Radiology, Wayne State University, Detroit, MI, USA, Detroit, MI, United States

Keywords: Parkinson's Disease, Parkinson's Disease, Glutathione, MEGA-PRESS, Deep gray matter

Motivation: It is important to characterize the relationship between oxidative stress and iron deposition in neurodegenerative diseases.

Goal(s): To investigate if there is a correlation between the glutathione (GSH) levels and brain iron in young healthy controls.

Approach: Taking advantage of proton magnetic resonance spectroscopy (^{1}H-MRS) with MEscher-Garwood Point RESolved Spectroscopy (MEGA-PRESS) and quantitative susceptibility mapping to detect GSH and iron levels.

Results: An intriguing phenomenon was found that as the iron content increased in the putamen, substantia nigra, and red nucleus, the GSH level showed an increasing trend in the basal ganglia and midbrain region respectively.

Impact: The relationship between oxidative stress and excessive iron deposition is complicated. This preliminary study offers new insight to investigate the time sequence in iron homeostasis and oxidative stress.

17:48 Discussion

Raul Martinez-Fernandez

Grupo Hospitales De Madrid

Power Pitch

Pitch: fMRI: Vessels, Networks & Analysis

Power Pitch Theatre 1

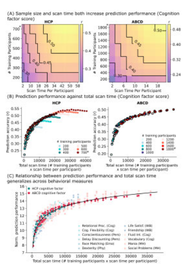
Monday
Pitches: 16:00 - 17:00
Posters: 17:00 - 18:00

Moderators: Juan Zhou & Pinar Özbay

(no CME credit)

0317 Pitch: 16:00
Poster: 17:00
Screen 1

[MRI meets economics: Balancing sample size and scan duration]



Leon Qi Rong Ooi[1], Csaba Orban[1], Thomas E Nichols[2], Shaoshi Zhang[1], Trevor Wei Kiat Tan[1], Ru Kong[1], Scott Marek[3], Nico Dosenbach[3], Timothy Laumann[3], Evan Gordon[3], Juan Helen Zhou[1], Danilo Bzdok[4], Simon Eickhoff[5], Avram Holmes[6], and B.T. Thomas Yeo[1]

[1]National University of Singapore, Singapore, Singapore, [2]Big Data Institute, Oxford, United Kingdom, [3]Washington University, St. Louis, MO, United States, [4]McGill University, Montreal, QC, Canada, [5]Research Center Jülich, Jülich, Germany, [6]Rutgers University, Piscataway, NJ, United States

Keywords: fMRI Analysis, fMRI (resting state)

Motivation: Resting-state functional connectivity (RSFC) is widely used to predict behavioral traits in individuals.

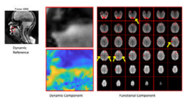
Goal(s): A pervasive dilemma when collecting functional MRI data is whether to prioritize sample size or scan duration given fixed resources.

Approach: We systematically investigate the trade-off between sample size and scan time in the context of prediction accuracy and reliability of brain-behavior relationships using RSFC.

Results: Increasing sample size (with fixed scan time) or scan time (with fixed sample size) leads to similar accuracy. Reliability of brain-behavior association can only be improved with bigger sample sizes but not scan time.

Impact: Our findings establish an empirically informed reference for calibrating scan times and sample sizes to maximize prediction of behavioral performance and reliability of brain-behavior associations when using resting-state functional connectivity.

0318 Pitch: 16:00 Poster: 17:00 Screen 2



[SimulScan and Partial Least Squares: Linking speech and swallowing dynamics to brain function]

Anthony Bosshardt[1], Georgia A. Malandraki[2], and Bradley P. Sutton[1,3,4]

[1]Carle Illinois College of Medicine, University of Illinois Urbana Champaign, Urbana, IL, United States, [2]Purdue University, West Lafayette, IN, United States, [3]Bioengineering, University of Illinois Urbana Champaign, Urbana, IL, United States, [4]Beckman Institute for Advanced Science and Technology, University of Illinois Urbana Champaign, Urbana, IL, United States

Keywords: fMRI Analysis, fMRI (task based), speech, swallowing, fMRI analysis, dynamic imaging

Motivation: SimulScan enables the joint imaging of dynamic oropharyngeal movements during speech and swallowing along with their central control from functional MRI.

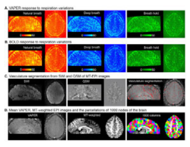
Goal(s): The large, complex dataset requires memory-efficient analysis to find the uncover the underlying relationships between the dynamic and functional imaging data.

Approach: Here we develop a memory-efficient implementation of partial least square (PLS) and apply it to a blocked tongue tapping task.

Results: The PLS method separates out correlated motions and brain function for different components of the task.

Impact: SimulScan with PLS analysis can enable the visualization of central control of complex processes such as speech and swallowing. This approach will enable the in-depth study of healthy and disordered speech and swallowing mechanisms in age and disease.

0319 Pitch: 16:00 Poster: 17:00 Screen 3



[Improving laminar fMRI specificity by reducing macrovascular bias caused by respiration effects]

Yuhui Chai[1], A. Tyler Morgan[2], Daniel Handwerker[2], Linqing Li[2], Laurentius Huber[2], Bradley Sutton[1], and Peter Bandettini[2]

[1]UIUC, Urbana, IL, United States, [2]NIMH, NIH, Bethesda, MD, United States

Keywords: fMRI Acquisition, fMRI, layer fMRI

Motivation: Although fMRI has achieved sub-millimeter spatial resolution especially with ultra-high field (≥7T) scanners, its spatial specificity has not kept pace.

Goal(s): This study aims to map and validate the influences of natural respiratory variations on fMRI signals and use it to improve laminar fMRI specificity.

Approach: We compare the influences of natural respiratory variations with the patterns induced by deep breath and breath hold tasks and probe their spatial correlation with vascular density.

Results: This respiratory variation revealed information can be used to remove macrovascular-dominated voxels, thereby enhance laminar fMRI specificity.

Impact: We highlight the significance of natural respiratory variations for improving laminar fMRI specificity. By understanding these variations and their link with vascular density, we can better identify and exclude macrovascular-dominated voxels, marking a notable advancement in high-resolution fMRI specificity.

0320 Pitch: 16:00 Poster: 17:00 Screen 4

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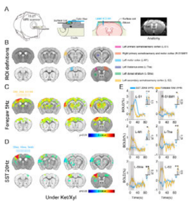


[Underlying mechanism of hemodynamic and fMRI response to optogenetic stimulation of somatostatin neurons.]

Thanh Tan Vo[1,2,3], Tong Jin[1,2], and Seong-Gi Kim[1,2]

[1]Center for Neuroscience Imaging Research (CNIR), Institute for Basic Science (IBS), Suwon 16419, Republic of Korea, Suwon, Korea, Republic of, [2]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Korea, Republic of, [3]Department of Intelligent Precision Healthcare Convergence, Sungkyunkwan University, Suwon, Korea, Republic of

Keywords: Functional Connectivity, High-Field MRI, fMRI, interneuron, neurovascular coupling

Motivation: SST neurons, 30% of cortical interneurons, are crucial in interpreting fMRI data and understanding neurovascular coupling within the cortex.

Goal(s): In this study we want to investigate the the SST-induced hemodynamic response

Approach: we used several methods such as neural recording, BOLD-fMRI, and optical intrinsic signaling (OIS) with pharmacological applications.

Results: We observed SST neuron activation causing local neural inhibition, resulting in negative BOLD-fMRI at projection sites. Additionally, it triggered initial NO-induced fast vasodilation, followed by astrocyte-mediated slow vasodilation.

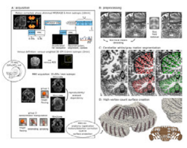
Impact: BOLD-fMRI reflects neural activity changes, yet certain interneurons induce hemodynamic responses without altering neural activity. Studying SST-induced responses is vital for interpreting fMRI.

0321

Pitch: 16:00

Poster: 17:00

Screen 5



Exploring the cerebellar cortical stripes in humans with 7T, motion-corrected, RF-shimmed MRI

Nikos Priovoulos[1,2,3], Matthan W A Caan[4], Emma J P Brouwer[1], Jorje F Mejias[5,6], Pierre Louis Bazin[7], Anneke Alkemade[8], and Wietske van der Zwaag[1]

[1]Spinoza Center for Neuroimaging, Amsterdam, Netherlands, [2]Biomedical Engineering and Physics, Amsterdam University Medical Centers, Amsterdam, Netherlands, [3]Computational and Cognitive Neuroscience and Neuroimaging, Netherlands Institute for Neuroscience, Amsterdam, Netherlands, [4]Department of Biomedical Engineering and Physics, Amsterdam University Medical Centers, Amsterdam, Netherlands, [5]Cognitive and Systems Neuroscience Group, Swammerdam Institute for Life Sciences, Amsterdam, Netherlands, [6]Research Priority Area Amsterdam Brain and Cognition, University of Amsterdam, Amsterdam, Netherlands, [7]Full Brain Picture Analytics, Leiden, Netherlands, [8]Integrative Model-Based Cognitive Neuroscience Unit, University of Amsterdam, Amsterdam, Netherlands

Keywords: fMRI Analysis, Brain, cerebellum, high-field, motion correction

Motivation: The cerebellar cortex is organized in stripe-like clusters, similar to the neocortical layers/columns. The cerebellar anatomical complexity and lack of non-invasive methods makes their detection in humans challenging.

Goal(s): To determine if the human cerebellum shows stripe-like patterns as observed in animals.

Approach: We employed high-resolution, motion-corrected, RF-shimmed, 7T MRI to construct detailed cerebellocortical surfaces. We examined the presence of stripes across fMRI paradigms, their relationship to macrovasculature and variability. We additionally used immunohistochemistry for validation.

Results: We observed consistent stripe-like patterns in the human cerebellum. These patterns were not associated with macrovasculature and conformed with immunohistochemistry, indicating a neuronal origin.

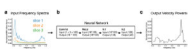
Impact: Cerebellar stripes are a widely-known functional-organization feature but unreported in humans. Here, we combine motion-corrected, 7T-(f)MRI and immunohistochemistry to demonstrate stripe-like patterns in humans. This may provide a new paradigm for cerebellar function, akin to the discoveries in neocortical layers.

0322

Pitch: 16:00

Poster: 17:00

Screen 6



Predicting flow velocity from fMRI inflow signals using physics-informed deep learning

Baarbod Ashenagar[1,2,3] and Laura Lewis[1,2,3]

[1]Department of Biomedical Engineering, Boston University, Boston, MA, United States, [2]Institute for Medical Engineering and Science, Department of Electrical Engineering and Computer Science, Massachusetts Institue of Technology, Cambridge, MA, United States, [3]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States

Keywords: fMRI Analysis, Velocity & Flow

Motivation: fMRI has been used to measure large scale cerebrospinal fluid (CSF) flow dynamics with high sensitivity and temporal resolution, however the measured signal is not quantitative.

Goal(s): Our goal is to develop a physics-based neural network framework for flow quantification directly from fMRI flow-enhanced signals.

Approach: We designed a neural network that can use fMRI data as input to predict flow velocity. We then trained the model on a simulated dataset generated using a physics-based model.

Results: Validation on phantom and human data showed accurate predictions of flow velocity when using measured fMRI signals as input into the neural network.

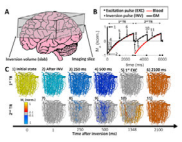
Impact: Here, we significantly increase quantitative information obtainable from fMRI which will enable neuroimaging researchers studying fluid flow dynamics to take advantage of the high sensitivity and temporal resolution of fMRI to obtain flow signals that are physically interpretable.

0323

Pitch: 16:00

Poster: 17:00

Screen 7



A novel biophysical simulation framework for intravascular MRI signals using 3D Vascular Anatomical Networks applied to VASO-fMRI

Grant Hartung[1,2], Daniel Gomez[1,2,3], Avery Berman[4,5], and Jonathan R. Polimeni[1,2,6]

[1]A.A. Martinos Center For Biomedical Imaging, MGH, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [4]Physics, Carleton University, Ottowa, ON, Canada, [5]Royal Ottowa Mental Health Centre, Ottowa, ON, Canada, [6]Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: fMRI Acquisition, Blood vessels, brain, contrast mechanisms, flow, fMRI (task based), gray matter, high-field MRI, in silico, modelling, signal modeling

Motivation: The emerging fMRI method VASO provides improved neuronal specificity compared to BOLD, however the precise interpretation of its origins and principled means to optimize this sequence is not straightforward.

Goal(s): To use biophysical models to investigate the origins of the VASO signal and compare it with direct estimates of CBV.

Approach: We extend our 3D biophysical Vascular Anatomical Network framework to incorporate intravascular signals undergoing inversion recovery to model the VASO sequence.

Results: The VASO signal appears sensitive to slab thickness, and activation biases occur if the slab is too thin. Simulated profiles of VASO differ from measurements, possibly due to model simplifications.

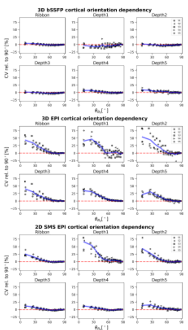
Impact: Our new methodology enables biophysical simulations of fMRI based on inverting blood. Our findings may provide a deeper understanding of the hemodynamic origins of VASO and provide guidance for optimizing SS-SI VASO protocols to yield veridical representation of neural activity.

0324

Pitch: 16:00

Poster: 17:00

Screen 8



Understanding signal specificity in fMRI: bSSFP vs. GRE-EPI signal dependence on cortical orientation to B0 at 9.4 Tesla

Dana Ramadan[1], Jonas Bause[1], Sebastian Mueller[1], Dario Bosch[1,2], Ruediger Stirnberg[3], Philipp Ehses[3], and Klaus Scheffler[1,2]

[1]High-Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Department of Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany, [3]German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany

Keywords: fMRI Analysis, fMRI (resting state), High-Field MRI

Motivation: GRE-EPI, the most widely used sequence for BOLD fMRI, is highly biased towards large draining veins that follow the cortical curvature and influence the surrounding magnetic field in an orientation-dependent manner increasing with field strength.

Goal(s): This work aims to investigate large vein biases resulting in cortical orientation-dependent signal variations in GRE-EPI and bSSFP resting-state fMRI signals.

Approach: We compared 2D and 3D GRE-EPI with 3D bSSFP rs-fMRI signal fluctuations in their dependence on the cortical orientation to B_0 in five subjects at 9.4 Tesla.

Results: Unlike GRE-EPI, intra- and inter-subject comparisons revealed no dependence of bSSFP on the cortical orientation to B_0.

Impact: Fluctuations in the GRE-EPI signal are highly dependent on the cortical orientation and depth. This was not observed with bSSFP, demonstrating the potentially higher specificity of bSSFP for smaller veins, closer to brain activation at field strengths ≥ 7 Tesla.

0325 Pitch: 16:00 Poster: 17:00 Screen 9

[Model-free detection of task-evoked neural activity in the whole brain with structurally constrained synchronization of fMRI signals]

Luying Li[1,2,3], Min Wu[1,2], Ting Yin[4], Xinlan Zhang[1,2], Su Lui[1,2], Zhipeng Yang[3], and Yu Zhao[1,2]

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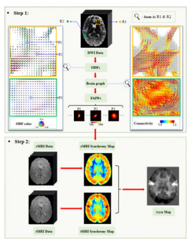


Keywords: Task/Intervention Based fMRI, Data Analysis, activation mapping

Motivation: The nonlinear nature of neurovascular coupling and background brain activities that are unrelated to extrinsic stimuli in tasks could result in an inadequate mapping of the task-evoked brain activations with the conventional-GLM in fMRI.

Goal(s): The aim of this study is to propose a new approach to map task-evoked brain activation without the linear assumption.

Approach: we proposed a model-free approach to map task-evoked activation in the whole brain by measuring increases in BOLD signal synchronization within anatomical structures.

Results: Compared to the GLM approach, the model-free approach could detect regions of brain activations beyond the conventional-GLM's characterization, especially in the white matter.

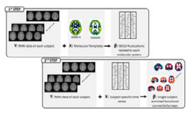
Impact: The model-free approach detects task-evoked brain activations by measuring changes in BOLD signal synchronization within local anatomical structures, which is expected to serve as a standardized tool to measure neural activities with nonlinear hemodynamic responses.

0326 Pitch: 16:00 Poster: 17:00 Screen 10

[Molecular-informed Functional Imaging of Working Memory Processes]

Asia Ferrari[1], Manuela Moretto[1], Francesca Saviola[1,2], Stefano Tambalo[1], Ottavia Dipasquale[3,4], and Jorge Jovicich[1]

[1]CIMeC, Center for Mind/Brain Sciences, University of Trento, Trento, Italy, [2]Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy, [3]Department of Neuroimaging, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, [4]Department of R&D Advanced Applications, Olea Medical, La Ciotat, France



Keywords: fMRI Analysis, fMRI (task based), Working Memory, Brain Functional Connectivity, Neuroreceptors

Motivation: Task-based fMRI studies highlighted the dorsolateral prefrontal cortex (dlPFC) involvement during working memory (WM) processes. However, BOLD fMRI indirectly estimates neural activity and lacks neuroreceptor specificity.

Goal(s): We investigated inhibitory and excitatory receptor density influence on functional connectivity (FC) during varying WM loads.

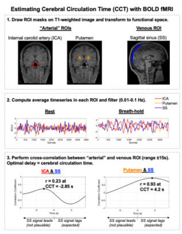
Approach: Using N-back fMRI tasks and Receptor-Enriched Analysis of Functional Connectivity by Targets (REACT), we assessed GABA-A and mGluR5 connectivity effects.

Results: We found decreased GABA-A- and increased mGluR5-enriched FC with increasing WM load in networks involving the dlPFC, in line with fMRI and single-voxel MRS studies. Therefore, REACT is a promising tool bridging whole-brain molecular organization and FC.

Impact: Our molecular-enriched fMRI analysis revealed how varying working memory load modulates functional connectivity related to the underlying neurotransmitters. This provides crucial information for a better understanding of the neural mechanisms underlying brain disorders like Alzheimer's disease and Schizophrenia.

0327 Pitch: 16:00 Poster: 17:00 Screen 11

MERIT AWARD MAGNA CUM LAUDE



<u>Improved estimates of cerebral circulation time from BOLD fMRI data using putamen and sagittal sinus signals</u>

Kristina M. Zvolanek[1,2], Claire Shen[2], Stefano Moia[3], Sarah J. Moum[4,5], and Molly G. Bright[1,2]

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Keywords: fMRI Analysis, fMRI, cerebral circulation time

Motivation: Cerebral circulation time (CCT) is a metric that provides insight into cerebrovascular health. However, conventional CCT measurements typically require injection of contrast agents, or demonstrate high variability.

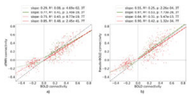
Goal(s): We propose an improved, contrast-free method to calculate CCT by cross-correlating fMRI signals from the putamen and sagittal sinus.

Approach: n 16 healthy adult datasets (8 subjects, 2 sessions), we compared CCT estimates using the internal carotid artery (as proposed in the literature) or putamen as “arterial” references in breath-hold and resting-state data.

Results: The putamen ROI provides more reliable CCT estimates, consistent with values from bolus-tracking methods.

Impact: A modified analysis of fMRI data provides a robust method to measure cerebral circulation time on a single-subject level. This method may offer an accessible, contrast-free metric of cerebrovascular health for future application in patient populations.

0328 Pitch: 16:00 Poster: 17:00 Screen 12



<u>Resting-state functional connectivity with diffusion fMRI minimizes anti-correlations and captures white matter connectivity at 3T and 7T</u>

Inès de Riedmatten[1,2], Wiktor Olszowy[3], Arthur Spencer[2], and Ileana Jelescu[1,2]

[1]Université de Lausanne, Lausanne, Switzerland, [2]Lausanne University Hospital (CHUV), Lausanne, Switzerland, [3]Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

Keywords: Functional Connectivity, fMRI (resting state), novel contrast mechanisms, non-BOLD fMRI, diffusion fMRI, resting-state connectivity

Motivation: Unlike BOLD (neurovascular contrast), dfMRI offers neuromorphological contrast that can detect white matter (WM) activity and attenuates anti-correlations in functional connectivity (FC) analysis.

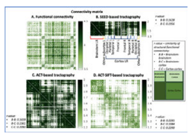
Goal(s): This work investigated resting-state gray and white matter connectivity and anti-correlations in BOLD and dfMRI, at 3T and 7T.

Approach: FC matrices and graph metrics were computed.

Results: Positive correlations were consistent among the contrasts whereas anti-correlations were attenuated with reduced hemodynamic contributions, suggesting a vascular origin to the latter. DfMRI FC displayed higher clustering than BOLD in WM. DfMRI provides unique insights into brain connectivity, particularly in WM, suggesting its value in enhancing our understanding of brain function.

Impact: In functional connectivity analysis, diffusion fMRI exhibits comparable positive correlations to BOLD but reduces anti-correlations, indicating a potential vascular origin for the latter. Additionally, it uncovers previously overlooked white matter connectivity, traditionally treated as a nuisance variable.

0329 Pitch: 16:00 Poster: 17:00 Screen 13



Structural and functional connectivity patterns of brainstem nuclei in living humans by 7 Tesla MRI

Subhranil Koley[1], Kavita Singh[1,2], María Guadalupe García-Gomar[1,3], Simone Cauzzo[1,4], Firdaus Fabrice Hannanu[1], and Marta Bianciardi[1,5]

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Keywords: Functional Connectivity, High-Field MRI, Neuro, Structural connectivity, Functional connectivity

Motivation: A definitive baseline connectome of brainstem nuclei is missing.

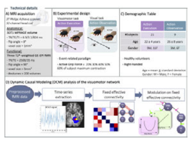
Goal(s): To improve brainstem hodology in living humans by using the similarity between functional and structural connectomes of brainstem nuclei as ground truth.

Approach: In healthy subjects, we mapped 58 Brainstem Navigator atlas labels to high spatial resolution functional and diffusion-weighted 7 Tesla MRI, and computed their functional and structural connectivity, the latter computed using three probabilistic tractography methods proposed in the literature (seed-, ACT-, ACT-SIFT-based), with 148 cortical and 21 subcortical areas.

Results: ACT-SIFT outperformed the other methods within the brainstem and the cortex by reducing large fiber bias.

Impact: Comparison of structural and functional connectomes achieved with different methodology can improve the understanding and mapping of brainstem nuclei connections in living humans and establish a baseline connectome useful to evaluate a broad set of diseases including movement/sleep disorders.

0330 Pitch: 16:00 Poster: 17:00 Screen 14



Differential control of nonlinear functional dynamics by cerebro-cerebellar interactions during action execution and observation

Roberta Maria Lorenzi[1], Gökçe Korkmaz[1], Adnan Alahmadi[2,3], Anita Monteverdi[4], Letizia Casiraghi[5], Egidio D'Angelo[1,4], Fulvia Palesi[1,4], and Claudia A.M. Gandini Wheeler Kingshott[1,3,4]

[1]Department of Brain and Behavioral Sciences, Università di Pavia, Pavia, Italy, [2]Department of Diagnostic Radiology, College of Applied medical sciences, King Abdulaziz University, Jeddah, Saudi Arabia, [3]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [4]Digital Neuroscience Centre, IRCCS Mondino Foundation, Pavia, Italy, [5]Department of Mental Health and Dependence, ASST of Pavia, Pavia, Italy

Keywords: Functional Connectivity, Brain Connectivity, Dynamic Causal Modeling, BOLD, Neuroscience

Motivation: Task-driven BOLD signal nonlinearities in visuomotor areas have been reported both during execution and observation of tasks.

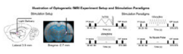
Goal(s): We aim to study how cerebral and cerebellar regions of a visuomotor network influence each other and drive nonlinear BOLD responses.

Approach: Dynamic Causal Modeling was used to estimate causal influences as *effective connectivity* to assess how the activity of each region modulated BOLD signal nonlinearities in a visuomotor task.

Results: Execution and observation networks showed the same fixed (0^{th} order) effective connectivity, while BOLD signal nonlinearities were modulated in the motor planning loop during execution only and were driven by the cerebellum.

Impact: Dynamic causal modeling elucidates the central role of the cerebellum as a forward controller in regulating input-driven modulation differentially in execution and observation. These mechanisms may be affected by pathologies and could have an important role in visuomotor disability.

0331 Pitch: 16:00
Poster: 17:00
Screen 15



The Role of Inhibitory Thalamic Reticular Nucleus (TRN) in Brain-wide Resting-state Functional MRI (rsfMRI) Connectivity

Alex T L Leong[1,2], Xunda Wang[1,2], Yankai Zhang[1,2], Linshan Xie[1,2], and Ed X Wu[1,2,3]

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Keywords: Task/Intervention Based fMRI, fMRI (resting state), fMRI(task based), functional connectivity, neuroscience

Motivation: Despite the enormous potential inherent in rsfMRI, the neural basis underlying rsfMRI connectivity remains unclear.

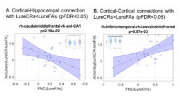
Goal(s): We aim to dissect the role of the TRN inhibitory neural population in rsfMRI connectivity given its prominent role in maintaining/regulating thalamo-cortical oscillations.

Approach: We examined brain-wide activity and rsfMRI connectivity changes after optogenetically manipulating neural activity in rodent TRN.

Results: We demonstrate that somatosensory-specific TRN inhibitory networks play a role in modulating rsfMRI connectivity of sensorimotor and default mode networks.

Impact: Present studies examining neural basis of rsfMRI have primarily focused on excitatory networks. Here, we investigated the role of a major inhibitory thalamic nucleus to advance our understanding of the contributions of inhibitory inputs in regulating brain-wide rsfMRI networks.

0332 Pitch: 16:00
Poster: 17:00
Screen 16



Investigating hippocampal-cortical and cortical-cortical connectivity changes during pattern separation: a 7T fMRI study

Xiaowei Zhuang[1], Zhengshi Yang[1], Katherine Koenig[2], James Leverenz[3], Tim Curran[4], Mark Lowe[2], and Dietmar Cordes[1,4]

[1]Cleveland Clinic Nevada, Las Vegas, NV, United States, [2]Cleveland Clinic Ohio, Cleveland, OH, United States, [3]Cleveland Clinic Ohio, Cleveland Clinic, OH, United States, [4]University of Colorado, Boulder, Boulder, CO, United States

Keywords: Functional Connectivity, fMRI (task based), pattern separation; hippocampal-cortical connection; cortical-cortical connection

Motivation: Studies have extensively demonstrated roles of hippocampus and its subdivisions during pattern separation, but cortical involvement has not yet been elucidated.

Goal(s): Our goal is to evaluate whole-brain functional connectivity changes during pattern separation.

Approach: We compared cortical-hippocampus and cortical-cortical FNCs during a total of 258 correct and incorrect lure discrimination trials, using high-resolution and high-quality 7T fMRI data.

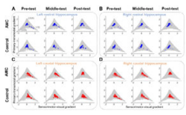
Results: Cortical-CA3DG FNCs and cortical-CA1 FNCs were significantly involved during pattern separation and completion, respectively. Around 83.35% cortical-cortical connections were with higher FNCs during lure discriminations, indicating their potential involvement during pattern separation.

Impact: Besides hippocampus and its subdivisions, cortical regions and its connections to hippocampus might be extensively involved in pattern separation process.

0333 Pitch: 16:00

Poster: 17:00

Screen 17



Aggregation of Connectivity Gradient in Hippocampus Induced by Long-Term Cognitive Training with Development

Tianyong Xu[1] and Feiyan Chen[1]

[1]School of Physics, Zhejiang University, Hangzhou, China

Keywords: fMRI Analysis, fMRI (resting state), Connectivity gradient, Hippocampus, Development, Cognitive training

Motivation: The hippocampus-cortical connections have shown rapid developmental-changed nature during childhood and learning-adapted plasticity with skill acquirement.

Goal(s): However, little is known about the effect of development interacting with cognitive training on the hippocampal connectivity gradient during puberty.

Approach: Here we employed longitudinal dataset (191 scans from training/control groups: n = 43/45) which collected neuroimaging data of school-age children across 0/3/5-year abacus mental calculation (AMC) training stages to explore this question.

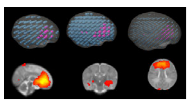
Results: By calculating connectivity gradient of hippocampus, we observed significantly development-induced gradient aggregation of hippocampus, and training promoted that effect, which were resulted from changes in functional connectivity between hippocampus with different cortices.

Impact: These findings provide novel insights into development and training effects on function specialization of hippocampus during puberty from a largescale perspective of connectivity gradient, which may be helpful for better understanding of functionally atypical trait of hippocampal disorder for clinicians.

0334 Pitch: 16:00

Poster: 17:00

Screen 18



A framework for graph theory analyses of functional connectivity within resting state networks (RSNs) of neonates

Ndivhuwo Magondo[1,2], Fleur Warton[1,2], Jia Fan[1,2], Barbara Laughton[3], Andre van der Kouwe[4,5], and Ernesta Meintjes[1,2,6]

[1]Biomedical Engineering Research Centre, Division of Biomedical Engineering, Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa, [2]Neuroscience Institute, University of Cape Town, Cape Town, South Africa, [3]Tygerberg Children's Hospital, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa, [4]A.A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [5]Department of Radiology, Harvard Medical School, Boston, MA, United States, [6]Cape Universities Body Imaging Centre, University of Cape Town, Cape Town, South Africa

Keywords: Functional Connectivity, Neonatal

Motivation: The topological organisation of RSNs can be studied with graph theory. While graph nodes can be defined using atlases in adults, infant atlases are not readily available.

Goal(s): To create a framework to define nodes and edges for graph theory analyses of infant RSNs.

Approach: We resampled the original template voxel size and created evenly distributed nodes within RSNs.

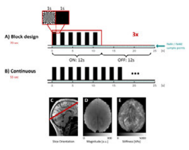
Results: We present a mask comprising 605 evenly-spaced spheres to discretize neonatal RSNs. Graph theory demonstrated lower global and/or nodal efficiency in 4 networks in HEU neonates compared to HUU, indicating decreased information transmission throughout and regionally within affected networks.

Impact: The proposed method may enable more comprehensive analyses of the topological organisation of RSNs in infant cohorts. This will advance knowledge on how functional networks process and distribute information from birth.

0335 Pitch: 16:00 Poster: 17:00 Screen 19

Real-time MR elastography of the brain in search of the fast viscoelastic response to functional activity

Jakob Schattenfroh[1], Helge Herthum[2], Matthias Anders[1], Carsten Warmuth[1], Josef Pfeuffer[3], Jürgen Braun[4], Ingolf Sack[1], and Stefan Hetzer[2]



[1]Department of Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Berlin Center for Advanced Neuroimaging, Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]Application Development, Siemens Healthcare GmbH, Erlangen, Germany, [4]Institute of Medical Informatics, Charité-Universitätsmedizin Berlin, Berlin, Germany

Keywords: Elastography, Elastography

Motivation: The need for advanced imaging techniques to precisely localize neuronal activity, overcoming the limitations of fMRI in terms of temporal resolution and direct measurement of neural activation.

Goal(s): To determine how neural activity influences tissue stiffness by detecting viscoelastic changes associated with neuronal firing and hemodynamic responses.

Approach: Using real-time MR elastography techniques to simultaneously measure both BOLD activation and viscoelastic changes in the brain during visual stimulation at two different time scales.

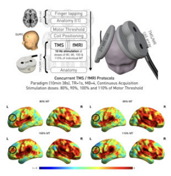
Results: Distinct viscoelastic activation patterns strongly link neurovascular coupling and tissue stiffness. However, no rapid viscoelastic response related directly to the underlying neural activity was detected.

Impact: Functional real-time MR elastography is sensitive to biomechanical property changes associated with the hemodynamic response to brain stimulation providing a valuable tool to study possible effects that occur on a subsecond timescale.

0336 Pitch: 16:00 Poster: 17:00 Screen 20

Interleaved TMS-fMRI Explains Variability in TMS Response

Maria Vasileiadi[1], Sarah Grosshagauer[1], Michael Woletz[1], Anna-lisa Schuler[2], David Linhardt[1], Nolan Williams[3], Christian Windischberger[1], and Martin Tik[1,3]



[1]Medical University of Vienna, Vienna, Austria, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Stanford University, Palo Alto, CA, United States

Keywords: Functional Connectivity, Brain Connectivity, brain stimulation

Motivation: TMS has become an invaluable asset in both research and clinical environments. However, variability in individual responses to TMS is a persistent issue, which limits its broader adoption.

Goal(s): The integration of TMS with fMRI through interleaved paradigms is a promising strategy for gaining insights into the factors that underlie this response variability.

Approach: Adopting an interleaved TMS-fMRI approach we explored the different factors of stimulation dose, sex differences, and cognitive state.

Results: Interleaved TMS-fMRI revealed individual dose-response patterns. Inherent sex differences were found between men and women. Precise timing of TMS relative to cognitive state demonstrated differential effects on relevant brain regions.

Impact: The findings represent a critical step toward addressing the challenge of response variability. TMS-fMRI promises to be a valuable tool for not only understanding factors that influence TMS response but also for potentially enhancing response rates in TMS applications.

Power Pitch

Pitch: AI-Empowered Image Reconstruction

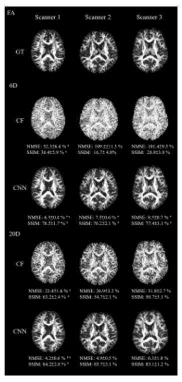
Power Pitch Theatre 2

Monday
Pitches: 16:00 - 17:00
Posters: 17:00 - 18:00

Moderators: Mehmet Akcakaya & Gastao Cruz

(no CME credit)

0337 Pitch: 16:00 Poster: 17:00 Screen 21



Accelerated Acquisition and Cross-Platform Reconstruction of Diffusion Tensor-Derived Indices Using Convolutional Neural Networks

Chih-Chien Tsai[1], Yao-Liang Chen[2], and Jiun-Jie Wang[1,2,3]

[1]Healthy Aging Research Center, Chang Gung University, Taoyuan, Taiwan, [2]Department of Diagnostic Radiology, Chang Gung Memorial Hospital at Keelung, Keelung, Taiwan, [3]Department of Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, Diffusion tensor imaging, convolutional neural network, curve fitting, mean diffusivity, fractional anisotropy

Motivation: Diffusion-MRI faced limitations due to extended scan times and scanner/protocol variations.

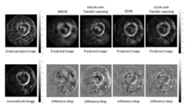
Goal(s): This study aims to assess its ability to accelerate imaging procedures and unify data from diverse sources.

Approach: A convolutional neural network was employed to reconstruct diffusion-weighted images into diffusion tensor images. The effectiveness of reconstructed model was evaluated by normalized mean-square error (NMSE) and structural similarity index (SSIM).

Results: The CNN showed significantly better SSIM and lower NMSE in FA and MD ($p < 0.001$) compared to conventional methods. Moreover, the CNN model maintained strong performance when applied to other Scanners for FA and MD.

Impact: Through convolutional neural networks, images might be acquired fast and easily be harmonized across platforms . Subsequent research will further utilize deep/machine learning tools to investigate the impact of reconstructed image-segmented brain regions on the performance of classification models.

0338 Pitch: 16:00 Poster: 17:00 Screen 22



Deep Complex Neural Network for Undersampling Spiral Artefact Removal in Diffusion Tensor Cardiovascular Magnetic Resonance with In-vivo Study

Yaqing Luo[1,2,3], Pedro F. Ferreira[1,2], Dudley J. Pennell[1,2], Guang Yang[2,4], Sonia Nielles-Vallespin[1,2], and Andrew D. Scott[1,2]

[1]National Heart and Lung Institute, Imperial College London, London, United Kingdom, [2]CMR Unit, Royal Brompton Hospital, London, United Kingdom, [3]EPSRC Centre for Doctoral Training in Smart Medical Imaging, King's College London and Imperial College London, London, United Kingdom, [4]Bioengineering Department and Imperial-X, Imperial College London, London, United Kingdom

Keywords: AI/ML Image Reconstruction, Diffusion Tensor Imaging

Motivation: Diffusion Tensor Cardiovascular Magnetic Resonance (DT-CMR) is hindered by low resolution and long acquisitions. Spiral trajectories could be efficient with effective removal of artefacts from undersampled images.

Goal(s): To remove artefacts from highly accelerated spiral in-vivo DT-CMR acquisitions using a novel deep learning method.

Approach: We proposed a Residual U-Net based Complex-valued Edge Attention Network (CEAN) to remove undersampling artefacts. Training with and without transfer learning were explored.

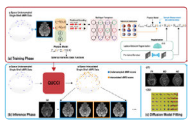
Results: CEAN with transfer learning outperformed other networks, achieving the lowest Mean Absolute Error (MAE) for DT-CMR parameters and preserving diffusion encoding information, suggesting future potentials in accelerating clinical DT-CMR studies.

Impact: This work will allow the acquisition and reconstruction of highly accelerated STEAM spiral DT-CMR, aided by the proposed deep Complex-valued Edge Attention Network. Further developments will allow increases in spatial resolution to facilitate clinical translation of DT-CMR.

0339 Pitch: 16:00

Poster: 17:00

Screen 23



[Unsupervised q-Space Interpolation Using Physics-Constrained Coordinate-Based Implicit Network]

Atakan Topcu[1,2], Abdallah Zaid Alkilani[1,2], Tolga Çukur[1,2,3], and Emine Ulku Saritas[1,2]

[1]Electrical and Electronics Department, Bilkent University, Ankara, Turkey, [2]National Magnetic Resonance Center (UMRAM), Bilkent University, Ankara, Turkey, [3]Neuroscience Graduate Program, Bilkent University, Ankara, Turkey

Keywords: AI/ML Image Reconstruction, Diffusion/other diffusion imaging techniques, implicit neural representation, q-space undersampling, spherical harmonics

Motivation: Most diffusion MRI techniques require extensive sampling of q-space to effectively resolve fiber structures at a fine detail. The scan times become impractically long, especially for clinical settings.

Goal(s): Our goal is to arbitrarily interpolate the q-space data to enable downsampling of q-space, while maintaining high fidelity diffusion metrics.

Approach: We propose QUCCI, a subject-specific unsupervised implicit network model that utilizes both implicit and physics-driven explicit regularization to encode diffusion MRI signals with angular continuity.

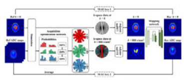
Results: QUCCI achieves superior q-space interpolation, outperforming traditional and deep learning methods.

Impact: QUCCI provides high-fidelity diffusion MRI metrics via improving the angular interpolation of diffusion MRI signals under highly undersampled q-space cases, which may especially be beneficial in the clinical settings where excessively long scan times are impractical.

0340 Pitch: 16:00

Poster: 17:00

Screen 24



[Joint learning of optimal acquisition and high quality ADC mapping for low field diffusion-weighted PROPELLER MRI]

Jiechao Wang[1], Lu Wang[1], Chunguang Zhang[2], Liangjie Lin[3], Congbo Cai[1], and Shuhui Cai[1]

[1]Xiamen University, Xiamen, China, [2]Foshan Ruijiatu Medical Technology Co., Ltd., Foshan, China, [3]MSC Clinical & Technical Solutions, Philips Healthcare, Beijing, China

Keywords: Acquisition Methods, Low-Field MRI

Motivation: Adequate image signal-to-noise ratio (SNR) and resolution within a reasonable scan time is challenging for low-field diffusion quantitative MRI.

Goal(s): To present a PROPELLER-acquisition and ADC mapping joint learning neural network to accelerate DWI with improved image SNR and resolution.

Approach: Considering the similar anatomical structure between diffusion-weighted MR images, this work achieved DWI PROPELLER-acquisition optimization and reconstructed high quality ADC maps from data acquired by optimized acquisition using U-net.

Results: *In vivo* and simulation results demonstrate that our proposed method can generate high SNR and resolution ADC maps within 2 minutes scan time under 0.23T human scanner.

Impact: Joint learning acquisition and quantitative reconstruction based on PROPELLER sampling trajectory using neural network has successfully achieved fast ADC mapping, offering great possibility for quantitative analysis in low-field diffusion MRI.

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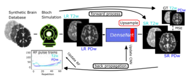

Joint sequence optimization beats pure neural network approaches for super-resolution TSE

Hoai Nam Dang[1], Vladimir Golkov[2,3], Jonathan Endres[1], Simon Weinmüller[1], Felix Glang[4], Thomas Wimmer[2], Daniel Cremers[2,3], Arnd Dörfler[1], Andreas Maier[5], and Moritz Zaiss[1,4,6]

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Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, super-resolution, turbo-spin-echo, joint-optimization

Motivation: TSE flip angle trains can have a strong influence on the actual resolution of the acquired image and have consequently a considerable impact on the performance of a super-resolution task.

Goal(s): We demonstrate the advantage of end-to-end optimization of sequence and neural network parameter compared to pure network training approaches.

Approach: This MR-physics-informed training procedure jointly optimizes radiofrequency pulse trains of a PD- and T2-weighted TSE and subsequently applied CNN to predict corresponding PDw and T2w super-resolution TSE images.

Results: The method generalizes from simulation-based optimization to in vivo measurements and acquired super-resolution images show higher accuracy compared to pure network training approaches.

Impact: Acquired super-resolution image may improve evaluation of the data. Reduction of acquisition time compared to direct high-resolution acquisition leads to increase in patient comfort and minimization of motion artifacts.

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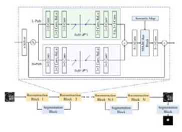

A Novel End-to-end Joint Reconstruction and Segmentation Interaction Network for MRI

Xiaodi Li[1] and Yue Hu[1]

[1]Harbin Institute of Technology, Harbin, China

Keywords: AI/ML Image Reconstruction, Data Processing

Motivation: For magnetic resonance imaging (MRI) applications, rapid imaging and automatic segmentation of target tissues are critical. However, most existing methods barely consider MR image segmentation in fast imaging scenarios.

Goal(s): Our goal is to simultaneously achieve high scanning acceleration and accurate multi-class tissue segmentation results under a unified framework.

Approach: We propose a novel multi-task method with a novel interaction module to reconstruct undersampled MR images based on modified ISTA-Net and simultaneously segment tissues based on lightweight U-Net.

Results: Experiments on cardiac and knee datasets demonstrate that our method outperforms existing state-of-the-art multi-task approaches for joint MR image reconstruction and segmentation.

Impact: The proposed multi-task interaction method can effectively achieve high scanning acceleration and accurate segmentation results simultaneously, which can further expand the application of MR in clinical disease diagnosis.

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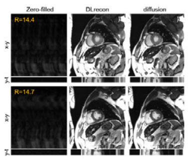
Clinically Feasible Diffusion Reconstruction for Highly-Accelerated Cardiac Cine MRI

Shihan Qiu[1,2,3], Shaoyan Pan[1,4,5], Yikang Liu[1], Lin Zhao[1], Jian Xu[6], Qi Liu[6], Terrence Chen[1], Eric Z. Chen[1], Xiao Chen[1], and Shanhui Sun[1]



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Keywords: AI/ML Image Reconstruction, Heart

Motivation: The currently limited quality of accelerated cardiac cine reconstruction may potentially be improved by the emerging diffusion models, but the clinically unacceptable long processing time poses a challenge.

Goal(s): To develop a clinically feasible diffusion-model-based reconstruction pipeline to improve the image quality of cine MRI.

Approach: A multi-in-multi-out diffusion enhancement model together with fast inference strategies were developed to be used in conjunction with a reconstruction model.

Results: The diffusion reconstruction reduced spatial and temporal blurring in prospectively undersampled clinical data, as validated by experts' inspection. The 1.5s/video processing time enabled the approach to be applied in clinical scenarios.

Impact: The proposed diffusion reconstruction pipeline provides a practical solution to cardiac cine reconstruction with enhanced quality for clinical usage. This pipeline may be transfered to the clinical application of other diffusion-based methods.

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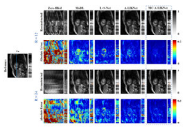
Deep-learning based motion-compensated A-LIKNet for cardiac Cine MRI reconstruction

Siying Xu[1], Aya Ghoul[1], Kerstin Hammernik[2], Jens Kuebler[3], Patrick Krumm[3], Andreas Lingg[3], Daniel Rueckert[2,4,5], Sergios Gatidis[1,6], and Thomas Kuestner[1]



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Keywords: AI/ML Image Reconstruction, Cardiovascular, Motion-compensated reconstruction

Motivation: Cardiac Cine MRI is commonly used for assessing cardiac function. However, extended acquisition times may cause patient discomfort or can result in respiratory motion artifacts and slice misalignments due to multiple breath-holds.

Goal(s): We aim to accelerate data acquisition into a single breath-hold ($$$\sim$$$24×) with spatial-temporal sharing along the cardiac cycle for accurate morphological and functional reconstruction.

Approach: We integrated inter-frame motion field estimations with a deep learning-based reconstruction. The motion-compensated A-LIKNet was trained on 115 subjects and tested on 14 subjects.

Results: The proposed method reconstructs high-quality images, especially improving morphological accuracy, and thus enables cardiac Cine imaging in a single breath-hold.

Impact: The proposed deep learning-based motion-compensated A-LIKNet can efficiently reconstruct highly undersampled cardiac Cine MRI for up to 24× accelerated acquisitions of a single breath-hold. Results demonstrate higher morphological authenticity, sharper details, and reduced artifacts compared to other methods.

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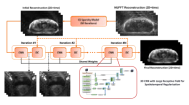

Model-Assisted Deep Learning-Based Reconstruction of Accelerated Golden-Angle Radial Data for Free-Breathing Dynamic Contrast-Enhanced MRI

Mahmoud Mostapha[1], Dominik Nickel[2], Laszlo Lazar[3], Nirmal Janardhanan[1], Simon Arberet[1], Daniel Tobias Boll[4], and Mariappan S. Nadar[1]

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Keywords: AI/ML Image Reconstruction, Image Reconstruction

Motivation: GRASP allows for free-breathing DCE-MRI with high spatial and temporal resolution. However, the current 4D iterative reconstruction is slow and still suffers from streaking artifacts, limiting clinical use.

Goal(s): Develop a DL solution that significantly reduces the reconstruction time and improves image quality.

Approach: A model-assisted DL reconstruction combining a sparsity model with an efficient 3D spatiotemporal network for fast and robust reconstruction of accelerated scans with high resolution.

Results: A sparsity-constrained DL-based can provide robust and fast reconstructions with improved image quality, evidenced by the superior quantitative metrics and the qualitative analysis of cases under-represented in the training data.

Impact: GRASP offers high-resolution 4D free-breathing DCE-MRI; however, it still suffers from under-sampling artifacts and long reconstruction times. A model-assisted DL reconstruction can reduce the reconstruction time, improve image quality, and increase system robustness—essential in translating to clinical practice.

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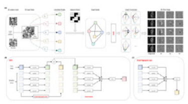

Unsupervised 4D-Flow MRI reconstruction with Deep Image Prior and Graph Convolution Neural-Network

Zhongsen Li[1], Aiqi Sun[2], Wenxuan Chen[1], Xiancong Liu[1], Haining Wei[1], Chuyu Liu[1], and Rui Li[1]

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Keywords: AI/ML Image Reconstruction, Cardiovascular

Motivation: Deep learning reconstruction algorithms offer significant advantages for accelerating 4D-Flow MRI acquisition. However, a large high-quality fully-sampled dataset is usually unavailable for network training.

Goal(s): To propose an unsupervised algorithm for 4D-Flow MRI reconstruction, without the need for any fully-sampled data.

Approach: We use branched CNNs and a Graph-Convolution-Network as the generator. Additionally, we devise an ADMM algorithm to alternately optimize the images and the network parameters. Experiments are conducted on aortic and intracranial 4D-Flow data.

Results: The proposed algorithm demonstrates superior reconstruction results, outperforming even supervised deep-learning method. Moreover, it exhibits good generalization capability when applied to another imaging target.

Impact: The proposed method is a promising algorithm for accelerating MR blood-flow imaging, owing to its exceptional performance and generalization capacity. Furthermore, the algorithm introduces a new model for 4D-flow MRI reconstruction which is valuable for further research.

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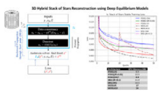

Robust Deep Equilibrium Paradigms for 3D Hybrid Stack of Stars Reconstruction

A M K Muntasir Shamim[1] and Kevin M Johnson[2,3,4]

[1]Electrical and Computer Engineering, University of Wisconsin-Madison, Madison, WI, United States, [2]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [3]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [4]Radiology, University of Wisconsin-Madison, Madison, WI, United States

Keywords: AI/ML Image Reconstruction, Image Reconstruction, Non-cartesian Reconstruction, Memory Efficient Reconstruction, Deep Learning, AI

Motivation: Exploring the stability of various memory efficient deep equilibrium architectures for non-cartesian stack of stars reconstruction.

Goal(s): Implementing memory efficient inversion-based and inversion free deep equilibrium models and assessing performance against unrolled network baselines.

Approach: Applying an implicit layer consisting of data-consistency and a 2D-UNet denoiser to find a fixed point and iteratively solving the optimization problem using proximal gradient descent with inversion free and inversion-based equilibrium backpropagation. Compare the efficacy of spectral normalization and Jacobian regularization on stability.

Results: The inversion-free deep equilibrium model exhibited performance similar to unrolled networks, achieving a significant 50% reduction in GPU memory usage.

Impact: Stable and memory-efficient training advances AI-based reconstructions by enhancing their robustness and efficiency, leading to more accurate diagnoses and treatments, ultimately improving patient care. Moreover, it renders these advanced AI solutions more accessible to resource-constrained systems.

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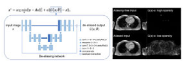

Accelerate 3D Coronary Magnetic Resonance Angiography by De-Aliasing Regularization based Compressed Sensing (DARCS)

Zhihao Xue[1], Fan Yang[1], Juan Gao[1], Zhuo Chen[1], Hao Peng[2], Chao Zou[2], and Chenxi Hu[1]

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Keywords: Machine Learning/Artificial Intelligence, Image Reconstruction, coronary magnetic resonance angiography, compressed sensing, deep learning

Motivation: While classical non-learning reconstruction methods for 3D coronary magnetic resonance angiography (CMRA) lack a task-adaptive image prior, 3D deep unrolling suffers from a low memory efficiency, causing a reduced number of iterations and a compromised image quality.

Goal(s): We aim to combine compressed sensing and deep learning regularization by using a trained de-aliasing network as the sparsifying transform.

Approach: We compared the method with PROST, Plug-and-Play, DAGAN, and MoDL for accelerating CMRA in 20 healthy subjects.

Results: Visual inspections and quantitative comparisons both found a substantially improved reconstruction quality from DARCS relative to the other methods.

Impact: The proposed method overcomes an important limitation of 3D unrolling while maintaining its core advantage of task-adaptive regularization. The method not only can accelerate 3D CMRA, but also has the potential for general 3D image reconstructions.

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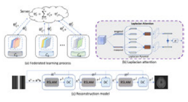

Generalizable and Accurate Federated learning for Fast MR imaging Equipped with Laplacian Attention Mechanism

Ruoyou Wu[1,2,3], Cheng Li[1], Juan Zou[1,4], Hairong Zheng[5], and Shanshan Wang[1,2]

[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Peng Cheng Laboratory, Shenzhen, China, [3]University of Chinese Academy of Sciences, Beijing, China, [4]School of Physics and Optoelectronics, Xiangtan University, Xiangtan, China, [5]Chinese Academy of Sciences, Shenzhen, China

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence

Motivation: Federated MR image reconstruction can make full use of data from multiple institutions while protecting patient privacy, but the images obtained by existing methods still need improvement in terms of fine structures.

Goal(s): Our goal is to improve the quality of clinical diagnosis by achieving accurate MR image reconstruction.

Approach: A Laplacian attention mechanism is proposed to capture fine structure and details for accurate MR image reconstruction from undersampled data.

Results: Qualitative and quantitative experimental results on an in-house and two public datasets validate the effectiveness of our method.

Impact: Federated MR image reconstruction promotes collaboration across multiple institutions and effectively leverages data from different organizations to enhance model performance, while mitigating privacy concerns.

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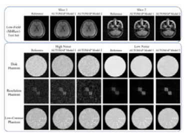

Evaluating Machine Learning-Based MRI Reconstruction Using Digital Image Quality Phantoms

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Keywords: AI/ML Image Reconstruction, Precision & Accuracy, image quality assessment, digital phantoms

Motivation: Quantitative image quality evaluation tools are needed for machine learning-based MR reconstruction.

Goal(s): To introduce digital image quality phantoms and evaluation metrics tailored for machine learning-based MR reconstruction, scalable to form large test sets, and flexible to simulate various object size, image contrast, signal-to-noise-ratio, resolution etc.

Approach: We created 2D disks, resolution arrays, and low-contrast phantoms resembling MR ACR phantom properties. The evaluation includes geometric accuracy, intensity uniformity, resolution, and low-contrast detectability. We evaluated the AUTOMAP reconstruction model trained on the M4Raw and FastMRI datasets with these phantoms.

Results: The study provides a tool for evaluating machine learning-based MRI reconstruction.

Impact: This research establishes digital phantoms and quantitative metrics for evaluating machine learning-based MRI reconstruction. These tools enable accurate assessment of fundamental image quality and generalizability over scan conditions, offering valuable feedback for improving machine learning-based methods development.

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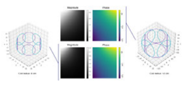

Coil Geometry Effects on Deep-learning-based MR Image Reconstruction

Natalia Dubljevic[1,2,3], Stephen Moore[2,3,4], Michel Louis Lauzon[2,3,5], Roberto Souza[3,6], and Richard Frayne[2,3,5]

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Keywords: AI/ML Image Reconstruction, Image Reconstruction

Motivation: Parallel imaging coil constraints can make it difficult to design comfortable coil arrays.

Goal(s): To investigate whether parallel imaging-imposed geometric coil constraints can be relaxed when using a deep learning (DL)-based image reconstruction method as opposed to a traditional non-DL method.

Approach: We synthesized an eight-channel head coil configuration and gradually increased coil overlap making the coils less ideal for parallel imaging. A DL reconstruction method was compared to a traditional non-DL method.

Results: As coil overlap increased, a smaller decrease in reconstruction performance was seen when using a DL method *versus* a non-DL method.

Impact: Our works suggests parallel imaging geometric coil constraints may be relaxed when using a deep learning reconstruction method. This flexibility would lead to an increased range of coil configurations that allow for improved patient comfort while decreasing scan times.

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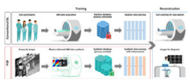

Physics-informed Synthetic Data Learning Boosts Multi-Scenario Fast MRI Reconstruction

Zi Wang[1], Xiaotong Yu[1], Chengyan Wang[2], Weibo Chen[3], Jiazheng Wang[3], Ying-Hua Chu[4], Hongwei Sun[5], Rushuai Li[6], Peiyong Li[7], Fan Yang[8], Haiwei Han[8], Taishan Kang[9], Jianzhong Lin[9], Chen Yang[10], Shufu Chang[11], Zhang Shi[11], Sha Hua[12], Yan Li[13], Juan Hu[14], Liuhong Zhu[10], Jianjun Zhou[10], Meijing Lin[1], Jiefeng Guo[1], Congbo Cai[1], Zhong Chen[1], Di Guo[15], and Xiaobo Qu[16]

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Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, MR Physics Model

Motivation: Deep learning (DL) is powerful for fast MRI reconstruction, but remains largely untapped in multiple clinical imaging scenarios.

Goal(s): To provide a feasible and cost-effective way to markedly boost the widespread usage of DL in various fast MRI applications.

Approach: In this work, we present a Physics-Informed Synthetic data learning framework for Fast MRI, called PISF, which is the first to enable generalizable DL for multi-scenario MRI reconstruction using solely one trained model.

Results: PISF trained on synthetic data enables high-quality, ultra-fast, and robust MRI reconstruction from different 4contrasts, 5 anatomies, 5 vendors and centers, and 2 pathologies, without further re-training.

Impact: Physics-informed synthetic data learning (DL) provides a feasible and cost-effective way to markedly boost the widespread usage of DL in various fast MRI applications, while freeing from the intractable ethical and practical considerations of *in vivo* human data acquisitions.

0353

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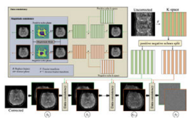
Screen 37



Zero-shot EPI Nyquist ghost correction with diffusion-based generative models and magnitude consistency regularization

Shoujin Huang[1], Jingyu Li[1], Yuwan Wang[1], Ziran Chen[1], Shaojun Liu[1], Yilong Liu[2], Yuhui Xiong[3], Bing Wu[3], Jingzhe Liu[4], Hua Guo[5], Ed X. Wu[6], and Mengye Lyu[1]

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Keywords: AI Diffusion Models, Data Processing, Phase error correct, Diffusion models.

Motivation: To address EPI phase error correction caused by the problem of inconsistent positive and negative phases.

Goal(s): We introduce an image prior-based method termed Phase Error Correction Diffusion-based Reconstruction with Echo Apart Magnitude-Consistency(PEC-DREAM).

Approach: The method was trained on structural imaging data, and it performs robustly the inference on EPI phase error correction task without specific model finetune. Here, we introduce novel data consistency including k-space and magnitude consistency to enhance the performance of the SGM during reverse diffusion.

Results: Experiments demonstrate the versatility of our approach across various scenarios, including human and rodent EPI, accelerated and non-accelerated imaging and SMS sampling.

Impact: The method we have proposed effectively addresses EPI phase error correction. Prospective experiments demonstrate the versatility of our innovative approach across various scenarios, and our method holds promise as a potent tool.

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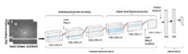

SISMIK: Search In Segmented Motion Input in K-space

Oscar Albert Dabrowski[1], Jean-Luc Falcone[1], Antoine Klauser[1], Julien Songeon[1], Michel Kocher[2], Bastien Chopard[1], Francois Lazeyras[1], and Sebastien Courvoisier[1]

[1]University of Geneva, Geneva, Switzerland, [2]EPFL, Geneva, Switzerland

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, k-space, motion, artifacts, quality metric

Motivation: Motion correction in MRI predominantly relies on image-based methods and continues to be a challenge. Innovative approaches could harness better motion information latent in k-space (i.e., the measurement space).

Goal(s): Developing a reference-less motion correction pipeline in k-space using deep learning.

Approach: Our k-space motion correction pipeline combines deep learning for motion parameter estimation with model-based image reconstruction. Large datasets were generated through physics-based simulations on 2D brain MRI acquisitions to enhance model training and performance.

Results: Our deep-learning model performs well in motion parameter estimation, even for successive motion events, effectively removing substantial motion artifacts when combined with model-based reconstruction.

Impact: SISMIK, our deep learning model successfully estimates motion parameters in the acquisition space of multi-slice 2D brain MRI. It allows substantial motion artifact removal through a model-based reconstruction approach, which is, by design, free of hallucination artifacts.

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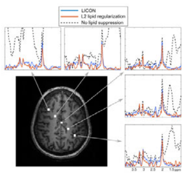


LIPCON: Lipid Identification with Convolutional Neural Network for MR Spectroscopic Imaging

Paul Weiser[1,2,3], Georg Langs[3], Stanislav Motyka[4], Bern Strasser[4], Wolfgang Bogner[4], Sébastien Courvoisier[5,6], Malte Hoffmann[1,2], Ovidiu Andronesi*[1,2], and Antoine Klauser*[1,5,7]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States, [3]Computational Imaging Research Lab - Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [4]High Field MR Center - Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [5]Center for Biomedical Imaging (CIBM), Geneva, Switzerland, [6]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [7]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland

Keywords: AI/ML Image Reconstruction, Spectroscopy, Lipid-Suppression, Brain, High-Field MR, Deep Learning

Motivation: Magnetic Resonance Spectroscopic Imaging (MRSI) offers non-invasive metabolic concentration mapping, aiding early pathology detection like brain tumors. However, extracranial lipid signals can compromise neurochemical data.

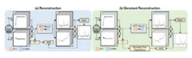
Goal(s): The potential of supervised neural networks remains unexplored, despite their success in other artifact removal and metabolite quantification tasks. We introduce a deep learning method for robust lipid removal.

Approach: Our approach is compared to a state-of-the-art L2-lipid-regularization using simulated and in-vivo whole-brain MRSI data.

Results: Our supervised deep learning method showed improved performance to the L2-lipid-regularization method by eliminating more lipid signal while preserving metabolic signals and spectral baseline.

Impact: The LIPCON method achieves accurate lipid suppression across whole-brain MRSI datasets without the need for parameter tuning and within a few seconds. This should mark a step in enhancing the reproducibility and efficiency of MRSI pipelines.

0356 Pitch: 16:00
Poster: 17:00
Screen 40



Deep Learning-based MRS Reconstruction with Artificial Fourier Transform Network (AFT-Net)

Yanting Yang[1], Matthieu Dagommer[1], and Jia Guo[1]

[1]Columbia University, New York, NY, United States

Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence

Motivation: Complex-valued deep neural network has not been fully investigated in MRS reconstruction and preprocessing.

Goal(s): We aim to solve the spectroscopy inverse problems in domain transform from FIDs to spectra, especially for accelerated MRS reconstruction.

Approach: A complex-valued deep learning framework artificial Fourier transform network (AFT-Net) is proposed to directly reconstruct and process the complex-valued raw data in the sensor domain.

Results: Evaluation of different acceleration rates was performed on the in vivo dataset. AFT-Net demonstrated the ability to reconstruct the data under up to 80 times acceleration rate. The proposed AFT-Net is an efficient and accurate approach for MEGA-PRESS MRS accelerated reconstruction.

Impact: MRS reconstruction and preprocessing with AFT-Net should be able to determine the domain-manifold mapping and process FID data directly, which shows superior performance compared with numerical method and can be served as an efficient and accurate approach for MRS acquisition.

Power Pitch

Pitch: Neuro-Oncology

Power Pitch Theatre 3

Monday
Pitches: 16:00 - 17:00
Posters: 17:00 - 18:00

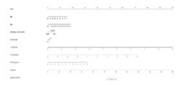
Moderators: Yoshiyuki Watanabe & Antonella Castellano

(no CME credit)

0357 Pitch: 16:00

Poster: 17:00

Screen 41



[Deep learning radiomic nomogram can distinguish intracranial solitary fibrous tumor from angiomatous meningioma: a multicenter study]

Xiaohong Liang[1], Xaioai Ke[2], Junlin Zhou[2], and Liqin Zhao[1]

[1]Beijing Tiantan Hospital, Capital Medical University, Beijing, China, [2]Lanzhou University Second Hospital, Lanzhou, China

Keywords: Tumors (Pre-Treatment), Machine Learning/Artificial Intelligence

Motivation: A novel and noninvasive method for distinguishing intracranial solitary fibrous tumor (ISFT) from angiomatous meningioma (AM) and predicting patient outcomes is urgent.

Goal(s): To evaluate the value of a MRI-based deep learning radiomic nomogram (DLRN) in distinguishing ISFT from AM and predicting patient outcomes.

Approach: A MRI-based DLRN was developed on training cohort (TC). We then validated it's performance on external validation cohort (EVC). Moreover, we investigated the value of the DLRN in survival analysis.

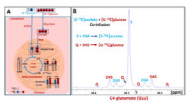
Results: The performance of DLRN was excellent (0.86 [0.84–0.88]) on EVC. Besides, DLRN was significantly associated with the overall survival (OS) of patients (n=273).

Impact: The proposed DLRN can potentially provide a noninvasive method for neurosurgeon to offer decision support for developing personalized treatment plans and predicting patient outcomes.

0358 Pitch: 16:00

Poster: 17:00

Screen 42



[In vivo metabolism of glucose and acetate in human meningiomas: A 13C NMR-based metabolic flux analysis]

Omkar B. Ijare[1], David S. Baskin[1], Suzanne Z. Powell[2], and Kumar Pichumani[1]

[1]Neurosurgery, Houston Methodist Hospital and Research Institute, Houston, TX, United States, [2]Pathology and Genomic Medicine, Houston Methodist Hospital and Research Institute, Houston, TX, United States

Keywords: Tumors (Pre-Treatment), Metabolism, 13C NMR, stable isotopomer analysis, metabolic imaging

Motivation: Metabolism plays a key role in the growth and proliferation of brain tumors including aggressive meningiomas. We previously reported that meningiomas preferentially utilize acetate as a bioenergetic substrate. However, the metabolism of acetate in the presence of glucose is not well understood.

Goal(s): To investigate the simultaneous *in vivo* metabolism of acetate and glucose in meningiomas.

Approach: We infused [2-^{13}C]acetate and [U-^{13}C]glucose as metabolic tracers in meningioma patients to determine the relative utilization of both nutrients by meningiomas.

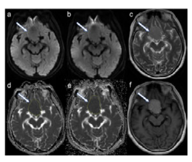
Results: Grade-II meningiomas utilize relatively less amount of glucose (grade-II: 0.6% vs. grade-I: ~5.4%) and more acetate than grade-I meningiomas (grade-II: 45.8% vs. grade-I: ~31.24%).

Impact: No chemotherapy is available for the treatment of meningiomas. The findings from this study will be helpful in designing targeted metabolic therapy for aggressive meningiomas using small molecule inhibitors (e.g., ACSS2 inhibitor) involved in acetate metabolism.

0359 Pitch: 16:00

Poster: 17:00

Screen 43



[Comparison of MUSE and ssEPI for diffusion-weighted imaging in meningioma: imaging quality and grading accuracy]

Danjie Lin[1], Yichao Zhang[2], Sihui Liu[1], Jialu Zhang[3], Yunjing Xue[1], and Lin Lin[1]

[1]Department of Radiology, Fujian Medical University Union Hospital, Fuzhou, Fujian, China, [2]School of Medical Imaging, Fujian Medical University, Fuzhou, Fujian, China, [3]MR Research, GE Healthcare, Beijing, China

Keywords: Tumors (Pre-Treatment), Neuro

Motivation: DWI is of key importance in evaluating biological behavior of meningioma, but image quality of conventional ssEPI-DWI is unsatisfactory due to susceptibility artifact near the skull.

Goal(s): Our goal was to compare the image quality of ssEPI-DWI and MUSE-DWI in meningiomas, and to compare diagnostic accuracy of them in meningiomas grading.

Approach: We used a 5-point Likert scale to assess image quality of DWI, and calculated SNR and CNR for quantitative evaluation. Combined models were constructed by using ADC histogram parameters extracted from whole tumor.

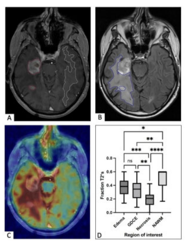
Results: MUSE-DWI significantly improved imaging quality of DWI, and showed a significantly higher diagnostic accuracy in meningioma grading.

Impact: Meningioma is the most commom intracranial tumours. This study revealed that MUSE-DWI, compared with ssEPI-DWI, can improve the imaging quality and grading accuracy of meningiomas, contributing to better clinical evaluation of meningiomas.

0360 Pitch: 16:00

Poster: 17:00

Screen 44



[Fast-Relaxing Sodium Fraction in Brain Tumors]

Christian Jan Oliver Neelsen[1], Sebastian Regnery[2], Nicolas Behl[3], Nina Weckesser[1], Felix Kurz[1], Jürgen Debus[2], Heinz-Peter Schlemmer[1], Mark Ladd[4], Daniel Paech[5], and Tanja Platt[1]

[1]German Cancer Research Center, Heidelberg, Germany, [2]Heidelberg University Hospital, Heidelberg Institute for Radiation Oncology (HIRO), Heidelberg Ion-Beam Therapy Center (HIT), National Center for Tumor Diseases (NCT), German Cancer Research Center (DKFZ), Heidelberg, Germany, [3]Siemens Healthineers AG, Erlangen, Germany, [4]German Cancer Research Center, Heidelberg University, Heidelberg, Germany, [5]German Cancer Research Center, University Hospital Bonn, Bonn, Germany

Keywords: Tumors (Pre-Treatment), Cancer, Sodium, Relaxometry

Motivation: Enhance the specificity of sodium (^{23}Na) imaging in brain tumors.

Goal(s): Distinguish intracellular and extracellular sodium distribution in glioblastoma.

Approach: We assessed the fraction of fast-relaxing sodium (F_{T2*s}) in 19 glioblastoma patients using a 3D radial ^{23}Na pulse sequence with six echoes at 7T.

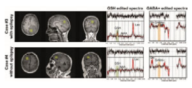
Results: F_{T2*s} was high in normal appearing white matter resembling expected intracellular behavior, and low in necrotic regions, akin to fluid-like environments. Values for contrast-enhancing tumors and adjacent edema were in between. The differentiation between normal brain tissue and changes in glioblastoma underscores the potential of F_{T2*s} to improve the specificity of sodium imaging in brain tumors.

Impact: The study could facilitate the establishment of the fast-relaxing sodium fraction as a diagnostic tool in brain tumors, potentially improving specificity in sodium quantification.

0361 Pitch: 16:00

Poster: 17:00

Screen 45



[In vivo detection of GSH and GABA in high-grade glioma using MEGA-sLASER spectral editing at 3 T]

Seyma Alcicek[1,2,3,4], Andrei Manzhurtsev[1], Michael W. Ronellenfitsch[2,3,4,5], Dinesh Deelchand[6], Joachim P. Steinbach[2,3,4,5], Vincent Prinz[7], Marie-Thérèse Forster[7], Elke Hattingen[1,2,3,4], Ulrich Pilatus[1], and Katharina J. Wenger[1,2,3,4]

[1]Institute of Neuroradiology, Goethe University Frankfurt, University Hospital, Frankfurt am Main, Germany, [2]University Cancer Center Frankfurt (UCT), Frankfurt am Main, Germany, [3]Frankfurt Cancer Institute (FCI), Frankfurt am Main, Germany, [4]German Cancer Research Center (DKFZ) Heidelberg, Germany and German Cancer Consortium (DKTK), Partner Site Frankfurt/Mainz, Frankfurt am Main, Germany, [5]Dr. Senckenberg Institute of Neurooncology, Goethe University Frankfurt, University Hospital, Frankfurt am Main, Germany, [6]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [7]Department of Neurosurgery, Goethe University Frankfurt, University Hospital, Frankfurt am Main, Germany

Keywords: Tumors (Pre-Treatment), Brain

Motivation: Alterations in glutamatergic and GABAergic (gamma-aminobutyric acid) mechanisms render peritumoral neuronal networks of infiltrating glioma hyper-excitable and more prone to seizures.

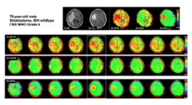
Goal(s): Glutamate, glutamine, glutathione (GSH), and GABA are therefore key metabolites in glioma-associated epilepsy.

Approach: Nowadays, J-editing MR spectroscopy is the primary technique in the detection of low-abundant metabolites (e.g., GSH, GABA) that overlap with more prominent signals. We used this technique combined with sLASER sequence (MEGA-sLASER) to improve localization accuracy and showed its reliability/repeatability for GSH and GABA quantification in glioblastoma, IDH-wildtype.

Results: This approach could foster our understanding of the biological effects of novel drugs targeting tumor-associated epilepsy.

Impact: MEGA-sLASER might improve the detectability and MRS localization accuracy of low-abundant metabolites (GSH, GABA) even in rather small, heterogeneous solid tumors. Here, we show the reliability/reproducibility of this method in the investigation of glioma-associated epilepsy in glioblastoma patients.

0362 Pitch: 16:00 Poster: 17:00 Screen 46



[Feasibility of 3D APT and NOE mapping using extrapolated semi-solid magnetization transfer reference fitting in brain tumors]

Osamu Togao[1], Jochen Keupp[2], Tatsuhiro Wada[3], Koji Yamashita[4], Kazufumi Kikuchi[1], and Kousei Ishigami[4]

[1]Department of Molecular Imaging & Diagnosis, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan, [2]Philips Research, Hamburg, Germany, [3]Division of Radiology, Department of Medical Technology, Kyushu University Hospital, Fukuoka, Japan, [4]Department of Clinical Radiology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan

Keywords: Tumors (Pre-Treatment), CEST & MT

Motivation: Currently, APT and NOE imaging with extrapolated semi-solid magnetization transfer reference (EMR) fitting has been performed with single-slice acquisition.

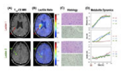
Goal(s): To demonstrate the feasibility of 3D APT and NOE imaging with EMR fitting using the 3D CEST sequence with CS-SENSE in patients with brain tumors.

Approach: 3D CEST imaging with CS-SENSE was adjusted to clinical scan. EMR fitting was performed on the 3D data.

Results: 3D APT and NOE mapping was feasible in all patients with brain tumors by using the 3D CEST imaging with CS-SENSE within a clinically acceptable acquisition time.

Impact: The feasibility of 3D APT and NOE mapping using 3D CEST imaging with CS-SENSE was demonstrated. Quantitative evaluation of APT and NOE on multiple slices allows for the quantitative assessment for the entire tumor area.

0363 Pitch: 16:00 Poster: 17:00 Screen 47



[Evaluating the Clinical Utility and Diagnostic Value of High-Resolution Deuterium MRS Imaging (DMRSI) in Patients with Brain Tumor]

Xiao-Hong Zhu[1], Xin Li[1], Yudu Li[2,3], Bashar Aldaraiseh[4], Liam Chen[4], Zhi-Pei Liang[2,5], Clark Chen[6], Kamil Ugurbil[1], and Wei Chen[1]

[1]CMRR, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [4]Deptartment of Laboratory Medicine and Pathology, University of Minnesota, Minneapolis, MN, United States, [5]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [6]Department of Neurosurgery, University of Minnesota, Minneapolis, MN, United States

Keywords: Tumors (Post-Treatment), Cancer, Deuterium metabolic Imaging

Motivation: Deuterium MRS imaging (DMRSI) can detect Warburg Effect in brain tumors; however, its clinical utility and value in brain tumor diagnosis and treatment has not been investigated.

Goal(s): To perform a preliminary investigation in human patients with brain tumor.

Approach: High-resolution dynamic DMRSI (HR-DMRSI) study was conducted in brain tumor patients on a 7T clinical scanner with an oral D66-glucose administration; biospecimens taken from DMRSI positive and negative regions were analyzed and compared with the DMRSI and clinical MRI results.

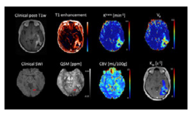
Results: HR-DMRSI technology enables detection and characterization of glioma infiltration with a level of precision surpassing traditional imaging modalities.

Impact: We clearly demonstrate that 7T high-resolution dynamic deuterium (^{2}H) MRS imaging is able to detect and characterize glioma infiltration in individual human patients with high accuracy and specificity that exceeds conventional imaging modalities available in standard clinical setting.

0364 Pitch: 16:00

Poster: 17:00

Screen 48



Improved MR Multitasking-based Dynamic Imaging for Cerebrovascular Evaluation (MT-DICE): Towards Multiparametric Brain Tumor Evaluation

Yang Chen[1,2], Jiayu Xiao[2], Anthony G. Christodoulou[3], Debiao Li[4], Frances Chow[5], Gabriel Zada[6], Eric Chang[7], Mark Shiroishi[2], and Zhaoyang Fan[1,2]

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Keywords: Tumors (Post-Treatment), DSC & DCE Perfusion, multiparametric brain tumor evaluation

Motivation: The lack of pathophysiologically relevant quantitative information hinders the precision management of brain tumors. Specifically, the characterization of intra-tumor heterogeneity influencing treatment decision-making, remains a critical challenge.

Goal(s): This work aims to optimize a recently developed technique MT-DICE, to provide multiparametric mapping information for more comprehensive brain tumor evaluation.

Approach: The MT-DICE technique was further refined by including 3D flow compensation, dictionary-based mapping, and water exchange quantification. Assessments for the repeatability of MT-DICE parameters and their agreement with routine measurements were performed.

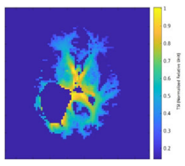
Results: Excellent reproducibility and agreement were achieved. Spatially co-registered multiparametric maps from MT-DICE facilitated comprehensive brain tumor characterization.

Impact: Individuals with brain tumors may benefit from more comprehensive brain tumor evaluation using multiparametric maps derived from our improved MT-DICE technique.

0365 Pitch: 16:00

Poster: 17:00

Screen 49



Personalized Radiotherapy Clinical Target Volume from a novel DTI-derived Tumour Spread Index (TSI) map

Parandoush Abbasian[1,2], Lawrence Ryner[1,2], Boyd McCurdy[1,2], Saranya Kakumanu[3,4], Niranjan Venugopal[1,5], James Guan[5], and Marshall Pitz[2,6]

[1]Physics and Astronomy, University of Manitoba, Winnipeg, MB, Canada, [2]Paul Albrechtsen Research Institute, CancerCare Manitoba, Winnipeg, MB, Canada, [3]Radiology, University of Manitoba, Winnipeg, MB, Canada, [4]Radiation Oncology, CancerCare Manitoba, Winnipeg, MB, Canada, [5]Medical Physics, CancerCare Manitoba, Winnipeg, MB, Canada, [6]Internal Medicine, University of Manitoba, Winnipeg, MB, Canada

Keywords: Tumors (Pre-Treatment), Radiotherapy, Glioblastoma

Motivation: GBM patients suffer from poor treatment outcome. The current radiotherapy planning (i.e. GTV, CTV, PTV) does not adjust the CTV margin to account for the microscopic spread of the glioma tumour cells along white matter fiber tracts.

Goal(s): Utilizing DTI MRI to tailor the CTV margin to each patient's unique tumour progression pathway.

Approach: Pre-surgical DTI-based tractography was used to quantify tumor spread probability, producing the Tumour Spread Index (TSI) map, which was used to generate a personalized CTV.

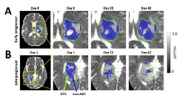
Results: This proof-of-concept study showed that using DTI-based tractography with a TSI map to personalize CTV improved coverage of recurrent regions in follow-up imaging.

Impact: Utilizing tractography to map the probable path of tumour spread and use this to direct radiation is a new paradigm in targeted radiotherapy which may lead to improved progression free survival in GBM patients.

0366 Pitch: 16:00

Poster: 17:00

Screen 50



Optimizing early response assessment in glioblastoma using diffusion imaging on a 1.5T MR-Linac

Liam S. P. Lawrence[1], Brige Chugh[2,3], James Stewart[2], Mark Ruschin[2], Aimee Theriault[2], Jay Detksy[2], Sten Myrehaug[2], Pejman J. Maralani[2], Chia-Lin Tseng[2], Hany Soliman[2], Mary Jane Lim-Fat[4], Sunit Das[5], Greg J. Stanisz[1,6,7], Arjun Sahgal[2], and Angus Z. Lau[1,6]

[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Department of Radiation Oncology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [3]Department of Physics, Toronto Metropolitan University, Toronto, ON, Canada, [4]Division of Neurology, Department of Medicine, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [5]Department of Surgery, St. Michael's Hospital, Toronto, ON, Canada, [6]Physical Sciences Platform, Sunnybrook Research Institute, Toronto, ON, Canada, [7]Department of Neurosurgery and Paediatric Neurosurgery, Medical University, Lublin, Poland

Keywords: Tumors (Post-Treatment), Cancer, Glioblastoma, apparent diffusion coefficient, response assessment

Motivation: Early response assessment for glioblastoma may be possible using regions of low apparent diffusion coefficient (low-ADC) during MRI-linear accelerator (MR-Linac) treatment, but low-ADC definition has not been optimized.

Goal(s): Optimize definition of low-ADC for correlation with progression-free survival.

Approach: We defined low-ADC regions from near-daily diffusion-weighted imaging and weekly contrast-enhanced T_1-weighted imaging for 41 glioblastoma patients during MR-Linac treatment (3-6 weeks). We compared correlation strength across b-values (800 versus 2000s/mm^2) and ADC thresholds (0.7 to 2.0µm^2/ms).

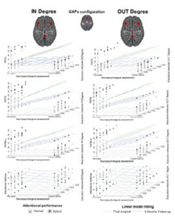
Results: The optimal b-value/threshold combination was b=800s/mm^2 and 1.2µm^2/ms (correlation for weeks 2-6).

Impact: We showed that early response assessment in glioblastoma during radiotherapy is possible with weekly acquisition of ADC maps and contrast-enhanced T_1-weighted imaging on MR-Linacs. Low-ADC regions could serve as targets for radiotherapy dose escalation to potentially extend patient survival.

0367 Pitch: 16:00

Poster: 17:00

Screen 51



Functional dynamic patterns of executive networks predict postoperative attentive outcome in glioma patients

Francesca Saviola[1,2], Luca Zigiotto[3,4], Silvio Sarubbo[3,4], and Jorge Jovicich[2]

[1]Department of Medical and Surgical Specialties, Radiological Sciences and Public Health, University of Brescia, Brescia, Italy, [2]CIMeC, Center for Mind/Brain Sciences, University of Trento, Rovereto, Italy, [3]Department of Neuroscience, Division of Neurosurgery, S.Chiara Hospital, APSS Trento, Trento, Italy, [4]Structural and Functional Connectivity Lab, S.Chiara Hospital, APSS Trento, Trento, Italy

Keywords: Tumors (Post-Treatment), Brain Connectivity, Neuroscience, Tumors

Motivation: Brain surgery glioma patients frequently exhibit attentional deficit, however the prediction of its appearance is largely unknown.

Goal(s): Investigate longitudinal temporal properties of executive function to gain insights about its relationship with cognitive attentive performance in gliomas.

Approach: We used longitudinal dynamic functional connectivity analysis of executive networking to associate it with neuropsychological attentive and executive performance.

Results: Post-surgical attentive performance is strictly related to functional temporal properties of executive networks, regardless of gliomas' features. Underlying substrates of impairment in the executive domain could be explained by looking at changes in temporal persistence of highly co-activated fronto-parietal networking.

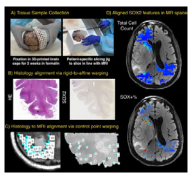
Impact: Co-activation patterns framework enables the prediction of post-operative attentional deficits by looking at pre-surgical temporal features of executive networking. We demonstrate how the dynamic nature of the brain contains crucial features to develop clinically relevant imaging markers for gliomas recovery.

0368

Pitch: 16:00

Poster: 17:00

Screen 52



A precise location comparison of SOX2 positive glioma invasion and conventional MP-MRI signatures at autopsy

Samuel Bobholz[1], Aleksandra Winiarz[1], Allison Lowman[1], Michael Flatley[1], Savannah Duenweg[1], Biprojit Nath[1], Fitzgerald Kyereme[1], Jennifer Connelly[1], Dylan Coss[1], Max Krucoff[1], Anjishnu Banerjee[1], and Peter LaViolette[1]

[1]Medical College of Wisconsin, Milwaukee, WI, United States

Keywords: Tumors (Post-Treatment), Tumor, glioma, neuro-oncology

Motivation: SOX2 is a marker of pluripotency that highlights tumor invasion beyond gross histological signatures, but the imaging characteristics of pluripotent tumor areas are unknown.

Goal(s): Do conventional imaging signatures deliniate SOX2 positive staining tumor cell regions?

Approach: This study compared imaging data from 22 glioma patients to aligned SOX2 autopsy tissue samples.

Results: SOX2-positive regions were often present beyond the imaging-defined tumor mass, with a positive but not collinear association between SOX2 and cell density across most. However, MR intensity distributions did not effectively distinguish SOX2 positivity.

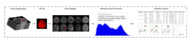
Impact: These results highlight a novel signature of tumor presence that exists well-beyond the imaging-defined margin and is not readily detectable via conventional imaging. These areas are spared treatment and require new technological developments to detect non-invasively.

0369

Pitch: 16:00

Poster: 17:00

Screen 53



Whole-Tumor Histogram Analysis of Synthetic MRI Predicts IDH mutation status in gliomas

Xin Ge[1], Ying shen[2], Yuhui Xiong[3], Min Li[3], Xiaodong Wang[4], and Jing Zhang[5]

[1]Second Clinical School, Lanzhou University, Lanzhou, China, [2]Department of Rehabilitation Medicine, Second Affiliated Hospital of Air Force Military Medical University, Xi'an, China, [3]GE Healthcare MR Research, Beijing, China, Beijing, China, [4]Department of Radiology, General Hospital of Ningxia Medical University, Yinchuan, China, [5]Department of Magnetic Resonance, Lanzhou University Second Hospital, Lanzhou, China

Keywords: Tumors (Pre-Treatment), Brain, Gliomas, Isocitrate Dehydrogenase, Synthetic MRI, Histogram Analysis

Motivation: There is an urgent need to identify a novel, cost-effective, and non-invasive method for determining the IDH mutation status in differentiating between astrocytoma and glioblastoma.

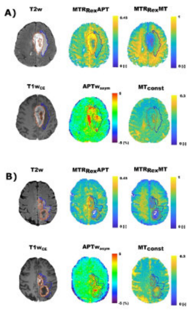
Goal(s): To investigate the potential value of whole-tumor histogram metrics derived from synthetic MRI in distinguishing IDH mutation status.

Approach: Histogram metrics were extracted from the quantitative maps. Variables with statistical significance in univariate analysis were included in multivariate logistic regression analysis to develop the combined model. The AUC were used to assess the diagnostic performance of metrics and models.

Results: The combined model could be a valuable preoperative tool to distinguish IDH mutation status.

Impact: The current study proposes a combined model that comprises T1-10th, cT1-10th, and age. This model demonstrates differentiation between IDH-M astrocytoma and IDH-W glioblastoma. Moreover, it has the potential to decrease genetic testing expenses while offering treatment decision support for clinicians.

0370 Pitch: 16:00 Poster: 17:00 Screen 54



Relaxation-compensated CEST imaging of the APT can predict response to radiotherapy and progression-free survival in patients with glioma at 3T

Nikolaus von Knebel Doeberitz[1], Florian Kroh[2,3], Svenja Graß[1], Laila König[4], Cora Bauspieß[1], Philip S. Boyd[2], Jürgen Debus[4,5,6], Peter Bachert[2,3], Mark E. Ladd[2,3,6], Heinz-Peter Schlemmer[1,6], Andreas Korzowski[2], and Daniel Paech[1,7]

[1]Division of Radiology, German Cancer Research Center, Heidelberg, Germany, [2]Division of Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany, [3]Faculty of Physics and Astronomy, University of Heidelberg, Heidelberg, Germany, [4]Department of Radiation Oncology, Heidelberg University Hospital, Heidelberg, Germany, [5]Clinical Cooperation Unit Radiation Oncology, German Cancer Research Center, Heidelberg, Germany, [6]Faculty of Medicine, University of Heidelberg, Heidelberg, Germany, [7]Department of Neuroradiology, Bonn University Hospital, Bonn, Germany

Keywords: Tumors (Pre-Treatment), CEST & MT, Asymmetry-based and Lorentzian-fit-based CEST contrast reconstruction

Motivation: There is a scarcity of studies comparing the clinical value of asymmetry- and different Lorentzian-fit-based CEST contrasts of the amide proton transfer (APT) and semi-solid magnetization transfer (ssMT) in patients with glioma.

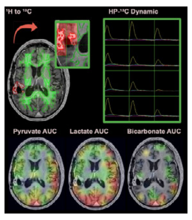
Goal(s): To assess and compare the potential of asymmetry-based ($APTw_{asym}$) and Lorentzian-fit-based CEST imaging with ($MTR_{Rex}APT$ and $MTR_{Rex}MT$) and without (MT_{const}) relaxation compensation for the prediction of therapy response and survival in patients with glioma.

Approach: 78 study participants prospectively underwent CEST MRI at baseline before radiotherapy.

Results: Imaging of the $MTR_{Rex}APT$ and $MTR_{Rex}MT$ predicted response to radiotherapy, whilst the $MTR_{Rex}APT$ was also associated with progression-free survival.

Impact: Here we demonstrate for the first time that Lorentzian-fit-based CEST imaging of the APT and ssMT with relaxation compensation can predict therapy response and progression-free survival of patients with glioma at baseline before radiotherapy, at 3T.

0371 Pitch: 16:00 Poster: 17:00 Screen 55



Clinical evaluation of patients with recurrent glioblastoma using hyperpolarized carbon-13 metabolic imaging

Sana Vaziri[1], Adam Autry[1], Jeremy W Gordon[1], Marisa LaFontaine[1], Hsin-Yu Chen[1], Yaewon Kim[1], Javier Villanueva-Meyer[1], Peder EZ Larson[1], Daniel B Vigneron[1,2], Nancy Ann Oberheim Bush[3,4], Susan M Chang[3], Jennifer Clarke[3,4], Duan Xu[1], Janine Lupo[1], and Yan Li[1]

[1]Radiology and Biomedical Imaging, UC San Francisco, San Francisco, CA, United States, [2]Bioengineering and Therapeutic Science, UC San Francisco, San Francisco, CA, United States, [3]Neurological Surgery, UC San Francisco, San Francisco, CA, United States, [4]Neurology, UC San Francisco, San Francisco, CA, United States

Keywords: Tumors (Post-Treatment), Hyperpolarized MR (Non-Gas)

Motivation: Despite aggressive treatments, patients with GBM have a median overall survival of 14-16 months and a need for noninvasive evaluation of therapeutics is apparent.

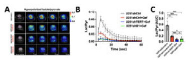
Goal(s): To assess whether treatment-induced metabolic changes can be observed in patients using parameters derived from hyperpolarized 13C metabolic imaging data.

Approach: 19 patients with recurrent GBM were followed for at least 6 months following treatment initiation and evaluated at various timepoints using HP-13C imaging.

Results: A difference in trends following treatment was observed in pyruvate-to-lactate conversion for patients who received anti-angiogenic treatments as compared to those who received a protein kinase inhibitor.

Impact: Given the challenges associated with evaluating progression and response to therapy in patients with glioblastoma using conventional MRI, this study provided evidence that hyperpolarized carbon-13 techniques can detect serial changes in dynamic metabolism which might help predict disease status.

0372 Pitch: 16:00 Poster: 17:00 Screen 56



Investigation of 1H and hyperpolarized 13C spectroscopy-based biomarkers for dual inhibition of TERT and EGFR in GBM cell and animal models.

Donghyun Hong[1], Noriaki Minami[1], and Sabrina M Ronen[1]

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

Keywords: Tumors (Post-Treatment), Spectroscopy, Tumor, Drugs, Hyperpolarized MR (Non-Gas)

Motivation: Inhibiting TERT or its upstream transcription factor GABPB1 can result in tumor growth inhibition. Inhibiting EGFR, upstream of TERT, can also reduce TERT expression.

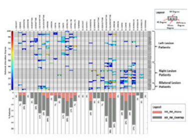
Goal(s): Investigating the combined effects of EGFR and TERT inhibition and assessing whether our MRS-based biomarkers can detect the impact of this combination therapy in cell and animal models.

Approach: Proton and hyperpolarized ^{13}C spectroscopy in cell and animal models

Results: Enhanced inhibition of both cell and tumor growth was observed in our GBM models when TERT/GABPB1 and EGFR were targeted simultaneously. This was associated with a drop in hyperpolarized lactate production from pyruvate.

Impact: This study identifies HP lactate as a metabolic biomarker of response to the dual TERT/GABPB1 and EGFR inhibition in cells and animals and points to the value of this biomarker in detecting the added value of this novel combination therapy.

0373 Pitch: 16:00 Poster: 17:00 Screen 57



Assessment of structural-functional integration impact on connectivity abnormalities in glioma patients

Maria Colpo[1,2], Erica Silvestri[2], Diego Cecchin[1,3], Maurizio Corbetta[1,4], and Alessandra Bertoldo[1,2]

[1]*Padova Neuroscience Center, University of Padova, Padova, Italy,* [2]*Department of Information Engineering, University of Padova, Padova, Italy,* [3]*Department of Medicine, Unit of Nuclear Medicine, University of Padova, Padova, Italy,* [4]*Department of Neuroscience, University of Padova, Padova, Italy*

Keywords: Tumors (Pre-Treatment), Brain Connectivity, Glioma; Multimodal; Integration; Structural Connectivity; Functional Connectivity

Motivation: Brain networks glioma's disruption was often explored through separate examinations of structural and functional connectivity. However, there were limited efforts in glioma research to investigate the interplay between structure-function and how this connection might influence our comprehension.

Goal(s): Can integrating structural and functional connectivity aid understanding the alterations' neurobiological foundation in brain networks caused by glioma?

Approach: The study design involves standard diffusion MR and rs-fMRI preprocessing, statistical methods including Pearson and Spearman correlation and Euclidean distance computation.

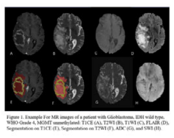
Results: This study underscores the significance of examining structure-function integration, where both microstructure and function play crucial roles in relation to white matter integrity.

Impact: Glioma, the primary brain tumor, affects both structural and functional connectivity. Understanding alterations in structure-function integration and connection with single-modalities, may be of highest significance for a more comprehensive explanation of compensatory mechanisms induced by glioma and its clinical progression.

0374 Pitch: 16:00 Poster: 17:00 Screen 58

[Radiomics for predicting Grades, IDH mutation and MGMT promoter methylation of Adult Diffuse Gliomas: Combination of structural MRI, ADC and SWI]

Zhengyang Zhu[1], Jianan Zhou[1], Huiquan Yang[1], Xue Liang[1], Xin Zhang[1], and Bing Zhang[1]



[1]Department of Radiology, Department of Radiology, The Affiliated Drum Tower Hospital of Nanjing University Medical School, Nanjing University, Nanjing, China

Keywords: Tumors (Pre-Treatment), Tumor, Glioma; SWI; ADC; Machine learning

Motivation: WHO Grade, IDH mutation and MGMT promoter methylation are important for precise diagnosis and treatment plans for diffuse glioma patients.

Goal(s): This study aimed to investigate the predictive value of radiomics features extracted from Structural MRI, ADC and SWI.

Approach: Radiomic features were extracted from T1WI, T2WI, T1CE, FLAIR, ADC and SWI. Analysis of variance F-test were used for feature selection. 11 classifiers were utilized for model establishment.

Results: For WHO Grade task, the highest AUC was 0.990; for IDH mutation task, the highest AUC was 0.947. All the constructed models failed to predict MGMT promoter methylation status efficiently.

Impact: This work will help neuro-oncologists better understand the radiological manifestation of gliomas.

0375 Pitch: 16:00 Poster: 17:00 Screen 59

[Deep learning enables robust quantification of cerebral blood flow using ASL in the presence of pathology: Application to treated gliomas]

Zhuoqin Yang[1], James Ruffle[2], H Rolf Jäger [2,3], Parashkev Nachev[2], Harpreet Hyare[2,3], Magdalena Sokolska[2,4], and Hui Zhang[1]

[1]Department of Computer Science, University College London, London, United Kingdom, [2]Queen Square Institute of Neurology, University College London, London, United Kingdom, [3]Imaging, University College London Hospitals, London, United Kingdom, [4]Medical Physics and Biomedical Engineering, University College London Hospitals, London, United Kingdom

Keywords: Tumors (Post-Treatment), Arterial spin labelling, Machine Learning/Artificial Intelligence, Tumor

Motivation: The accuracy of cerebral blood flow (CBF) quantification in arterial spin labelling (ASL) may reduce in regions exhibiting pathology-induced signal abnormalities in proton density (PD) images.

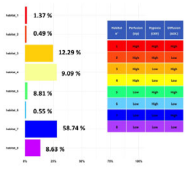
Goal(s): To develop an algorithm for improved CBF quantification by correcting signal abnormalities in PD images due to pathology.

Approach: To correct signal abnormalities, an image-inpainting algorithm based on deep learning (DL) was developed using healthy subject data. The algorithm was demonstrated with an application to patients post tumour treatment.

Results: The developed DL algorithm was able to effectively correct signal abnormalities, resulting in improved CBF maps.

Impact: The improvement in CBF accuracy through DL-corrected PD images may aid clinicians in their assessment of patients. This study demonstrates the potential benefit of the proposed method in an example application of monitoring tumour recurrence post treatment with ASL.

0376 Pitch: 16:00 Poster: 17:00 Screen 60



Imaging tumor habitats with PET-MRI HYPERDIrect maps to decode the spatial heterogeneity of malignant gliomas

Gianluca Nocera[1,2,3], Nicolo Pecco[1,2], Pasquale Anthony Della Rosa[2], Paola Scifo[4], Marcella Callea[5], Ilaria Neri[4], Federico Fallanca[4], Maria Picchio[1,4], Filippo Gagliardi[3], Pietro Mortini[1,3], Andrea Falini[1,2], Michele Bailo[3], and Antonella Castellano[1,2]

[1]Università Vita-Salute San Raffaele, Milano, Italy, [2]Neuroradiology Unit and CERMAC, IRCCS Ospedale San Raffaele, Milano, Italy, [3]Department of Neurosurgery and Gamma Knife Radiosurgery, IRCCS Ospedale San Raffaele, Milan, Italy, [4]Department of Nuclear Medicine, IRCCS Ospedale San Raffaele, Milan, Italy, [5]Pathology Unit, IRCCS Ospedale San Raffaele, Milan, Italy

Keywords: Tumors (Pre-Treatment), Radiomics, Malignant gliomas, Habitat imaging

Motivation: Malignant gliomas are characterized by considerable intra-tumor heterogeneity directly related to treatment failure. Habitat imaging allows to visualize *in vivo* such heterogeneity.

Goal(s): Investigating a novel approach based on 3T PET/MRI acquisitions for assessing HYpoxia, PErfusion, DIffusion, and methionine-PET for tissue metabolism in malignant gliomas.

Approach: Quantitative data from PET/MRI are combined in a unique HYPERDIrect map to identify discrete radiomic clusters or `habitats', possibly reflecting diverse genetic and biological features, to be proven by image-guided tissue sampling.

Results: Preliminary analysis showed high habitat imaging reproducibility and a reliable correlation between the expected microenvironment of the different habitats and the actual histopathological characteristics.

Impact: The HYPERDIrect map may represent a tool for decoding pattern of glioma heterogeneity and a new biomarker for stratifying prognosis and selecting patients for personalized approaches.

Study Group Business Meeting

Body MRI Business Meeting

Room 324 — Monday 17:00 - 18:00

(no CME credit)

Other

EDI Forum: Fostering a Culturally Intelligent Society

Room 331-332 — Monday 18:15 - 20:15

(no CME credit)

18:15 EDI in ISMRM: 2023-24 Recap

18:20 Cultural Intelligence

18:40 Panel Discussion

19:15 Meet the Speakers & Committee

Tuesday, 07 May 2024

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Sunrise Course

Cardiology for Physicists: Myocardial Ischemia & Infarction

Organizers: Michael Atalay, Teresa Correia, Tarique Hussain, Christopher Nguyen, Hajime Sakuma, Andrew Scott, Tobias Wech

Hall 606 — Tuesday 7:00 - 8:00 — *Moderators:* Byoung Wook Choi & Hideki Ota

7:00 Myocardial Ischemia & Infarction: From Coronary Disease to Heart Attacks & Heart Failure
Amedeo Chiribiri

7:30 The Role of CMR in the Bigger Picture of Diagnosis & Prognosis in Ischemia & Infarction
Michael Salerno

Sunrise Course

Absolute Beginner's Guide to Fat-Water Separation

Organizers: Sune Jespersen, Sila Kurugol, Shaihan Malik, Henrik Odéen, Yasuhiko Tachibana, Cristian Tejos, Richard Thompson

Nicoll 2 | Tuesday 7:00 - 8:00 | *Moderators:* Houchun Hu & Julia Velikina

7:00 Fat-Water Separation: Fundamentals
Dimitrios Karampinos

7:30 Fat-Water Separation: Clinical Applications
Peter Börnert

Sunrise Course

Hitting the Target: Focal Therapies & Hybrid Imaging

Organizers: Nandita DeSouza, Durgesh Dwivedi

Nicoll 3 | Tuesday 7:00 - 8:00 | *Moderators:* Steven Allen & Petra van Houdt

7:00 MR Linac: The Future of Targeted Radiotherapy
Andreas Wetscherek

7:20 MR-Guided HIFU: Enhancing Our Therapeutic Armamentarium
Jin Wei Kwek

7:40 PET-MRI in the Evaluation of Treatment Response
Ali Pirasteh

Sunrise Course

Unlocking Productivity & Impact in Teaching & Publishing II

Organizers: Agah Karakuzu, Shin-Lei Peng

Room 325-326 | Tuesday 7:00 - 8:00 | *Moderators:* Haikun Qi & Rita Schmidt

7:00 Interactive Visualizations
Carlos Castillo-Passi

7:30 Transcending the Limitations of Traditional Research Dissemination
Mathieu Boudreau

Sunrise Course

All About Head & Neck: Hemorrhage, Stroke & Beyond II: Imaging Cerebrovascular Disease

Organizers: Wei-Tang Chang, Seena Dehkharghani, Xiao-Qi (Juliana) Huang

Room 331-332 | Tuesday 7:00 - 8:00 | *Moderators:* Shannon Helsper & Fei Li

7:00 Measuring Cerebrovascular Reactivity (CVR) with MRI
Peiying Liu

7:30 MR Biomarkers for Cerebrovascular Diseases
Stephan Kaczmarz

Sunrise Course

Quantification & Analysis: Diffusion

Organizers: HyungJoon Cho, Rita Nunes, Khin Tha, Mingming Wu

Room 334-336 | Tuesday 7:00 - 8:00 | *Moderators:* Andrada Ianus & C. C. Tchoyoson Lim

7:00 Advanced Diffusion Imaging: Technical
Chantal Tax

7:30 Advanced Diffusion Imaging: Application
Takashi Yoshiura

Sunrise Course
Seeing the Unseen: MRI in Traumatic Musculoskeletal Disease
Organizers: Alissa Burge, Iman Khodarahmi

Summit 1 | Tuesday 7:00 - 8:00 | *Moderators:* Benjamin Fritz

7:00 MRI in Acute MSK Trauma
Huishu Yuan

7:20 MRI in Chronic Musculoskeletal Trauma
Le Roy Chong

7:40 Expanding MRI Applications in MSK Trauma: Where Are We Heading?
Benjamin Fritz

Sunrise Course
Surprising Aspects of MRI Physics: How To Manage Without Gradients for Spatial Encoding
Organizers: Brian Hargreaves, Shaoying Huang, Rita Schmidt, Rolf Schulte, Andrew Webb, Ramesh Venkatesan

Summit 2 | Tuesday 7:00 - 8:00 | *Moderators:* Anke Henning & Christoph Juchem

7:00 Spatial Encoding with RF Pulses
Sai Abitha Srinivas

7:30 Spatial Encoding with Non-Linear Gradients
Sebastian Littin

Study Group Business Meeting
MR Elastography Business Meeting

Room 303-304 | Tuesday 8:15 - 9:15

(no CME credit)

Study Group Business Meeting
White Matter Business Meeting

Room 324 | Tuesday 8:15 - 9:15

(no CME credit)

Weekday Course
Which MRI Contrast for TBI Assessment?
Organizers: Nadya Pyatigorskaya, Yasuhiko Tachibana

Summit 1 | Tuesday 8:15 - 10:15 | *Moderators:* Manisha Aggarwal & Mary McLean

8:15 DTI & Beyond: Exploring the Microstructure in Brain Trauma

Ante Zhu[1]

[1]*Technology and Innovation Center, GE HealthCare, Niskayuna, NY, United States*

Keywords: Neuro: Brain, Contrast mechanisms: Diffusion, Contrast mechanisms: Microstructure

During a head impact, brain tissues deform due to the force act on the skull. The shearing and stretching of brain tissue structures affect both the function and connectivity of the brain. Diffusion MRI is highly sensitive to structural changes at the microscopic level. This lecture will introduce the microstructure changes associated with traumatic brain injury and how diffusion tensor imaging can probe them. Cutting-edge diffusion-MRI based microstructure imaging techniques and their emerging role in the study of brain damage will also be discussed.

8:45 

QSM: Mechanism in Acute/Chronic TBI

Chunlei Liu[1]

[1]*University of California, Berkeley, United States*

Keywords: Neuro: Brain, Contrast mechanisms: Electromagnetic tissue properties, Neuro: White matter

Quantitative susceptibility mapping (QSM) is a computational technique that calculates voxel-wise magnetic susceptibility values, typically based on the phase images of gradient-echo MRI data. Magnetic susceptibility values of brain tissues can be paramagnetic (i.e. positive) or diamagnetic (i.e. negative) depending on molecular and cellular composition of the tissue. As a result, magnetic susceptibility of brain tissue can be changed by traumatic brain injury (TBI), both in the short term and the long term. This course will discuss the molecular and cellular mechanisms underlying these alterations.

9:15 MRS: Imaging the Metabolic Changes in Brain Trauma

Jae Mo Park[1]

[1]*Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States*

Keywords: Neuro: Brain, Contrast mechanisms: Spectroscopy, Contrast mechanisms: Hyperpolarization

Hyperpolarized carbon-13 (13C) MRI provides unprecedented in vivo imaging opportunities to assess critical metabolic pathways by imaging both the injected substrate and its metabolic products. This technique with 13C-labeled pyruvate can assess aberrant pyruvate metabolism in the brain by measuring produced 13C-lactate and 13C-bicarbonate in TBI. Studies with hyperpolarized pyruvate demonstrated an acute increase in 13C-lactate production (hyperglycolysis) and a decrease in 13C-bicarbonate production (mitochondrial dysfunction) from a rat TBI model. In parallel, mild TBI patients showed similar observations. These results demonstrate the feasibility and exciting opportunities of hyperpolarized 13C-pyruvate to monitor TBI-associated metabolic changes non-invasively.

9:45 Hybrid PET/MRI: Synergy To Understand Trauma

Damien Galanaud[1]

[1]*Sorbonne Université, France*

Weekday Course

Junior Fellows Symposium: Innovations & Future Perspectives in MRI Technology

Organizers: Sola Adeleke, Erpeng Dai, Maria Engel, Joana Pinto, Gabriel Ramos Llordén, Rianne van der Heijden, David Waddington, Vivek Yedavalli

Summit 2 | Tuesday 8:15 - 10:15 | *Moderators:* Sola Adeleke & Rianne van der Heijden

8:15 Junior Fellows Symposium: Innovations & Future Perspectives in MRI Technology

Rianne A van der Heijden[1,2], Olusola Adeleke[3], Erpeng Dai[4], Maria Engel[5], Joana Pinto[6], Gabriel Ramos Llorden[7], David Waddington[8], and Vivek Yedavalli[9]

[1]*University of Wisconsin-Madison, Madison, WI, United States,* [2]*Erasmus University Medical Center, Rotterdam, Netherlands,* [3]*King's college London, London, United Kingdom,* [4]*Stanford University, Stanford, CA, United States,* [5]*Cardiff University, Cardiff, United Kingdom,* [6]*University of Oxford, Oxford, United Kingdom,* [7]*Harvard Medical School, Charlestown, MA, United States,* [8]*University of Sydney, Sydney, Australia,* [9]*Johns Hopkins University, Baltimore, MD, United States*

Keywords: Transferable skills: Impact planning

This year's Junior Fellow Symposium delves into groundbreaking MRI methods poised to revolutionize the field in the future. Emphasizing the clinical translation of these innovative approaches, this symposium will offer a specialized focus on bridging cutting-edge research with practical applications.

Target Audience

Engineers, physicists, scientists, and trainees interested in novel MR methods and techniques with a focus on clinical translation.

Educational Objectives

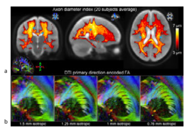
- Gain insights into cutting-edge MRI methods with the potential to revolutionize medical imaging.
- Understand the clinical applications and translational aspects of emerging MRI technologies.
- Explore avenues for future research and contributions to the evolving landscape of MRI advancements.

8:20 Exploring the Potential of High-Field MRI

Thoralf Niendorf[1]

[1]*Max-Delbrueck Center for Molecular Medicine, Germany*

8:35 The Impact of Big Gradients on the Future of MRI



Susie Huang[1]

[1]*Massachusetts General Hospital, United States*

Keywords: Physics & Engineering: Hardware, Contrast mechanisms: Diffusion

The engineering advances required to achieve strong gradient amplitudes and fast slew rates have directly benefitted the radiological sciences and clinical imaging by encouraging all the major scanner vendors to incorporate stronger and faster gradients into their commercially available products. A new generation of ultra-high gradients are now being adopted, such that hundreds of mT/m will be more readily accessible and routinely available for imaging patients. This lecture will highlight key clinical and research applications that will benefit most from such powerful gradients and advance our limits of detecting, understanding, and managing disease in patients across a range of pathologies.

8:50 Beyond Hydrogen: Novel MRI Methods

Peder Larson[1]

[1]*University of California, San Francisco, United States*

9:05 Synergy of PET-MRI in Future Imaging

Ali Pirasteh[1]

[1]*University Of Wisconsin Madison, United States*

9:20 Low-Field MRI's Impact on Future Healthcare

Shaoying Huang[1]

[1]*Singapore University of Technology and Design, Singapore*

Keywords: Physics & Engineering: Low-field MRI

The talk will present a perspective on the impacts of low-field MRI on future healthcare, including new clinical applications with new tissue contrasts, patient comfort, and friendliness to implants, and potential transformation of the clinical routines, reshape of the allocations of healthcare resources, and the democratization of MRI.

9:35 Round-Table Discussion

Markus Barth[1], James Pipe[2]

[1], [2]

9:45 Round-Table Discussion

Oral

Cutting-Edge MRI with Diffusion Probabilistic Modeling

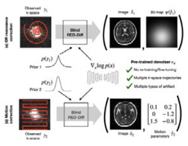
Hall 606 | Tuesday 8:15 - 10:15 | *Moderators:* Jonathan Tamir & Dong Liang

8:15 Introduction

Jonathan Tamir

The University of Texas at Austin, United States

0377 8:27



Variational diffusion models for blind MRI inverse problems

Julio A. Oscanoa[1], Cagan Alkan[2], Daniel Abraham[2], Mengze Gao[3], Aizada Nurdinova[3], Daniel Ennis[3], Kawin Setsompop[3], John Pauly[2], Morteza Mardani[4], and Shreyas Vasanawala[3]

[1]Department of Bioengineering, Stanford University, Stanford, CA, United States, [2]Department of Electrical Engineering, Stanford University, Stanford, CA, United States, [3]Department of Radiology, Stanford University, Stanford, CA, United States, [4]NVIDIA Inc., Santa Clara, CA, United States

Keywords: AI Diffusion Models, Machine Learning/Artificial Intelligence, Diffusion models

Motivation: Diffusion models have shown state-of-the-art performance in solving inverse problems. However, current solutions typically consider cases only when the forward operator is fully known, which limits their applicability to the wide variety of MRI inverse problems.

Goal(s): Develop a general method for blind MRI inverse problems with unknown forward operator parameters.

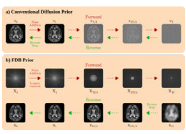
Approach: We extend the RED-diff framework, which has the key strength of not requiring training or fine–tuning for each specific task. We test our method for image reconstruction with off-resonance and motion correction.

Results: Our blind RED-diff framework can successfully approximate the unknown forward model parameters and produce accurate reconstructions.

Impact: We demonstrate the potential of current diffusion models to readily tackle a wide range of blind inverse problems in MRI without application-specific re-training or fine-tuning. Image reconstruction with motion and off-resonance correction are the first demonstration applications.

0378 8:39

MERIT AWARD SUMMA CUM LAUDE



Accelerated MRI Reconstruction with Fourier-Constrained Diffusion Schrodinger Bridges

Muhammad Usama Mirza[1,2], Onat Dalmaz[1,2], Hasan Atakan Bedel[1,2], Gokberk Elmas[1,2], Alper Gungor[3], and Tolga Cukur[1,2]

[1]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey, [2]National Magnetic Resonance Research Center, Bilkent University, Ankara, Turkey, [3]ASELSAN, Ankara, Turkey

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, image reconstruction; diffusion models

Motivation: Diffusion probabilistic methods synthesize realistic images via a denoising transformation from Gaussian noise onto MRI data, but this normality assumption can yield suboptimal performance in accelerated MRI reconstruction tasks.

Goal(s): Our goal was to devise a new diffusion-based method that generates high-quality images by capturing a task-relevant transformation for accelerated MRI.

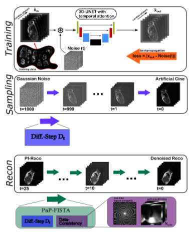
Approach: We introduced a novel reconstruction method based on a diffusion Schrodinger bridge (FDB) that learns to directly transform between undersampled and fully-sampled MRI data via a multi-step process.

Results: Higher reconstruction performance was obtained with FDB over previous state-of-the-art at up-to 8-fold acceleration.

Impact: The improvement in image quality and acquisition speed in accelerated MRI enabled through FDB may facilitate comprehensive MRI exams in many applications, particularly in assessments of pediatric and elderly individuals in need of fast exams due to limited motor control.

0379 MERIT AWARD MAGNA CUM LAUDE

8:51



Using a Video Diffusion Model-prior for reconstructing undersampled dynamic MR-data – An application to real-time cardiac MRI

Oliver Schad[1], Julius Frederik Heidenreich[1], Nils-Christian Petri[2], Bernhard Petritsch[1], and Tobias Wech[1,3]

[1]Department of Diagnostic and Interventional Radiology, University Hospital Würzburg, Würzburg, Germany, [2]Department of Internal Medicine 1, University Hospital Würzburg, Würzburg, Germany, [3]Comprehensive Heart Failure Center, University Hospital Würzburg, Würzburg, Germany

Keywords: AI Diffusion Models, Machine Learning/Artificial Intelligence

Motivation: MR-based “real-time” imaging of dynamic processes, as the beating heart, often depends on fast (undersampled) scans, which are subsequently reconstructed by algorithms exploiting prior knowledge. Spatio-temporal models describing the data in suboptimal manner can thereby lead to residual artifacts.

Goal(s): A high-quality model to regularize the reconstruction of real-time cardiac MRI based on undersampled spiral data acquisitions.

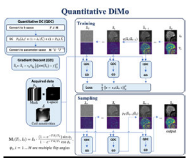
Approach: A video diffusion model was trained using cine videos in magnitude reconstruction and subsequently applied as a prior in a plug-and-play FISTA approach.

Results: Reconstructions of undersampled real-time frames with higher image quality than a low rank plus sparse approach.

Impact: We show the potential of probabilistic video diffusion models as a promising prior in iterative reconstructions of undersampled dynamic MR data. In our example, the approach enabled high quality real-time cardiac functional MRI in patients with arrhythmia.

0380

9:03



qDiMo: Domain-conditioned Diffusion Modeling for Accelerated qMRI Reconstruction

Wanyu Bian[1,2], Albert Jang[1,2], and Fang Liu[1,2]

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Keywords: AI Diffusion Models, Machine Learning/Artificial Intelligence, Rapid MRI, Quantitative MRI, knee, brain

Motivation: Quantitative MRI (qMRI) is time-consuming and requires substantial efforts for acceleration to cut down the acquisition time.

Goal(s): This paper proposes a novel generative AI approach for image reconstruction based on diffusion modeling conditioned on the native data domain.

Approach: Our method is applied to multi-coil quantitative MRI reconstruction, leveraging the domain-conditioned diffusion model within the tissue parameter domain.

Results: The proposed method demonstrates a significant promise for reconstructing quantitative maps at high acceleration factors. Notably, it maintains excellent reconstruction accuracy and efficiency for MR parameter maps across diverse anatomical structures.

Impact: This work demonstrates the feasibility of a new generative AI method for rapid qMRI. Beyond its immediate applications, this method provides potential generalization capability, making it adaptable to inverse problems across various domains.

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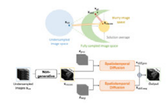

Spatiotemporal Diffusion Model with Paired Sampling for Accelerated Cardiac Cine MRI

Shihan Qiu[1,2,3], Shaoyan Pan[1,4,5], Yikang Liu[1], Lin Zhao[1], Jian Xu[6], Qi Liu[6], Terrence Chen[1], Eric Z. Chen[1], Xiao Chen[1], and Shanhui Sun[1]

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Keywords: AI Diffusion Models, Image Reconstruction, Heart

Motivation: Current deep learning reconstruction for accelerated cardiac cine MRI suffers from spatial and temporal blurring.

Goal(s): To improve image sharpness and motion delineation for cine MRI under high undersampling rates.

Approach: A combined non-generative reconstruction and diffusion enhancement model along with a novel paired sampling strategy was developed.

Results: The proposed combined method provided sharper tissue boundaries and clearer motion than the original reconstruction in experts' evaluation on clinical data. The innovative paired sampling strategy substantially reduced artificial noises in the generative results.

Impact: The approach has the potential to improve reconstruction quality in highly accelerated cardiac cine imaging. The novel paired sampling for diffusion generation may be applied to other conditional tasks to reduce the artificial noises stemming from noisy training data.

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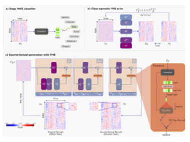

Explaining Deep fMRI Classifiers with Diffusion-Driven Counterfactual Generation

Hasan Atakan Bedel[1,2] and Tolga Çukur[1,2,3]

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Keywords: AI Diffusion Models, Machine Learning/Artificial Intelligence, fMRI, xAI, diffusion, transformers

Motivation: Deep-learning classifiers for functional MRI (fMRI) offer state-of-the-art performance in detection of cognitive states from BOLD responses, but their black-box nature hinders interpretation of results.

Goal(s): Our goal was to devise a reliable method to infer the important BOLD-response attributes that drive the decisions of deep fMRI classifiers.

Approach: We introduced a novel counterfactual explanation method (DreaMR) based on a new fractional, distilled diffusion prior for efficient generation of high-fidelity counterfactual samples.

Results: DreaMR generated more specific and plausible explanations of deep fMRI classifiers trained for resting-state and task-based fMRI analysis than previous state-of-the-art explanation methods.

Impact: The improvement in sensitivity, plausability and efficiency in explanation of deep classifiers through DreaMR may facilitate adoption of AI-based analyses in fMRI studies, thereby benefiting assessment of cognitive processes in both normal and neurological disease states.

0383 9:39

[Decoding Visual Information from fMRI Data: A Multimodal Approach to Image and Caption Reconstruction]

Matteo Ferrante[1], Tommaso Boccato[2], Furkan Ozcelik[3], Rufin VanRullen[4], and Nicola Toschi[2]

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Keywords: AI Diffusion Models, fMRI, brain decoding, fMRI

Motivation: The study addresses the challenge of decoding and reconstructing visual experiences from fMRI data, an area yet to be mastered in neuroscience.

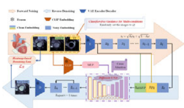
Goal(s): We propose a methodology that deciphers brain activity patterns and renders these into visual and textual representations.

Approach: We trained a linear model to map brain activity to image latent represenations. This informed a generative image-to-text transformer and a visual attribute-focused regression model, culminating in the creation of photorealistic images using a text-to-image diffusion model.

Results: The model effectively combined high-level semantic understanding and low-level visual details, producing plausible reconstruction images from fMRI data.

Impact: Our findings enhance our understanding of visual processing in the brain, with significant implications for integrating artificial intelligence (AI) with neuroscience.

0384 9:51



[CMRDiff: Multi-sequence CMR synthesis]

Puguang Xie[1], Zhongsen Li[2], Yu Ma[1], and Jingjing Xiao[3]

[1]Chongqing Emergency Medical Centre, Chongqing University Central Hospital, School of Medicine, Chongqing University, Chongqing, China, [2]Center for Biomdical Imaging Research, Tsinghua University, Beijing, China, Beijing, China, [3]Bio-Med Informatics Research Centre \& Clinical Research Centre, Xinqiao Hospital, Army Medical University, Chongqing, China

Keywords: AI Diffusion Models, Cardiovascular

Motivation: The synthesis of multi-sequence cardiac magnetic resonance (CMR) images is of great significance to shorten the scan durations and expand the beneficiary population from CMR examination.

Goal(s): Achieving accurate synthesis is particularly challenging due to the inherent suboptimal image quality and the persistent interference from noise.

Approach: We first propose a novel method based on diffusion model, CMRDiff, for multi-sequence CMR synthesis.

Results: We evaluated the proposed CMRDiff on the MICCAI2020 MyoPS Challenge dataset. Our experiments demonstrate that CMRDiff outperforms other state of-the-art multi-modal MRI synthesis methods.

Impact: We design the first denoising diffusion probabilistic modelin the literature for multi-sequence CMR synthesis, promising to serve as an effective tool for multi-sequence CMR synthesis.

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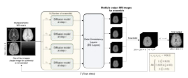

Unified Diffusion model for Multi-contrast Ensembling Synthesis

Yeeun Lee[1], Yejee Shin[2], Doohyun Park[2], Geonhui Son[2], Taejoon Eo[2,3], and Dosik Hwang[2,4,5,6]

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Keywords: Acquisition Methods, Brain

Motivation: Scanning for multi-contrast MR images is time-consuming. To reduce scan time, it is beneficial to explore methods for efficiently synthesizing target contrast images from existing contrast scans.

Goal(s): To address the stability issues encountered when dealing with multi-contrast MR image domains individually, we propose a methodology for effectively synthesizing images while incorporating multi-contrast domains.

Approach: Our model is a novel unified diffusion model (UDM) that improves the synthesis of detailed anatomical structures in target contrast images through an ensemble method.

Results: UDM demonstrates effectiveness across multiple domains, outperforming existing methodologies in synthesizing images for each contrast domain.

Impact: By reducing scan times and costs for multi-contrast imaging, UDM facilitates prognosis prediction and treatment planning. This method is not only usable for image synthesis but also extendable to various applications such as reconstruction.

Oral

Brain Motion Correction: Freeze, Don't Move!

Nicoll 1 Tuesday 8:15 - 10:15 *Moderators:* Jana Hutter & Pankaj Pankaj

0386 8:15

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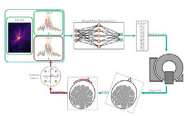

AI-based motion estimation in k-space using guidance lines enables scoutless prospective motion correction.

Julian Hossbach[1,2], Daniel Splitthoff[2], Bryan Clifford[3], Daniel Polak[2,4], Wei-Ching Lo[3], Stephen Cauley[3], Tobias Kober[5], Min Lang[4,6], Azadeh Tabari[4,6], Jeremy Ford[4,6], Komal Manzoor[4,6], Lawrence Wald[4,6,7], Otto Rapalino[4,6], Pamela Schaefer[4,6], John Conklin[4,6], Susie Huang[4,6,7], Heiko Meyer[2], and Andreas Maier[1]

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Keywords: Motion Correction, Motion Correction, Prospective, motion estimation

Motivation: Novel research reduced the acquisition of motion navigators to a few guidance lines. A prospective correction is not yet possible due to reconstruction and optimization times.

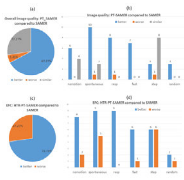
Goal(s): We determine the feasibility of a fast AI-based motion estimation for prospective correction in a 3D MPRAGE research sequence.

Approach: A DL network to prospectively estimate the head pose from seamlessly integrated guidance lines in a 3D MPRAGE research sequence was trained on simulated data and used for a rapid adaption of the FOV to achieve a prospective correction.

Results: *In-vivo* experiments showed greatly reduced motion artifacts. The motion estimation is accurate and stable.

Impact: Prospectively adapting the FOV using the proposed AI-based method greatly improves the image quality of 3D MPRAGE acquisitions. This unique application of ML enables promising research of prospectively mitigating motion artifacts with minimal changes to the sequence.

0387 8:27



Best of both MoCo worlds: combining fast pilot tone motion sensing with retrospective SAMER correction

Yantu Huang[1], Huixin Tan[1], Ce Wang[1], Nan Xiao[1], Daniel Nicolas Splitthoff[2], Daniel Polak[2], Dominik Nickel[2], Tom Hilbert[3,4,5], and Tobias Kober[3,4,5]

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Keywords: Motion Correction, Motion Correction, pilot tone

Motivation: Model-based retrospective motion correction has shown good results but sometimes lacks enough information to accurately derive motion parameters.

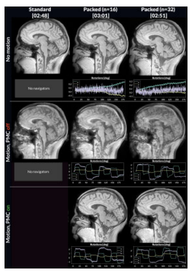
Goal(s): To use the pilot tone to address the drawbacks of retrospective methods by providing them with high-frequency motion information for more robust and efficient motion correction.

Approach: We use pilot tone to refine and increase the temporal resolution of motion parameters for the Scout Accelerated Motion Estimation and Reduction (SAMER) method.

Results: Motion phantom and volunteer tests show improved image quality of pilot tone + SAMER compared to SAMER-only while the reconstruction takes clinically acceptable 20s.

Impact: Our results demonstrate that pilot tone can be used to improve the precision and temporal resolution of a model-based retrospective motion correction method, while being robust and fast. This will help to further mitigate motion artifacts in clinical routine.

0388 8:39



Navigator based prospective motion correction in short TR sequences with minimal scan time penalty

Adam van Niekerk[1], Henric Rydén[1,2], Sophie Shauman[1], Ola Norbeck[1,2], Tim Sprenger[3], Enrico Avventi[1,2], and Stefan Skare[1,2]

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Keywords: Motion Correction, Motion Correction

Motivation: Inserting navigators into short-TR gradient echo pulse sequences increases scan duration as the TR needs to be extended to maintain a steady-state.

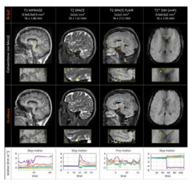
Goal(s): Periodically interleave navigators without disrupting stead-state.

Approach: A packed pulse sequence encoding was implemented that divides the phase encoding table into partitions. Each partition begins with two blank-TRs that contain identical RF and spoiling to the parent sequence. The first blank-TR readout is replaced with a navigator acquisition. The second is replaced with computation time to perform a field of view update.

Results: The packed sequences reduced the time penalty from 1-minute to 3-13 seconds, without impacting motion correction efficacy.

Impact: The packed sequence structure allows researchers to augment the acquisition of short-TR GRE sequences with fast (<TR) navigators for almost no additional scan time without affecting motion correction efficacy, and is applicable to all sequences where the TR is minimised.

0389 8:51



Integrating scout and guidance line-based retrospective motion correction into a 3D deep learning reconstruction for fast and robust brain MRI

Daniel Polak[1], Marcel Dominik Nickel[1], Daniel Nicolas Splitthoff[1], Jeanette Deck[1], Bryan Clifford[2], Yantu Huang[3], Wei-Ching Lo[2], Susie Y. Huang[4], John Conklin[4], Lawrence L. Wald[5], and Stephen F. Cauley[2]

[1]Siemens Healthineers, Erlangen, Germany, [2]Siemens Medical Solutions, Boston, MA, United States, [3]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China, [4]Massachusetts General Hospital, Boston, MA, United States, [5]A. A. Martinos Center for Biomedical Imaging, Boston, MA, United States

Keywords: Alzheimer's Disease, MR Value

Motivation: Rising medical imaging utilization and increasing use of automated support systems demand high-quality, fast, and reproducible/robust MRI techniques. Despite rapid scanning afforded by deep learning, motion remains a common source of artifacts.

Goal(s): Integrate retrospective motion correction into a deep learning reconstruction to facilitate high-quality, fast, and motion-robust brain imaging.

Approach: Scout and guidance line-based motion correction was implemented into MPRAGE, SPACE and SWI to enable rapid motion trajectory estimation. A data-consistency driven neural network reconstruction was adapted to perform network regularized motion correction.

Results: Improved SNR and reduced motion artifacts are demonstrated *in vivo* using 4-6-fold accelerated scans with instructed subject motion.

Impact: Retrospective motion correction was integrated into a deep learning reconstruction to facilitate fast and motion-robust 3D brain imaging across T1, T2, T2 FLAIR and T2*/SWI. This should add clinical value to routine brain exams and emerging neuro-degenerative screening protocols (ARIA).

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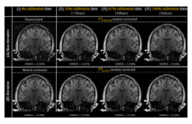

Versatile motion-corrected brain MRI leveraging ERIC-PT: Efficient, Robust and Instruction-free Calibrated Pilot Tone

Yannick Brackenier[1,2,3], Lucilio Cordero-Grande[1,2,4], Sarah McElroy[1,2,5], Raphael Tomi-Tricot[1,2,6], Philippa Bridgen[1,3,7], Shaihan J Malik[1,2,3], and Joseph V Hajnal[1,2,3]

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Keywords: Motion Correction, Motion Correction, Pilot Tone

Motivation: Robust motion correction relies on sequence modifications, either adding navigators or re-ordering the k-space sampling. These modifications might not be possible for every sequence.

Goal(s): To leverage motion-sensitive Pilot Tone (PT) signals to guide motion correction for any standard 3D acquisition.

Approach: We propose the *ERIC* calibration protocol, which distributes short self-navigated (DISORDER) acquisitions across the whole examination. Combined with data-driven motion correction reconstructions, we can achieve robust PT calibration.

Results: We show the potential to correct standard MPRAGE acquisitions with a linear phase encoding scheme in 4 healthy volunteers (HV) even when using 54 seconds worth of calibration data.

Impact: Correcting motion in any 3D acquisition is an unsolved problem. Combining pre-calibrated PT signals with data-driven optimizations explores a promising avenue. To this end, building a robust calibration model by acquiring ~1min worth of data would easily integrate into examinations.

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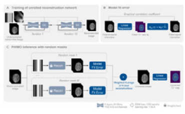

PHIMO: Physics-Informed Motion Correction of GRE MRI for T2* Quantification

Hannah Eichhorn[1,2], Kerstin Hammernik[2], Veronika Spieker[1,2], Elisa Saks[3,4], Kilian Weiss[5], Christine Preibisch[3,4,6], and Julia A. Schnabel[1,2,7]

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Keywords: Motion Correction, Quantitative Imaging, Motion Correction, Deep Learning, Brain

Motivation: T2* quantification from GRE-MRI is particularly impacted by subject motion due to its sensitivity to magnetic field inhomogeneities. The current multi-parametric quantitative BOLD motion correction method depends on additional k-space acquisition, extending overall acquisition times.

Goal(s): To develop a learning-based motion correction method tailored to T2* quantification that avoids redundant data acquisition.

Approach: PHIMO leverages multi-echo T2* decay information to identify motion-corrupted k-space lines and excludes them from a data-consistent deep learning reconstruction.

Results: We are able to correct motion artifacts in subjects with stronger motion, approaching the performance of the current motion correction method, while substantially reducing the acquisition time.

Impact: PHIMO reduces strong motion artifacts in T2* maps by utilizing T2* decay information in an unrolled DL reconstruction. PHIMO avoids redundant data acquisition compared to a current correction method and reduces the acquisition time by over 40%, facilitating clinical applicability.

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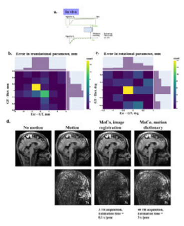

High temporal resolution motion correction in MRF using quantitative-scout-based navigation (QUEEN) and motion-dictionary matching.

Aizada Nurdinova[1], Xiaozhi Cao[1], Julio Oscanoa[2], Daniel Raz Abraham[3], Nan Wang[1], and Kawin Setsompop[1,3]

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Keywords: Motion Correction, Motion Correction

Motivation: Motion correction in MRF using navigators in sequence deadtime improves imaging robustness, however, temporal resolution of the approaches is limited to 6-10 s.

Goal(s): We aim to achieve accurate motion tracking at 0.5 s temporal resolution, by integrating the QUantitatively-Enhanced parameter Estimation from Navigators (QUEEN) approach into MRF.

Approach: Compact navigators were inserted throughout the MRF acquisition at a minimal encoding efficiency reduction of ~5%. The acquisition of the quantitative scout was integrated into the MRF's dummy scan, resulting in no added scantime.

Results: The estimated in vivo motion parameters have MAE of 0.4 mm and 0.2 deg compared to image registration estimates.

Impact: The proposed method can achieve high temporal resolution motion estimates, and therefore, is a promising approach for high-precision motion correction in MRF.

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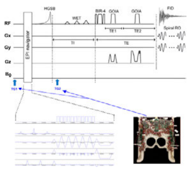

[Real-time motion correction and multicoil shim array B0 update for whole-brain MR spectroscopic imaging]

Ovidiu Cristian Andronesi[1], Robert Frost[1], Nicolas Sebastian Arango[2], Nutandev Bikkamane Jayadev[3], Yulin Chang[3], Paul Wighton[1], Malte Hoffmann[1], Jason Stockmann[1], and Andre van der Kouwe[1]

[1]Radiology, Martinos Center for Biomedical Imaging, Harvard Medical School, Massachusetts General Hospital, Boston, MA, United States, [2]Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [3]Siemens Medical Solutions, Boston, MA, United States

Keywords: Motion Correction, Motion Correction, Real-time shimming, Multicoil shim array, Metabolic Imaging

Motivation: Very high quality of MR spectroscopic imaging (MRSI) data is needed for robust and reproducible metabolite quantification. This critically depends on the B_0 shimming and scan stability. Integrated RF-receive/B_0-shim arrays significantly improve spectral quality.

Goal(s): Real-time motion correction and multicoil shimming update with an integrated RF-receive/B_0-shim array for robust whole-brain MRSI.

Approach: We developed a rapid navigator for head tracking and B0 fieldmapping in combination with rapid processing for real-time update of multicoil shim currents and MRSI localization.

Results: Real-time motion correction and multicoil shimming provides significantly narrower linewidth, higher signal-to-noise, reduced quantification errors and reproducible metabolic imaging.

Impact: Whole-brain MRSI is a unique method for non-invasive mapping of brain neurochemistry, and in combination with real-time motion correction and multicoil shim array update provides robust and reproducible quantitative metabolic imaging for clinical use.

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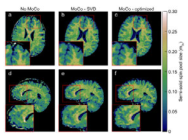

[Contrast-Optimized Basis Functions for Self-Navigated Motion Correction in 3D quantitative MRI]

Sebastian Flassbeck[1,2], Elisa Marchetto[1,2], Andrew Mao[1,2,3], and Jakob Assländer[1,2]

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Keywords: Motion Correction, Motion Correction, MR Fingerprinting, qMT, low rank

Motivation: Motion-induced artifacts are a significant barrier to achieving clinically acceptable image quality for multi-compartment quantitative MRI techniques, e.g. a 2-pool magnetization transfer model.

Goal(s): To develop a self-navigating approach to estimating motion parameters in an MR-fingerprinting-like acquisition.

Approach: We optimize a subspace that maximizes the contrast-to-noise ratio between brain parenchyma and cerebrospinal fluid for a low-resolution, time-segmented low-rank reconstruction used to estimate motion.

Results: Compared to the typical SVD basis, the contrast-optimized basis improves the smoothness of the motion estimates and the apparent resolution of the reconstructed coefficient images and quantitative maps.

Impact: The proposed retrospective, self-navigating motion correction technique does not require any sequence modifications and/or additional scan time. It can therefore be applied to many quantitative MRI techniques where the signal's variation over time can be well-described in a low-rank subspace.

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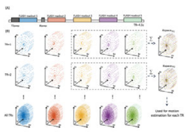

Motion resolved rapid 3D multiparametric brain mapping with self-navigation

Shohei Fujita[1,2,3,4], Yohan Jun[1,2], Xingwang Yong[1,2,5], Jaejin Cho[1,2], Borjan Gagoski[2,6], and Berkin Bilgic[1,2,7]

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Keywords: Quantitative Imaging, Neuro

Motivation: While 3D multiparametric mapping acquisitions can provide rich and quantitative information, their long acquisition time renders them susceptible to motion.

Goal(s): To develop a rapid, multiparametric technique for motion-robust brain mapping.

Approach: 3D-QALAS acquisition with Cartesian variable-density sampling was implemented to achieve self-navigation while maintaining high scan efficiency. Brain position was estimated for each TR and incorporated in the reconstruction's forward model.

Results: The proposed method enabled reconstruction of motion-resolved datasets at a time resolution of 4.5s with tracking accuracy of <0.2 degrees and <0.5mm, providing T1 and T2 maps with significantly reduced artifacts and improved agreement with measurements from motion-free scans.

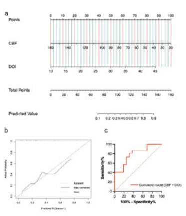
Impact: We propose an efficient, whole-brain quantitative scan at 1mm^3 resolution in 3:36min and incorporate self-navigated motion-correction, thereby obviating the need for navigators or external hardware. This benefits clinical translation especially for imaging unsedated children in clinical and research settings.

Oral

Tumors in the Brain, Head & Neck

Nicoll 2 | Tuesday 8:15 - 10:15 | *Moderators:* Gilbert Hangel & Manabu Kinoshita

0396 8:15



Pretreatment arterial spin labelling combined with depth of invasion predict disease progression in nonmetastatic NPC after IMRT

Fan Yang[1], Haoran Wei[1], Xiaoduo Yu[1], Meng Lin[1], and Hongmei Zhang[1]

[1]Department of Diagnostic Radiology, National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, 100021, China, Beijing, China

Keywords: Head & Neck/ENT, Arterial spin labelling, Nasopharyngeal carcinoma; prognosis; depth of invasion

Motivation: Arterial spin labeling (ASL) showed the promising value in diagnosis and early treatment outcome prediction in head and neck. Whether ASL combined with tumor invasion depth could help predicting disease progression needs further investigate.

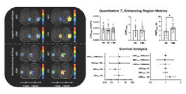
Goal(s): To explore the value of CBF derived from ASL and depth of invasion in predicting 3-year disease progression in NPC.

Approach: Prospective inclusion of consecutive patients with regular follow-up. Selection of appropriate statistical methods to construct and compare models.

Results: CBF and tumor invasion depth are significantly correlated with progression-free survival, and both of them could help predicting 3-year disease progression.

Impact: ASL and tumor infiltration depth shown for the first time to predict disease progression in NPC, which could help with clinical treatment decisions.

0397 8:27



Multiparametric quantitative MRI for assessment of clinical response to M032 oncolytic virotherapy in patients with high-grade glioma

Carlos A Gallegos[1], Ameer Mansur[1], Dagoberto Estevez-Ordonez[2], James M Markert[2], and Anna G Sorace[1,3,4]

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Keywords: Tumors (Post-Treatment), Quantitative Imaging, Multiparametric

Motivation: Standard-of-care MRI in high-grade glioma (HGG) immunotherapy offers limited value for early response assessment and monitoring given its inability to distinguish tumor progression from treatment-induced inflammatory responses.

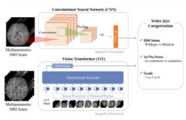
Goal(s): This study aims to evaluate multiparametric MRI and voxel-wise habitat mapping of vascular and cellular properties to assess response to M032 virotherapy in HGG.

Approach: Multiparametric quantitative assessment of cellularity and vascularity, through DWI-MRI and DSC-MRI, was explored for the early evaluation of intratumoral changes post-immunotherapy and associations with overall survival.

Results: Anatomical and quantitative MRI metrics revealed changes early over the course of therapy and showed significant associations with overall survival in this cohort.

Impact: Characterization of multiparametric quantitative MRI metrics associated with early immunotherapy positive response can aid in the assessment and monitoring of therapeutic efficacy and allow for optimization of clinical care in patients with high-grade glioma.

0398 8:39



Deep Learning Algorithm for Prediction of Molecular Subtypes and Grades in Adult-type Diffuse Gliomas: According to the 2021 WHO Updates

Yunsu Byeon[1], Yae Won Park[2], Soohyun Lee[1], HyungSeob Shin[1], Doohyun Park[1], Sung Soo Ahn[2], Seung-Koo Lee[2], and Dosik Hwang[1,2,3,4]

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Keywords: Tumors (Pre-Treatment), Cancer

Motivation: Noninvasive prediction of molecular subtype and grade in adult-type diffuse gliomas based on 2021 WHO classification can aid in clinical practice.

Goal(s): To establish a robust and interpretable deep learning model for molecular subtyping and grading in adult-type diffuse gliomas.

Approach: Institutional multiparametric MRI data (n=1,053) were used to train deep learning models, including 2D CNN and Vision Transformer. Our models were externally validated on the TCGA dataset (n=200). Explainable AI methods were used to interpret the predictions of our models.

Results: ViT outperformed CNN with AUCs of 0.87, 0.73, and 0.81 for prediction of IDH mutation, 1p/19q codeletion, and grading, respectively.

Impact: Our study demonstrates that Vision Transformer provides reliable and interpretable prediction of molecular subtype and grades in adult-type diffuse gliomas based on the 2021 WHO classification using multiparametric MRI data.

0399 8:51

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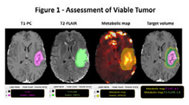

[Integration of Whole Brain Spectroscopic Imaging in Planning Workflow for Personalized Delivery of TTFields in Glioblastomas]

Laiz Laura de Godoy[1], Arthich Rajan[1], Brian Berger[2], Sulaiman Sheriff[3], Atom Sarkar[4], Rinku Shah[4], Dawit Aregawi[5], Tara Morrison[6], Srilatha Hosur[7], Sunjay Shah[8], Gaurav Shukla[8], Rachelle Lanciano[9], Varsha Jain[10], Scott Herbert[10], Nduka Amankulor[11], Stephanie Weiss[12], Anshu Giri[13], Aruna Padmanabhan[12], Stephen Bagley[1], Kheng Choon Lim[14], Demetrius Ribeiro de Paula[15], Demetrius Lee[1], Kristina Vineis[1], Lisa Desiderio[1], MacLean Nasrallah[1], Suyash Mohan[1], and Sanjeev Chawla[1]

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Keywords: Tumors (Post-Treatment), Spectroscopy, glioblastoma; TTFields; WBSI; MRI

Motivation: Optimal treatment for GBM requires precise targeting of all viable tumor cells, many of which are not visible on conventional neuroimaging.

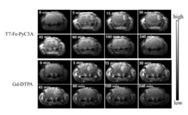
Goal(s): We aimed to utilize WBSI to identify infiltrating tumor cells in GBM patients for selecting a precise target volume for personalized mapping of transducer arrays for enhanced delivery of TTFields.

Approach: A mean value of choline/NAA was computed from normal mask, and all voxels that exceeded two-fold threshold value were included in a 3D-composite mask from the tumor region.

Results: WBSI provided higher yield of voxels with good spectral quality, resulting in improved brain tumor coverage compared to anatomical MRI sequences.

Impact: Alternative array configuration created from WBSI will allow precise delineation of tumor margins for enhanced delivery of TTFields dose to all proliferating regions of a GBM, decreasing the rate of local recurrence and ultimately improving overall survival.

0400 9:03



[A targeted Fe-based MR contrast agent for glioma imaging]

Yue Zhu[1,2], Lei Zhang[1], Shizhen Chen[1], and Xin Zhou[1]

[1]Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, WuHan, China, [2]Huazhong University of Science and Technology, WuHan, China

Keywords: Contrast Agents, Brain, glioma

Motivation: Neurological adverse effects caused by the deposition of gadolinium-based contrast agents in the brain remain uncertain, and it is necessary to develop a biocompatible alternative molecule for evaluation of glioma malignancy and site occupancy.

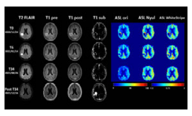
Goal(s): To demonstrate that Fe-based contrast agents have superior safety, stability, and longevity in glioma imaging compared to gadolinium-based contrast agents.

Approach: The T7-Fe-PyC3A was synthesized, and its stability was validated through in vitro kinetic thermodynamic experiments. Furthermore, A in situ glioma model mice was choosen for investigating the imaging ability.

Results: A targeted Fe-based MR contrast agent provides clear glioma contours with a 15-60 minutes post-dose imaging window.

Impact: Although gadolinium-based contrast agents are widely used in the clinic, iron-based contrast agents targeting gliomas show the enhanced safety and stability profile. The extended imaging window allows them as preferable alternative for gliomas imaging.

0401 9:15 **Intensity normalization of ASL measured perfusion improves reproducibility and treatment evaluation in glioblastoma patients**



Limin Zhou[1], Yiming Wang[2], Durga Udayakumar[1,3], Marco C. Pinho[1,3], Michael Youssef[4,5], Joseph A. Maldjian[1,3], and Ananth J. Madhuranthakam[1,3]

[1]Department of Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Philips Healthcare, Shanghai, China, [3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [4]Department of Neurology, UT Southwestern Medical Center, Dallas, TX, United States, [5]Department of Hematology and Oncology, UT Southwestern Medical Center, Dallas, TX, United States

Keywords: Tumors (Post-Treatment), Translational Studies, Treatment response, Cancer, Glioblastoma (GBM), Reproducibility, Perfusion, Quantitative Imaging

Motivation: Chemoradiation in patients with glioblastoma (GBM) causes a 10-13% perfusion decrease in normal appearing tissue, confounding reproducibility of ASL measurements and longitudinal treatment evaluations. This confounds intra-patient and inter-patient comparisons, irrespective of perfusion variations from tumor progression/response.

Goal(s): To improve ASL measurement reproducibility and longitudinal treatment assessment in GBM patients using intensity normalization methods.

Approach: Different normalization methods were applied to ASL measured perfusion in a prospective study for reproducibility analyses and response assessment.

Results: Intensity normalization of ASL measured perfusion in GBM patients improved reproducibility enabling longitudinal treatment evaluation for intra- and inter-patient comparisons.

Impact: Intensity normalization of ASL reduces variability, improves reproducibility, and enables accurate quantitative intra- and inter-patient comparison. This can play an important role in evaluating treatment response assessment and building predictive models with ASL across different studies and sites.

0402 9:27 **Predicting IDH Mutation and MGMT Methylation Status in Glioma Patients at the Voxel Level using CEST-Based Deep Learning**

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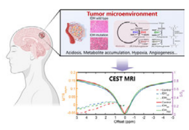


Siyu Wang[1], Jue Lu[2], Xinli Zhang[2], Jing Wang[2], and Lin Chen[1]

[1]Department of Electronic Science, Fujian Provincial Key Laboratory of Plasma and Magnetic Resonance, School of Electronic Science and Engineering, National Model Microelectronics College, Xiamen University, Xiamen, China, [2]Department of Radiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

Keywords: CEST / APT / NOE, Tumor

Motivation: Predicting glioma subtypes based on molecular profiles is crucial for treatment decisions and predicting survival rates.

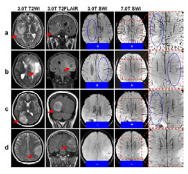
Goal(s): We proposed a CEST-based deep learning method to predict IDH mutation and MGMT methylation status in glioma patients at the voxel level.

Approach: 86 patients were recruited for CEST experiments on 3T MRI scanner. A CEST-based deep learning method, composed of a 1D convolutional neural network, was proposed for different types of status prediction at the voxel level. The confusion matrix and ROC were conducted to evaluate the performance of the proposed method.

Results: Our method achieves higher accuracy compared to existing CEST-based prediction methods.

Impact: The proposed method may facilitate the application of CEST MRI in the diagnosis of glioma.

0403 9:39



[Characterizing asymmetric deep medullary veins by 7.0T susceptibility-weighted MRI to predict glioma genotype and Ki-67 index]

Chenxi Li[1], Jinhao Lyu[1], Xiaoxiao Ma[1], Caohui Duan[1], Jianxun Qu[2], Qi Duan[1], and Xin Lou[1]

[1]Chinese PLA General Hospital, Beijing, China, [2]MR Research Collaboration Team, Siemens Healthineers, Beijing, China

Keywords: Tumors (Pre-Treatment), High-Field MRI, susceptibility-weighted MRI

Motivation: Knowing the genotype of gliomas is critical for prognostic assessment and treatment selection. 7.0T susceptibility-weighted imaging (SWI) allows visualizing the deep medullary veins and provides additional metabolic information.

Goal(s): We used the asymmetric deep medullary vein (ADMV) sign on 7.0T SWI to predict glioma isocitrate dehydrogenase mutation status and Ki-67 expression level.

Approach: We assessed the ADMV sign and conventional morphological and screening features (P<0.1) via multivariate logistic regression to evaluate the predicted performance.

Results: The ADMV sign on 7.0T images was independently associated with isocitrate dehydrogenase mutation status and Ki-67 index and improved the images' diagnostic efficacy.

Impact: Discovery of the ADMV sign as an imaging biomarker and the advantages of 7.0T MRI may help markedly improve the diagnosis and management of gliomas and may have broader applications in medical imaging and biomarker development.

0404 9:51

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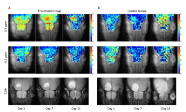


[Monitoring intranasal treatment to brain tumor using multiple CEST contrasts]

Lok Hin Law[1], Haoyun Hin Su[1,2], Yang Hin Liu[1,2], and Kannie WY Hin Chan[1,2,3,4,5]

[1]Biomedical Engineering, City University of Hong Kong, Hong Kong, China, [2]Hong Kong Centre for Cerebro-Cardiovascular Health Engineering (COCHE), Hong Kong, China, [3]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [4]City University of Hong Kong Shenzhen Research Institute, Shenzhen, China, [5]Tung Biomedical Sciences Centre, City University of Hong Kong, Hong Kong, China

Keywords: Tumors (Post-Treatment), CEST & MT, Glioblastoma, Intranasal, Theranostic

Motivation: *Theranostic application of intranasal drug delivery to glioblastoma using multiple CEST contrast.*

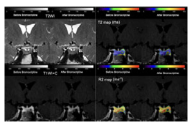
Goal(s): Our goal is to monitor the drug delivery to brain tumor and evaluate the treatment effect simultaneously.

Approach: We investigated the imaging of liposome-based drug delivery to the brain tumor via intranasal administration,in which the amount of liposome and the tumor response can be detected by CEST MRI at 3T.

Results: CEST contrast at 3.5ppm of tumor region and the tumor size comparison between treatment and control group could indicate the therapeutic effect.CEST contrast at 4.3and-3.5ppm from pre-injection to post-injection in-vivo,could indicate the liposome drug delivery efficacy and drug distribution.

Impact: CEST MRI guided intranasal drug delivery could provide valuable information for assessing efficacy of drug delivery and treatment outcome. This can potentially translate to clinics as a non-invasive theranostic approach for glioblastoma treatment.

0405 

10:03 

Application of accelerated quantitative magnetic resonance imaging in predicting drug resistance in pituitary prolactinomas

Rong Lu[1], Lijin Ji[2], Weijun Tang[1], Qing Li[3], Caixia Fu[4], Ying-Hua Chu[3], Zheyuan Wu[5], Tobias Kober[6,7,8], Tom Hibert[6,7,8], Shangxuan Shi[9], and Tingfang Hwang[1]

[1]Radiology, Huashan Hospital, Fudan University, Shanghai, China, [2]Endocrinology, Huashan Hospital, Fudan University, Shanghai, China, [3]MR Research Collaboration, Siemens Healthineers Ltd., Shanghai, China, [4]Application Developments, Siemens Shenzhen Magnetic Resonance Ltd., 518057 Shenzhen, China, Shanghai, China, [5]Shanghai Municipal Center for Disease Control and Prevention, Shanghai, China, [6]LTS5, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, [7]Department of Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland, [8]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland, [9]ShanghaiTech University, Shanghai, China

Keywords: Tumors (Post-Treatment), Endocrine, Pituitary prolactinoma

Motivation: Predicting and managing dopamine agonists (DA) resistance of prolactinomas remain a challenge. There is no reliable quantitative imaging marker.

Goal(s): The goal is to use accelerated quantitative T2 mapping(GRAPPATNI) for early diagnosis of drug resistance in pituitary prolactinomas to guide treatment.

Approach: This is a cross-sectional study. It will analyze the differences in T2 values between drug-resistant and sensitive groups and explore their diagnostic value in predicting drug sensitivity.

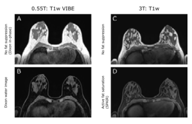
Results: Quantitative T2 values have better sensitivity than T2 signal intensity (SI) in predicting drug resistance in pituitary prolactinoma.

Impact: This is the first study to apply GRAPPATINI in prolactinoma. We found that T2 values of tumors were lower in drug-resistant prolactinoma than sensitive patients. T2 values might be a promising predictive imaging tool.

Oral

Extending Boundaries of Breast Cancer MRI

Nicoll 3 | Tuesday 8:15 - 10:15 | *Moderators:* Min Sun Bae & Ritse Mann

0406 8:15 

Initial evaluation of breast MRI protocols for cancer treatment monitoring at low field 0.55 T

Judith Zimmermann[1,2], Pan Su[3], Lisa Wilmes[1], Pedro Itriago Leon[3], Marcel Dominik Nickel[4], Wen Li[1], Bonnie Joe[1], and Nola Hylton[1]

[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Siemens Medical Solutions, USA, Inc., Malvern, PA, United States, [4]Siemens Healthineers AG, Erlangen, Germany

Keywords: Breast, Low-Field MRI, Breast

Motivation: With increasing availability and technical advances of low field 0.55T MRI systems, it is important to understand their value for breast applications.

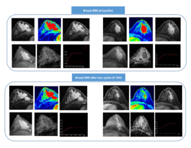
Goal(s): To present preliminary data of breast MRI at 0.55T with a newly available dedicated 7-channel prone breast coil.

Approach: Breast MRI at 0.55T and 3T with NIST-calibrated breast phantom and two healthy female volunteers using protocols that are clinically relevant for breast cancer treatment monitoring.

Results: Preliminary 0.55T breast MRI data has been successfully generated with acceptable image quality and will initiate future studies with breast cancer patients to advance breast MRI with low field systems.

Impact: This first acquisition of breast phantom and healthy volunteer data using sequences relevant in breast cancer treatment monitoring (T1-weighted, T2-weighted, diffusion-weighted) will initiate further, more detailed studies to explore the value of low field MRI for examining the breast.

0407 8:27



[Early Prediction of Treatment Response in HER2-Positive Breast Cancer Using multiparametric MRI]

Siyi Chen[1], Wenjie Tang[1], Yuan Guo[1], Zhidan Zhong[1], Yongzhou Xu[2], Lu Han[3], and Xinhua Wei[1]

[1]Department of Radiology, Guangzhou First People's Hospital, Guangzhou, China, [2]Philips Healthcare, Guangzhou, China, [3]Philips Healthcare, Shanghai, China

Keywords: Breast, Tumor, multiparametric MRI, neoadjuvant chemotherapy (NAC), HER2-positive breast cancer

Motivation: Imaging pre- and post- neoadjuvant chemotherapy (NAC) fails to adequately capture and quantify temporal heterogeneity and biological changes of tumors.

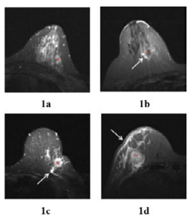
Goal(s): To assess if longitudinal changes in multiparametric MRI can predict early response to neoadjuvant chemotherapy (NAC) in HER2-positive breast cancer and to establish quantitative models based on these features.

Approach: Two predictive models were developed, one based on clinicopathologic features and another that combined clinicopathologic and MRI features.

Results: The combined model performs optimally in all datasets. Changes observed in multiparametric MRI can predict early treatment responses in HER2-positive BC and assist in tailoring personalized treatment plans.

Impact: The prediction model was simple and feasible, which was helpful for individualized treatment planning.

0408 8:39



Classification of Breast Edema on T2-weighted imaging for predicting sentinel lymph node metastasis and biological behavior in breast cancer

Shijia Xie[1], Mengxiao Liu[2], Zhe Hou[1], and Yunfeng Zhou[1]

[1]Yijishan Hospital, Wuhu, China, [2]MR Research Collaboration Team, Diagnostic Imaging, Siemens Healthineers Ltd, Shanghai, China, Shanghai, China

Keywords: Breast, Breast

Motivation: Predicting sentinel lymph node (SLN) metastasis and biological behavior in patients with early-stage breast cancer is important.

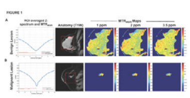
Goal(s): To determine whether preoperative classification of breast edema can predict SLN metastasis and biological behavior in patients with early-stage breast cancer.

Approach: Breast edema was scored on a scale of 1 to 4 on T2WI to explore additional predictive value of the breast edema score (BES) model.

Results: The combined BES model significantly improved the predictive performance of SLN metastasis.

Impact: Breast edema on T2-weighted imaging can be used to predict SLN metastasis in breast cancer, helping clinicians to develop individualized treatment plans and evaluate prognosis.

0409 8:51



In vivo CEST-MRI Parameters correlate to Transcriptome and Metabolic Features in Breast Lesions

Durga Udayakumar[1], Xiaojing Wang[1], Ling Cai[2], Yin Xi[1], Stephen Seiler[1], Sunati Sahoo[3], Ivan E Dimitrov[4], Jochen Keupp[5], and Elena Vinogradov[1]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Peter O'Donnell Jr. School of Public Health, UT Southwestern Medical Center, Dallas, TX, United States, [3]Pathology, UT Southwestern Medical Center, Dallas, TX, United States, [4]Philips Healthcare, Gainesville, FL, United States, [5]Philips Research, Hamburg, Germany

Keywords: Breast, Breast, CEST, Biomarkers, Cancer, Tissue Characterization

Motivation: CEST-MRI could provide biochemical and molecular information on breast lesions before detection of physiological and anatomical changes.

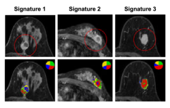
Goal(s): Our goal is to identify suitable *in vivo* CEST-MRI biomarker candidates.

Approach: 12 patients with 6 benign and 8 malignant lesions (pathology confirmed) who had concurrent CEST-MRI, transcriptome, and metabolomic data were included.

Results: Expression of several genes and metabolites correlated with MTRasym values ($P<0.05$) at 1, 2, and 3.5 ppm. At 1 and 2 ppm, DNA damage, cell cycle, stress response, and small molecule metabolic processes were prominently represented. Specific metabolites (e.g., Citrate/Isocitrate, glucuronate) showed significant correlations at 1, 2, and 3.5 ppm.

Impact: In vivo CEST-MRI parameters are reflective of transcriptome and metabolomic features in breast lesions. This provides molecular information, potentially before the detection of physiological and anatomical changes, and could facilitate accurate prediction of response to therapy allowing earlier interventions.

0410 9:03



Identification of pretreatment habitat signatures for the prediction of patient outcome in triple negative breast cancer

Anum Kazerouni[1], Laura Kennedy[2], Shaveta Vinayak[1], Suzanne Dintzis[1], Habib Rahbar[1], and Savannah Partridge[1]

[1]University of Washigton, Seattle, WA, United States, [2]Vanderbilt University, Nashville, TN, United States

Keywords: Breast, Radiomics, habitat imaging

Motivation: Triple negative breast cancer (TNBC) patients exhibit diverse response to therapy, with ~30% achieving pathological complete response (pCR).

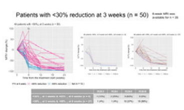
Goal(s): In this study, we seek to spatially-resolve heterogeneity of the tumor microenvironment using multiparametric MRI (mpMRI) in TNBC patients undergoing neoadjuvant chemotherapy to predict treatment outcomes.

Approach: We employ habitat imaging, clustering mpMRI data to identify physiologically distinct tumor subregions, or habitats. Patients are then defined by tumor habitat composition and clustered to identify common habitat signatures. Associations between habitat signatures and patient outcomes are evaluated.

Results: Clustering of patients yielded three habitat signatures with significantly different rates of pCR and recurrence-free survival.

Impact: We demonstrate that tumor habitat signatures can differentiate triple-negative breast cancer patients prior to neoadjuvant chemotherapy, identifying those with improved treatment response and long-term outcomes. Clinical translation of this approach could enable patient stratification for therapy escalation/de-escalation and treatment optimization.

0411 9:15



Prospective performance of an MRI algorithm for early re-direction of breast cancer neoadjuvant treatment

Natsuko Onishi[1], Jesiica E Gibbs[1], Wen Li[1], Elissa R Price [1], Barbara LeStage[2], William F Symmans[3], Christina Yau[4], John Kornak[5], the I-SPY 2 Imaging Working Group, the I-SPY 2 Investigator Network[6], Angela DeMichele[7], Laura J Esserman[4], and Nola M Hylton[1]

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Keywords: Breast, Cancer

Motivation: In our preliminary study of breast cancer patients undergoing neoadjuvant treatment in the I-SPY 2 TRIAL, functional tumor volume (FTV)-based algorithm using 3-week and 6-week MRI successfully identified sub-optimal responders as potential candidates for early treatment re-direction.

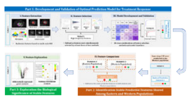
Goal(s): We aimed to evaluate the performance of the algorithm using data collected after the requirement for 6-week MRI based on 3-week response was officially added.

Approach: We tested PPV and sensitivity of the algorithm in 146 patients enrolled in I-SPY 2 between October 2021 and June 2022.

Results: The combined 3-week and 6-week MRI algorithm showed high PPV and high sensitivity in identifying sub-optimal responders.

Impact: In the I-SPY 2 neoadjuvant breast cancer trial, an MRI-based algorithm demonstrated its ability to identify sub-optimal responders at 6 weeks of treatment. This will impact response-based personalization of treatment in future clinical trials and ultimately treatment in the clinic.

0412 9:27



[Radiogenomics reveals tumor heterogeneity associated with the response to neoadjuvant chemotherapy in luminal breast cancer]

Shiyun Sun[1], Chao You[1], and Yajia Gu[1]

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Keywords: Breast, Breast, Luminal breast cancer, Radiomics, Magnetic resonance imaging (MRI), Tumor heterogeneity, Interpretability

Motivation: There is an urgent clinical need to develop predictive biomarkers that can help identify proper candidates for neoadjuvant chemotherapy (NAC) in luminal breast cancer.

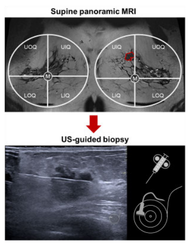
Goal(s): To develop tailored prediction model for response to NAC, identify stable predictive features shared between Eastern and Western populations and reveal their biological interpretability.

Approach: Multiscale radiomic features, multiple feature selection methods and classifiers, bioinformatics analysis, three independent cohorts.

Results: The combination of "high-frequency features-XGBoost" demonstrated the best predictive performance for NAC response. Four multiscale radiomic features were identified as stable and discriminative predictive features between Eastern and Western populations, which associated with the immune-related and PPAR pathways.

Impact: We proposed a more rigorous approach to ensure the robustness of radiomic features and explored the stable predictive features and their biological significance across different populations of luminal breast cancer. It will capture the interest of radiologist and clinicians.

0413 9:39



[Supine breast MRI with a wearable coil (BraCoil) improves lesion localization and clinical workflow for US-guided biopsy]

Raphaela Czerny[1], Paola Clauser[2], Michael Obermann[1], Pascal A. T. Baltzer[2], Elmar Laistler[1], and Lena Nohava[1]

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Keywords: Breast, Visualization

Motivation: Supine breast MRI might enable higher image correlation to supine ultrasound (US) and therefore facilitate the clinical workflow.

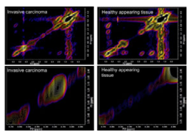
Goal(s): The aim was to quantify lesion displacement between supine US, prone MRI, and supine MRI in Cartesian and panoramic views, and derive the impact on the clinical workflow.

Approach: Using MRI and US patient data, the spatial lesion displacement was measured. For supine MRI a wearable breast coil (BraCoil) was used.

Results: Supine MRI shows comparable lesion position compared to US, in contrast to prone MRI. 18% of the lesions could only be localized in 2nd look US or biopsy after supine BraCoil MRI.

Impact: Supine breast MRI with a wearable coil could improve the clinical workflow by facilitating lesion localization for 2nd look US, biopsy, or surgery.

0414 9:51



NORMAL APPEARING BREAST TISSUE ON BREAST MRI HAS ALTERED CHEMISTRY CONSISTENT WITH “SWITCHED-ON” STATES IN WOMEN WITH INVASIVE CARCINOMA

Carolyn Mountford[1,2], Darren Lukas[1,2], Natali Naude[1], Jeremy Khoo[3], Gorane Santamaria Hormaechea[1,4], John Irvine[1,2], Thomas Lloyd[3], Ian Bennett[3], David Clark[5], Randell Brown[6], Lisa Rich[1], Laurie Kear[1], and Peter Malycha[1,7]

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Keywords: Breast, Spectroscopy, lipids, cholesterol

Motivation: Adenoma-carcinoma cell models examined using 2D COSY recorded altered triglyceride, cholesterol and metabolites prior to malignant transformation.

Goal(s): Investigate if such chemical profiles are recorded *in vivo* in MRI apparently normal tissue in women with invasive cancer.

Approach: Nineteen women with invasive breast cancer were compared with healthy low risk controls.

Results: Compared to controls, MRI normal tissue in cancer patients with low-density breasts recorded increases in cross peak F (68%), cholesterol (127%), and tumor promotor UDP-GlcNAc (81%). For dense breasts, increases recorded in cross peak F (47%), decreases in cholesterol (12%), triglyceride (56%) and double bonds (40%) in "switched-on" tissue.

Impact: Altered chemistry states, consistent with mechanisms leading to development of invasive carcinoma, are recorded *in vivo* from breast tissue distant to the cancer compared to controls. These states are referred to as "switched-on" tissue and differ according to breast density.

0415 10:03 WITHDRAWN

Oral
Technology Covering Global MRI Access

Room 325-326 | Tuesday 8:15 - 10:15 | *Moderators:* David Waddington & Sonal Krishan

8:15 Introduction

David Waddington
University of Sydney, Australia

0416 8:27

MRI advancement and research in Africa: Report on the Inaugural ISMRM African Chapter conference

Johnes Obungoloch[1], Adesola Emmauel Adepoju[2], Petronella Samuels[3,4], Mary-Jane Orevaoghene Amadi[5], Segun Joseph Ayilara [6], Mary Kamuzora [7], Klenam Dzefi-Tettey [8], Anthonia A Ikpeme [9], Frances Robertson[3], Udunna Anazodo [10], Chip Truwit [11], Farouk Dako[12], Andrew Webb[13], Yaw B Mensah [8], Iris Asllani[14,15], Ernesta Meintjes [3,16], and Godwin Ogbole[2]

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Keywords: Low-Field MRI, Low-Field MRI, Networking, Innovation

Motivation: Due to rising non-communicable diseases, limited MRI accessibility, and Africa's underrepresentation in ISMRM, the African Chapter (AC) was founded in 2023. An inaugural conference in Ghana focused on emerging MRI technology for improved accessibility.

Goal(s): To provide the inaugural conference report of AC-ISMRM, with the identification of challenges and barriers to MRI access and propose solutions toward democratization of MRI across Africa.

Approach: A white paper approach was adopted

Results: Over 100 scientists from 12 African countries met to identify challenges and propose solutions for advancing MRI access and value in Africa. Low-field MRI was identified as a breakthrough innovation toward this goal.

Impact: The AC-ISMRM conference marks a pioneer event, convening African scientists and clinicians, aimed at establishing a network dedicated to rectify Africa's underrepresentation in MRI research, seeking solutions to challenges on the continent and promoting collaboration and MRI advancements

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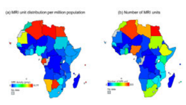
0417 8:39



Bridging Health Disparities: Accessible MRI in Underserved African Countries

Israa S. Hissein[1,2], Jingting Yao[3], Ming Zhao[1,4], Foksouna Sakadi[5], André J.W. van der Kouwe[3], and Jerome L. Ackerman[3]

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Keywords: New Devices, Neuro, Healthcare Disparities, Neurological Disorders, Accessible MRI

Motivation: Neurological disorders, including cerebral malaria and HIV/AIDS-associated complications, are leading causes of death in underserved African nations, hindered by a lack of medical equipment, particularly MRI facilities.

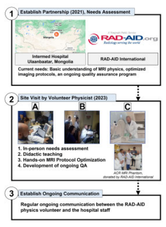
Goal(s): We seek to address two key questions: the need for MRI facilities in underserved African regions and the potential of accessible MRI in reducing healthcare disparities related to medical imaging.

Approach: We employed a multifaceted approach, involving literature review, interviews, and evaluations of accessible scanner benefits and enhancements.

Results: The marked disparities in MRI capabilities in Africa underscore the pressing need for investment in enhanced MRI infrastructure and customized imaging technologies, tailored to resource-limited settings.

Impact: This research underscores the urgent need for MRI facilities to address neurological disorders in African countries, highlighting infrastructure gaps and the potential for innovative, compact MRI solutions to improve healthcare in resource-limited settings.

0418 8:51



Medical physics mentoring through a RAD-AID International partnership with Intermed Hospital in Mongolia: Development and initial visit

Joseph Weygand[1,2], Batnasan Shagdarsuren[3], Tamir Munkhtuvshin[3], Bayarbaatar Bold[3], Khulan Khurelsukh[3], Eman Suliman[4], John M. Bryant[5], Gage Redler[5], Benjamin C. Musall[6], Shauna M. McVorran[1], Travis C. Salzillo[7], Sharon Mohammed[2,8], and Daniel J. Mollura[2]

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Keywords: Safety, Health Care Economics, Global Health, Outreach

Motivation: Despite wide application in high-income countries, MRI is largely underutilized in low- and middle-income countries[3] (LMIC's). One reason is a lack of expertise in MRI physics in LMIC's. RAD-AID International is an organization engaged in radiological outreach and is active in over twenty countries.

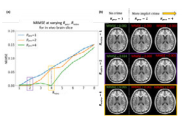
Goal(s): In this abstract, a roadmap for an MRI physics mentorship partnership is presented and illustrated at a private hospital in Northeast Asia.

Approach: A physicist volunteering for RAD-AID International visited Intermed Hospital in Mongolia.

Results: He taught the basics of MRI physics, optimized their imaging protocols, and established a quality assurance program. Collaboration will be ongoing.

Impact: MRI is underutilized in low-resource settings. One impediment to its utilization is lack of physics expertise. In this work, a roadmap is presented whereby a philanthropic organization partners with an Asian hospital to better incorporate physics concepts into clinic practice.

0419 9:03



Parallel Imaging Reconstruction in Public Datasets Biases Downstream Analysis in Retrospective Sampling Studies

Evan Frenklak[1], Yamin Arefeen[1,2], and Jonathan I Tamir[1]

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Keywords: Data Processing, Image Reconstruction, implicit data crimes

Motivation: We explore the "Implicit Data Crime" of datasets whose subsampled k-space is filled using parallel imaging. These datasets are treated as fully-sampled, but their points derive from (1)prospective sampling, and (2)reconstruction of un-sampled points, creating artificial data correlations given low SNR or high acceleration.

Goal(s): How will downstream tasks, including reconstruction algorithm comparison and optimal trajectory design, be biased by effects of parallel imaging on a prospectively undersampled dataset?

Approach: Comparing reconstruction performance using data that are fully sampled with data that are completed using the SENSE algorithm.

Results: Utilizing parallel imaging filled k-space results in biased downstream perception of algorithm performance.

Impact: This study demonstrates evidence of overly-optimistic bias resulting from the use of k-space filled in with parallel imaging as ground truth data. Researchers should be aware of this possibility and carefully examine the computational pipeline behind datasets they use.

0420 9:15

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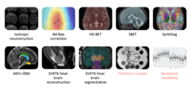

Facilitating access to neuroimaging and computational resources in low-resource settings through a centralised biomedical imaging platform

Niall J Bourke[1], Jonathan O'Muircheartaigh[1], Sean Deoni[2], Pablo Velasco[3], Doug Dean III[4], Emil Ljungberg[1,5], Jessica E Ringshaw[6], Maclean Vokhiwa[7,8], Marc Seal[9], Richard Beare[9], Victoria Nankabirwa[10], Francesco Padormo[11], Costas Tsougarakis[3], Can Akgun[3], Carly Bennallick[12], František Váša[1], Layla E Bradford[6], Marlie Miles[13], Michal Zieff[6], Thandeka Mazubane[6], Zayaan Goolam Nabi[6], Simone Williams[6], Yaw Mensah [14], Samuel A Oppong[15], Levente Baljer[1], Muriel Bruchhage[16], Natasha Lepore[17], Khula South Africa Data Collection Team[6], Daniel Alexander[18], Derek Jones[19], Kirsten A Donald[6], and Steven Williams[1]

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Keywords: Neuro, Low-Field MRI

Motivation: MRI remains inaccessible in many parts of the world, as are the computational resources to perform neuroimaging analysis. We hope to develop resources for a growing neuroimaging community in low-resource settings.

Goal(s): To develop scalable neuroimaging tools, building capacity across low-resource settings and supporting a community for neuroimaging research.

Approach: Partnership with Hyperfine, Flywheel and numerous collaborators in sub-Saharan Africa and south Asia to collect and process MRI scans of children in the early years of life.

Results: Containerised workflows optimised for ultra-low field paediatric imaging were developed. Derived volume estimates were generated from geographically dispersed regions for further global health questions.

Impact: Multiple low-resource sites in a global consortium have generated derived volume estimates through standardised workflows of ultra-low field MR images. This enables answering of locally relevant clinical questions on factors affecting neurodevelopment, such as maternal anaemia, HIV exposure, malnutrition etc.

0421 9:27

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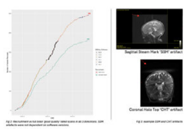

Research use of an ultra-low-field MRI to measure child neurodevelopment at 3 and 12 months of age in Southern Malawi, Sub-Saharan Africa

Maclean Vokhiwa[1,2], Able Khosa[1], Blessings Nthulula[1], Karen Chetcuti[3], Louise Randall[4], Steven Greenstein[5], Marc Seal[5], Richard Beare[5], Niall Bourke[6], Francesco Padormo[7], John Rogers[7], Pip Torelli[7], Sean Deoni[8], Sant-Rayn Pasricha[4], and Kamija S. Phiri[1,2]

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Keywords: Neuro, Low-Field MRI, Infant Brain Development; Brain MRI; Ultra-Low-Field MRI

Motivation: In Sub-Saharan Africa, limited MRI access and expertise can be addressed through international collaborations to enhance quality neuroimaging data collection in brain research.

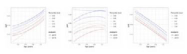
Goal(s): We describe research usability and reliability of an ultra-low-field (64mT) MRI data collection from Zomba, Malawi.

Approach: We scanned ~481 children at 3 and 12 months of age, using hyperfine Swoop ULF-MRI (64T) for neuroimaging data to augment traditional randomized control trial outcome measures. We summarize procedures, participant responsiveness, and neuroimaging quality.

Results: Full-scan success was in over 88% of participants within 55 weeks, with 87.4 to 99.6% completing all 5 scanning sequences. Full-brain quality scans were in >79%.

Impact: International collaborations, such as UNITY project, utilizing ultra-low-field MRI improves research capacity and enables reliable measurement of brain development in Sub-Saharan Africa. This significantly promotes advancement of developmental neuroscience in the region.

0422 9:39



Portable Ultra-Low Field MRI is Sensitive to Distinct Profiles in Brain Development of Malnutrition and Nutritional Intervention

Muriel Bruchhage[1], Hang Zhou[2], Yidong Zhou[2], Daniel Elijah Scheiene[1], Niall J. Bourke[3], Jonathan O'Muircheartaigh[4,5], James Cole[6], Kristofer E. Bouchard[7,8], Susanne Martin-Herz[9], Victoria Laleau[9], Valerie Flaherman[9], Sean C. L. Deoni[10], Hans-Georg Müller[2], Joan Murungi[11], and Victoria Nankabirwa[11]

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Keywords: Neuro, Pediatric, Low-Field MRI

Motivation: The first years are essential for a child's development and adverse factors, including malnutrition, can affect neurodevelopment and survival rates. Access to high-field MRI scanners in Sub-Saharan Africa is highly limited.

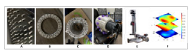
Goal(s): To detect distinct profiles in brain development of malnutrition and nutritional intervention using ultra-low field MRI.

Approach: We used ultra-low field MRI in a pediatric cohort in Uganda of 71 infants (<1.5 years) with and without history of malnourishment, imaged before and after receiving an intervention.

Results: Using PACE brain-for-age growth percentiles, we demonstrate that ultra-low field MRI is sensitive to distinct profiles in brain development of malnutrition and nutritional intervention.

Impact: The distinct profiles of early malnourishment on neurodevelopment and their changes after nutritional intervention derived by ultra-low field MRI could allow for more appropriate neurodevelopmental burden estimates in LMIC pediatric populations and support early intervention evaluation.

0423 9:51



MRI4All: A Week-Long Hackathon for the Development of an Open-Source Ultra-Low-Field MRI System

Sai Abitha Srinivas[1], Leeor Alon[2,3], Akbar Alipour[4], Anais Artiges[3,5], Kai Tobias Block[3,5], Fernando Boada[6], Doug Bratner[5], Ryan Brown[5], Jingjia Chen[7], Vito Ciancia[8], Clarissa Cooley[9], Tarun Dutt[5], David Garrett[10], Sairam Geethanath[11], Bernhard Gruber[9,12], Dinank Gupta[13], Carlotta Ianniello[14], Ilknur Icke[15], Kalina Jordanova[16], Hector Lise de Moura[5], Yvonne Lui[5], Andrew Mao[5], Jonathan Martin[17], Anmol Monga[5], Amritha Musipatla[5], Shounak Nandi[4], Aaron Purchase[9], Thiago Rubio[18], Amanpreet Saimbhi[5], Anja Samardzija[19], Charlotte Sappo[20], Greg Shakar[21], Yun Shang[22], Jeff Short[9], Daniel Sodickson[5], Jason Stockmann[9], Zach Stoebner[23], Heng Sun[19], Florin Teleanu[18], Sebastian Theilenberg[14], Radhika Tibrewala[5], Antonio Verdone[5], George Verghese[5], Roy Wiggins[5], Bingyu Xin[24], Guang Yang[25], Chengtong Zhang[18], Horace Zhang[19], Ruoxun Zi[5], Riccardo Lattanzi[5], Nora Krassnig-Plass[12], Karthik Lakshmanan[5], Kranthi Kiran[21], Lavanya Umapathy[5], Luoyao Chen[5], and Alex Nwigwe[26]

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Keywords: Low-Field MRI, Low-Field MRI, open-source

Motivation: To break the accessibility barrier of high-field MRI, we demonstrate that hardware and software systems necessary for an affordable MRI system, can be designed and constructed within a week using open-source tools and conventional 3D printing approaches.

Goal(s): To illustrate the realization of an ultra low field MRI system fully operational using open source tools

Approach: Over the course of a week, researchers across the USA have assembled to build the main magnet, field homogenization, gradient, radio-frequency (RF), and software systems needed for the creation of MRI.

Results: We present, for the first time, a community-driven open-source MRI system built within a week.

Impact: to introduce a community-driven open-source MRI low-field systems have the capability to widely democratize MRI throughout the community and the world.

10:03 Discussion

David Waddington

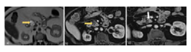
University of Sydney, Australia

Oral

A Tale of Liver & Pancreas

Room 331-332 | Tuesday 8:15 - 10:15 | *Moderators:* Michael Ohliger & S Senthil Kumaran

0424 8:15



Clinical Utility of 0.55T MRI System for the Surveillance of Intraductal Papillary Mucinous Neoplasm

Radhika Rajeev[1], Lauren Kelsey[1], Benjamin Mervak [1], Nikita Consul [1], Shane A. Wells [1], Erica Stein[1], Reve Chahine [1], Tayson Lin[1], Mishal Mendiratta-Lala[1], Vikas Gulani[1], Nicole Seiberlich[1], and Hero K. Hussain[1]

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

Keywords: Hepatobiliary, Biliary

Motivation: Explore surveillance of Intraductal Papillary Mucinous Neoplasms (IPMN) at 0.55T, as an alternative to high field strength systems.

Goal(s): To assess the image quality at 0.55T and its impact on radiologists' confidence in evaluating IPMN versus 1.5T/3T

Approach: Images from 39 patients with IPMN who underwent 0.55T and 1.5/3T MRI were rated by 7 blinded radiologists for image quality and diagnostic certainty. Pearson correlation analysis performed

Results: A strong positive correlation existed between image quality and rater's confidence. Negligible differences in confidence observed between 0.55T and 1.5T/3T for images with quality scores≥5.

Impact: 0.55T can be used for IPMN surveillance without compromising diagnostic effectiveness

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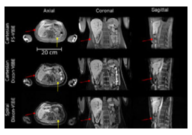
0425 8:27

MERIT AWARD SUMMA CUM LAUDE



Spiral T1w-Dixon-VIBE for high resolution abdominal imaging at 0.55T

Bilal Tasdelen[1], Nam G. Lee[1], Sophia X. Cui[2], and Krishna S Nayak[1]

[1]*Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States,* [2]*Siemens Medical Solutions USA, Los Angeles, CA, United States*

Keywords: Liver, Low-Field MRI, Spiral, Dixon, abdomen

Motivation: Breath-held abdominal fat-suppressed imaging is challenging at mid- and low-field strengths (<1.5T). Fat saturation often fails due to the short T1 of lipid; and Cartesian Dixon imaging provides poor spatial resolution due to the need for long ΔTE, due to the smaller Δf between water and lipid.

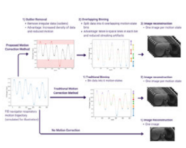
Goal(s): Breath-held fat-suppressed high-resolution volumetric abdominal imaging with T1 contrast.

Approach: Stack-of-Spirals Dixon imaging, with estimation and compensation for phase due to concomitant fields

Results: We demonstrate that spiral Dixon imaging at 0.55T makes excellent use of the required ΔTE, improving SNR efficiency and spatial resolution (1.7x1.7x5.0mm^3) compared Cartesian Dixon (3.5x3.5x5.0mm^3), within a 17-second breath-hold.

Impact: We demonstrate that spiral Dixon single breath-hold volumetric imaging is an attractive alternative to existing Cartesian-based methods for volumetric single breath-hold fat-suppressed imaging at 0.55T, as it simultaneously provides high-resolution and excellent fat-suppression.

0426 8:39



Enhancing Motion Correction in T1-Weighted Abdominal MRI Through Outlier Removal and Overlapping Binning

Michelle Su[1], Cemre Ariyurek[2], Jeanne Chow[2], Onur Afacan[2], and Sila Kurugol[2]

[1]*Radiology, Boston Children's Hospital, Boston, MA, United States,* [2]*Radiology, Boston Children's Hospital and Harvard Medical School, Boston, MA, United States*

Keywords: Liver, Motion Correction, T1-weighted imaging, abdomen

Motivation: Respiratory motion creates blurring artifacts in abdominal MRIs for the liver and kidneys, preventing identification of tumors and blood vessels and optimal treatment administration.

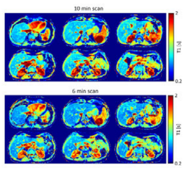
Goal(s): We aimed to increase respiratory data density, decrease motion, and maximize data utilization in each motion-state.

Approach: We proposed a motion-correction method to remove respiratory irregularities and sort data into overlapping motion-states. We compared signal density and conspicuity of artifacts and organ structures for images reconstructed from the proposed and traditional methods.

Results: Compared with the traditional method, the proposed method consistently increased data density by over 50% and produced more motion-robust images for inhale-states of irregular-breathing patients.

Impact: Our proposed motion-correction method for T1-weighted abdominal MRIs increases respiratory data density to improve visibility of liver and kidney vessels and boundaries, supporting treatment for irregular-breathing and pediatric patients. This method may enhance dynamic contrast-enhanced MRI with temporal resolution constraints.

0427 8:51



Free-Breathing Stack-of-Stars Look-Locker T1-mapping with Whole Liver Coverage

Ute Goerke[1], Shu-Fu Shih[2], Eze Ahanonu[3], Holden H. Wu[2], Vibhas Deshpande[4], Ali Bilgin[3], Waqas Majeed[5], and Maria I. Altbach[6]

[1]Siemens Medical Solutions USA, Tucson, AZ, United States, [2]Department of Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States, [3]Department of Electrical Engineering, University of Arizona, Tucson, AZ, United States, [4]Siemens Medical Solutions USA, Austin, TX, United States, [5]Siemens Medical Solutions USA, San Francisco, CA, United States, [6]Department of Medical Imaging, University of Arizona, Tucson, CA, United States

Keywords: Liver, Liver

Motivation: Many patients cannot hold their breath as required on standard protocols for abdominal imaging

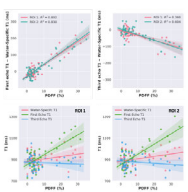
Goal(s): We develop a new new free-breathing Look-Locker T1-mapping method with whole liver coverage.

Approach: The new free-breathing Look-Locker T1-mapping method employs a pilot tone signal for detecting the respiratory state. This signal is used to reconstruct motion-corrected T1-weighted images, which are used to calculate T1-maps.

Results: Robust T1-maps are obtained covering the whole liver obtained from 6 min free-breathing scan.

Impact: A new free-breathing Look-Locker T1-mapping method with whole liver coverage has been developed for patients who are not able to hold their breath as required in standard protocols.

0428 9:03



3D Fat/Water-Separated Liver T1 Mapping: A Study on the Influence of Fat and Repeatability

Jingjia Chen[1,2], Yuhui Huang[1,2], Ding Xia[3], Hersh Chandarana[1,2], and Li Feng[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Biomedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States

Keywords: Liver, Fat

Motivation: Liver T1 estimation depends on the echo time when fat signal is not eliminated, implying that traditional T1 mapping techniques without considering the presence of fat may lack accuracy and reliability.

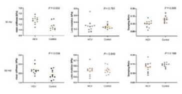
Goal(s): This study investigated the correlation between liver T1 and fat fraction in 3D free-breathing Fat/Water-Separated T1 mapping and the repeatability of water-specific T1 measurement.

Approach: Fifty subjects were recruited and four of them were scanned multiple times to assess the repeatability.

Results: Difference between the first echo T1 and water-specific T1 shows strong correlation with the fat fraction, while water-specific T1 shows little correlation. Water-specific T1 mapping is repeatable.

Impact: This study aims to investigate the influence of fat on liver T1 in 3D free-breathing T1 mapping. This can help understand how the fat affects liver T1 mapping and facilitate the development new techniques for estimating water-specific liver T1.

0429 9:15



[Longitudinal Changes of Hepatic Mechanical Properties in Patients with Early-Stage HCV Infection Treated with Direct-Acting Antiviral Agents]

Caixin qiu[1], Nana K Owusu[1], Kevin J Glaser[1], Jiahui Li[1], Hao Wu[1], Sudhakar K Venkatesh[1], Douglas A Simonetto[2], Ehman L Richard[1], and Meng Yin[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States, [2]Division of Gastroenterology and Hepatology, Mayo Clinic, Rochester, MN, United States

Keywords: Liver, Elastography, HCV, loss modulus, damping ratio

Motivation: While DAAs have significantly improved the treatment of HCV patients, some individuals still face relapse or progression. There is currently a deficiency in non-invasive and simple methods for effectively monitoring the longitudinal treatment effects.

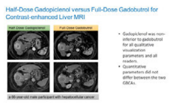
Goal(s): To develop a reliable biomarker for detecting inflammatory response to DAA treatment in the early stages of HCV infection.

Approach: Longitudinal monitoring of changes in early-stage HCV patients after DAA treatment using multiparametric MRE.

Results: Multi-parameter MRE can detect HCV at the early stage and can monitor both short-term inflammatory response and long-term treatment effect of the liver in HCV patients after DAA treatment.

Impact: Developed a non-invasive biomarker for monitoring the efficacy of DAA treatment in early-stage HCV patients.

0430 9:27



[Efficacy of gadopiclenol in contrast-enhanced MRI of the liver: a post-hoc analysis]

Jeong Min Lee[1]

[1]Seoul National University Hospital, Seoul, Korea, Republic of

Keywords: Liver, Liver

Motivation: Gadolinium dose reduction while maintaining MRI diagnostic efficacy is crucial.

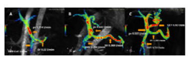
Goal(s): Compare gadopiclenol (0.05 mmol/kg) and gadobutrol (0.1 mmol/kg) in liver MRI.

Approach: Post-hoc analysis on patients with liver lesions from the PROMISE phase III study (N=66).
Lesion visualization was qualitatively (border delineation, internal morphology, contrast enhancement) and quantitatively (enhancement percentage, lesion-to-background ratio) evaluated by three blinded readers. Three additional readers assessed diagnostic preference.

Results: Gadopiclenol was non-inferior to gadobutrol for all qualitative visualization parameters and all readers.
Quantitative parameters did not differ between the two GBCAs.
Readers had in most cases no preference between images with the two GBCAs.

Impact: The reduction in the injected gadolinium dose achieved with gadopiclenol may be particularly important in patients undergoing multiple contrast-enhanced MRI examinations. This will also reduce the amount of gadolinium released into wastewater systems, limiting any potential ecological impact.

0431 9:39



[Clinical Value of 4D Flow MRI in Assessing High-Risk Esophagogastric Varices: A Prospective Study]

Qian Zhang[1], Mingfeng Wu[1], Yi Zhu[2], Ke Jiang[3], and Rongpin Wang[1]

[1]Guizhou Provincial People's Hospital, Guiyang, China, [2]Philips Healthcare, Beijing, China, [3]Philips Healthcare, Chengdu, China

Keywords: Liver, Body, 4D Flow MRI; portal hypertension; Esophagogastric Varices

Motivation: The pursuit of less invasive diagnostic methods to gauge portal hypertension and the associated risk of variceal bleeding in cirrhosis patients.

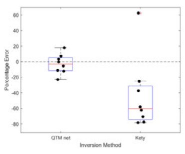
Goal(s): To determine the effectiveness of hemodynamic parameters derived from 4D flow MRI for the non-invasive assessment of portal hypertension and to stratify the risk of variceal bleeding in patients with cirrhosis.

Approach: Utilizing hemodynamic parameters from 4D flow MRI to profile portal circulation.

Results: Results showed significant differences in FFC and maximum splenic blood flow between low-risk and high-risk patients. Moreover, the combination of FFC and maximum splenic blood yielded high diagnostic accuracy.

Impact: Demonstrating the utility of 4D flow MRI in evaluating portal hypertension and variceal bleeding risk.

0432 9:51 [Validating Quantitative Transport Mapping (QTM) on a Perfused Liver Phantom]



Dominick Romano[1,2], Qihao Zhang[2], Mert Şişman[2,3], Renjiu Hu[2,4], Benjamin Weppner[1,2], Thanh Nguyen[2], Pascal Spincemaille[2], Martin Prince[2,5], and Yi Wang[2]

[1]Biomedical Engineering, Cornell University, Ithaca, NY, United States, [2]Radiology, Weill Cornell Medical College, New York, NY, United States, [3]Electrical Engineering and Computer Science, Cornell University, Ithaca, NY, United States, [4]Mechanical And Aerospace Engineering, Cornell University, Ithaca, NY, United States, [5]Radiology, Columbia University Vagelos College of Physicians and Surgeons, New York, NY, United States

Keywords: Cancer, Perfusion, Dynamic Contrast Enhanced MRI; Liver; Validation; Deep Learning; Phantoms

Motivation: To validate deep learning based Quantitative Transport Mapping (QTMnet) on a perfused tissue phantom.

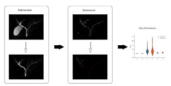
Goal(s): Evaluate the accuracy of QTMnet derived flow and compare to traditional tracer-kinetic flow estimation.

Approach: We developed a workflow to prepare porcine liver as a perfusion phantom[1]. We perfused n=8 porcine livers with a controllable pump and acquired DCE-MRI. We then estimated the liver flow with QTMnet and traditional tracer-kinetics.

Results: QTMnet accurately estimates our phantom flow (**mean error**: -2.82%, **mean absolute error**: 10.0%). Furthermore, QTMnet flow estimation was more accurate than traditional tracer-kinetics flow estimation (**mean error:** -43.29%, **mean absolute error:** 58.9%, P<0.00001).

Impact: Our liver phantom workflow allows demonstrating accuracy of estimated flows. Superior accuracy was observed using QTMnet compared to traditional tracer-kinetics. Accurate estimation of liver blood flow allows better diagnosis and follow-up in the imaging of primary and secondary liver cancer.

0433 10:03 [Magnetic Resonance Cholangiopancreatography at 5 T: Quantitative and Qualitative Comparison with 3 T]



Liang Yin[1], Zhongchang Li[1], Bowen Tang[1], Dan Yu[2], and Jie Gan[1]

[1]Shandong Provincial Third Hospital, Jinan, China, [2]United Imaging Research Institute of Intelligent Imaging, Beijing, China

Keywords: Preclinical Image Analysis, Quantitative Imaging, Biliary

Motivation: To evaluate the 5 T MRI's effectiveness for MRCP imaging.

Goal(s): To demonstrate 5 T imaging's comparability in visualization, SNR, and image quality to 3 T.

Approach: MRCP was performed on subjects using both 3 T and 5 T MRI, assessing the bile duct tree visualization and SNR, with radiologists evaluating image quality and artifacts.

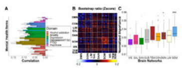
Results: 5 T revealed superior bile duct tree visualization, with comparable SNR, image quality, and artifact management to 3 T.

Impact: The study highlights 5 T MRI's potential in MRCP, suggesting improved biliary visualization which could lead to better clinical outcomes and guide further technological advancements in non-invasive diagnostics.

Oral
MRI for Psychopathology

Room 334-336 | Tuesday 8:15 - 10:15 | *Moderators:* Anouk Schrantee & Hailong Li

0434 8:15



Brain functional connectome phenotype relates to psychopathology in middle-aged and older adults

Thuan Tinh Nguyen[1,2], Kwun Kei Ng[1], Janice Jue Xin Koi[1], and Juan Helen Zhou[1,2,3]

[1]Centre for Sleep and Cognition & Centre for Translational Magnetic Resonance Research, National University of Singapore, Singapore, Singapore, [2]Integrative Sciences and Engineering Programme, National University of Singapore, Singapore, Singapore, [3]Department of Electrical and Computer Engineering, National University of Singapore, Singapore, Singapore

Keywords: Psychiatric Disorders, Psychiatric Disorders

Motivation: To better understand brain network vulnerability in mental health disorders in the understudied middle-aged and older adults and see if it fits the hierarchical model of psychopathology.

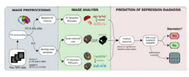
Goal(s): We sought to unveil the structure of psychopathology through investigating the brain phenotypes underlying various mental outcomes using the UK Biobank cohort.

Approach: We investigated how brain functional connectivity relates to 36 mental outcome items using a multivariate partial least squares correlation approach.

Results: Across middle-aged and older adults, we identified a general disease factor and another reflecting the divergence between alcohol addiction and depression/PTSD related symptoms, consistent with the hierarchical model of psychopathology.

Impact: These findings highlighted the importance of characterizing mental disorders in terms of transdiagnostic dimensions instead of separate disorders. It also shed light on how imaging biomarkers can be used to characterize population suffering from poor mental health.

0435 8:27



Explainable depression classification: a machine learning approach based on brain network size and functional connectivity

Jesper Pilmeyer[1,2], Lisa Koolen[1], Marcel Breeuwer[1,3,4], Jacobus F.A. Jansen[1,5,6], and Svitlana Zinger[1,2]

[1]Electrical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands, [2]Research and Development, Epilepsy Centre Kempenhaeghe, Heeze, Netherlands, [3]Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands, [4]Philips Healthcare, Best, Netherlands, [5]Radiology and Nuclear Medicine, Maastricht University Medical Center, Maastricht, Netherlands, [6]School for Mental Health and Neuroscience, Maastricht University, Maastricht, Netherlands

Keywords: Psychiatric Disorders, Psychiatric Disorders, depression

Motivation: Major depressive disorder (MDD) affects ~6% of adults annually worldwide, but a lack of understanding of the pathology and heterogeneity may underlie its low treatment effectiveness.

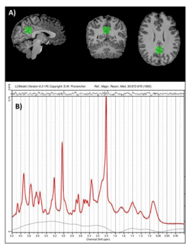
Goal(s): This study aimed to identify explainable functional MRI biomarkers of MDD on an individual level.

Approach: Classification models were run to predict MDD for three functional measures.

Results: In two datasets, >70% MDD accuracy was achieved for each measure. Highest performance was obtained with region-based functional connectivity but spatial extent provided novel perspectives on abnormal brain functioning, such as decreased cerebellum involvement in the frontoparietal network, potentially reflecting decreased emotion regulation or control during cognitive processes.

Impact: This MRI research contributes to the identification of robust depression biomarkers, enhancing our understanding of the abnormal brain functioning. The explainability of the spatial extent feature provides additional insights into its pathology which may be utilized for diagnostic tools.

0436 8:39



Pilot Results Investigating Treatment Effects on Neurometabolites in Major Depressive Disorder: A 7T MRS Study of the Posterior Cingulate Cortex

Ravichandran Rajkumar[1,2,3,4], Ezequiel Farrher[2], Gereon J Schnellbächer[1,2], Jana Hagen[1,2], Maria Collee[1,2], Shukti Ramkiran[1,2,4], Alna Reem Al Latheef[1,2], Tanja Veselinović[1], N. Jon Shah[2,3,5,6], and Irene Neuner[1,2,3,4]

[1]Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH Aachen University, Aachen, Germany, [2]Institute of Neuroscience and Medicine, INM-4, Forschungszentrum Jülich, Juelich, Germany, [3]JARA – BRAIN – Translational Medicine, Aachen, Germany, [4]Center for Computational Life Science, RWTH Aachen University, Aachen, Germany, [5]Department of Neurology, RWTH Aachen University, Aachen, Germany, [6]Institute of Neuroscience and Medicine, INM-11, Forschungszentrum Jülich, Juelich, Germany

Keywords: Psychiatric Disorders, Psychiatric Disorders, MRS, MDD, Neurotransmitters, UHF

Motivation: This research addresses a critical gap by investigating the impact of depression treatment on neurometabolites in the PCC.

Goal(s): This exploratory study aims to investigate the relationship between neurometabolite levels in the PCC and assess its impact on treatment.

Approach: Structural MRI and MRS data were acquired from 16 MDD patients and 16 healthy controls. The concentration of neurometabolites was quantified. ANOVA models were used to assess differences between groups.

Results: Treatment effectively reduced depressive symptoms but did not significantly alter neurometabolite levels in the PCC. Factors such as medication, small sample size, and short follow-up intervals may have contributed to these results.

Impact: This research highlights that, despite effective treatment response in improving depressive symptoms in MDD patients, neurometabolite levels in the PCC were not significantly altered, emphasizing the necessity for further, more extensive research to comprehensively understand MDD and its treatment.

0437 8:51

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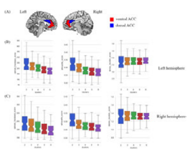


Distinct functional connectivity of anterior cingulate cortex subregional networks in first-episode and recurrent major depressive disorder

Zilin Zhou[1], Lingxiao Cao[1], Yingxue Gao[1], Weijie Bao[1], Mengyue Tang[1], Hailong Li[1], Lianqing Zhang[1], Huaiqiang Sun[1,2], Qiyong Gong[3], and Xiaoqi Huang[1,2]

[1]Department of Radiology and Huaxi MR Research Center (HMRRC), Functional and Molecular Imaging Key Laboratory of Sichuan Province, West China Hospital, Sichuan University, Chengdu, China, [2]Research Unit of Psychoradiology, Chinese Academy of Medical Sciences, Chengdu, China, [3]Department of Radiology, West China Xiamen Hospital of Sichuan University, Xiamen, China

Keywords: Psychiatric Disorders, fMRI (resting state), major depresive disorder

Motivation: The fine-grained anterior cingulate cortex (ACC) subregional functional connectivity alterations in first-episode and recurrent major depressive disorder (MDD) remained unclear.

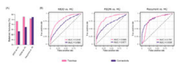
Goal(s): To obtain optimal functional ACC subdivisions and explore alterations in intrinsic functional connectivity of ACC subregional networks in first-episode and recurrent MDD.

Approach: We utilized a data-driven connectivity-based parcellation to obtain optimal ACC subdivisions, calculated ACC subregional functional connectivity, and compared among first-episode, recurrent MDD patients and healthy controls.

Results: Ventral and dorsal ACC per hemisphere were identified as optimal parcellation. The ACC subregional connectivity was reduced in all MDD patients, while dorsal ACC connectivity was significantly reduced only in recurrent patients.

Impact: Our discovery of impaired functional architectures of ACC subdivisions in MDD, with a more prominent disrupted connectivity of dorsal ACC in relapsed patients, emphasize a potential role of ACC subregional connectivity in distinguishing MDD at different episodes and predicting relapse.

0438 9:03



Abnormal Topology and Connectivity of Structural Covariance Network Related to Diagnosis and Phenotyping in Major Depressive Disorder

Kun Qin[1], Jing-Yi Long[2], Nanfang Pan[3], Cunqing Kong[1], Weiyin Vivian Liu[4], Wen Chen[1], and Yi Li[2]

[1]Department of Radiology, Taihe Hospital, Hubei University of Medicine, Shiyan, China, [2]Wuhan Mental Health Center, Wuhan, China, [3]West China Hospital of Sichuan University, Chengdu, China, [4]GE Healthcare, MR Research China, Beijing, China

Keywords: Psychiatric Disorders, Brain Connectivity

Motivation: Findings on brain network abnormalties in major depressive disorder (MDD) were mixed owing to small-scale and single-site designs. The diagnostic value of network topology and connectivity remain unclear.

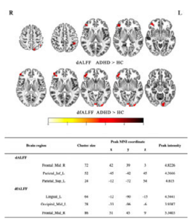
Goal(s): To identify robust structural network abnormalities in MDD and relevant clinical phenotypes and to discern the diagnostic value of network topology and connectivity.

Approach: Group-level comparsion and individual-level machine learning classification was performed based on structural covariance network connectivity and topological metrics.

Results: Different patterns of network topology and connectivity abnormalities were observed between first-episode drug-naive and recurrent patients with MDD. Topological metrics enabled more accurate classification performance on MDD diagnosis and phenotyping.

Impact: Our findings advance the current understanding of network-level neurobiological mechanisms of MDD, providing a solid basis for future development of network topology-based diagnosis models.

0439 9:15



Dynamic alterations in spontaneous neural activity in patients with attention-deficit/hyperactivity disorder: a resting-state fMRI study

Rui Hu[1,2], Wei Du[1], Fan Tan[2], Yong Wu[2], Wen Chen[2], and Yanwei Miao[1]

[1]The First Affiliated Hospital of Dalian Medical University, Dalian, China, [2]Taihe Hospital, Hubei University of Medicine, Shiyan, China

Keywords: Psychiatric Disorders, fMRI (resting state), attention-deficit/hyperactivity disorder

Motivation: The dALFF and dfALFF of ADHD have not been fully revealed and publicized.

Goal(s): We investigate dALFF and dfALFF in ADHD and further explore whether dALFF and dfALFF can be used to test the feasibility of differentiating ADHD from HC.

Approach: The ALFF and fALFF methods were combined with sliding-window approaches to investigate the abnormal time-varying local brain activity of ADHD.

Results: ADHD showed statistically significant differences in dALFF and dfALFF. Clinical scores and executive function were correlated with the quantitative values of dynamic differential brain regions. ADHD and HC can be effectively distinguished using an auxiliary diagnostic model based on random forest.

Impact: From the perspective of dynamic local brain activity, this study provides insight into the brain dysfunction of ADHD. Understanding dALFF/dfALFF variability can be helpful in understanding neurophysiological mechanisms and possibly guiding ADHD diagnosis.

0440 9:27

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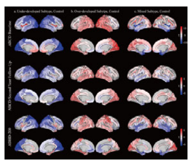


[Distinct Neuroimaging Subtypes within ADHD Population Based on Semi-supervised Learning]

Yiwei Chen[1], Mingyang Li[1], Tianshu Zheng[1], Xinyi Xu[1], Ruoke Zhao[1], Ruike Chen[1], Haoan Xu[1], Yuqi Zhang[1], Guanghai Wang[2], and Dan Wu[1]

[1]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Department of Developmental and Behavioral Pediatrics, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Keywords: Psychiatric Disorders, Psychiatric Disorders, Cortical Thickness, Disease Subtype, Generative Adversarial Network

Motivation: Attention deficit hyperactivity disorder (ADHD) is a childhood-onset disease whose diagnosis and subtyping methods are primarily based on clinical traits, which is prone to subjectivity and instability. Also, the patient outcome and neuroimaging signatures of these subtypes are not clear.

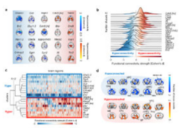
Goal(s): We aimed to use a data-driven approach for subtyping.

Approach: We used a semi-supervised learning method based on 929 ADHD patients selected from ABCD study.

Results: We identified three distinct subtypes in ADHD based on cortical thickness (under-developed, over-developed, and mixed subtypes). Follow-up analysis found significant differences in cognitive and behavior outcomes, disease progression, and response to medication among the subtypes.

Impact: We identified three distinct subtypes in ADHD based on cortical thickness (under-developed, over-developed, and mixed subtypes), with unique cognitive, behavioral, progression profiles, and treatment responses. These findings may shed insights into personalized treatment in ADHD.

0441 9:39



[Cross-species fMRI reveals transcriptomically and behaviorally-dissociable autism neurosubtypes]

Marco Pagani[1,2], Valerio Zerbi[3], Alberto Galbusera[1], Filomena Alvino[1], Ting Xu[2], Michael Lombardo[1], Michael Milham[2], Adriana Di Martino[2], and Alessandro Gozzi[1]

[1]IIT, Rovereto, Italy, [2]CMI, New York, NY, United States, [3]ETH, Zurich, Switzerland

Keywords: Psychiatric Disorders, Brain Connectivity

Motivation: Resting-state fMRI (rsfMRI) studies have revealed atypical patterns of functional connectivity in autism. However, large heterogeneity in the manifestation of these alterations exists across samples and its etiopathological significance remains unclear.

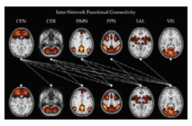
Goal(s): Here, we used cross-species rsfMRI to probe if distinct patterns of functional dysconnectivity observed across 20 genetic models can be identified in rsfMRI scans of individuals with idiopathic autism.

Approach: We mapped whole brain functional connectivity in 20 genetic mouse models and in over 2000 individuals with and without autism.

Results: Our work reveals two autism neurosubtypes characterized by divergent patterns of dysconnectivity, and dissociable transcriptomic and behavioral profiles.

Impact: Connectivity alterations in idiopathic autism encode for etiologically-relevant information.

0442 9:51



<u>Altered Functional Connectivity of Resting State Networks in Children with Sensory Over-Responsivity But Not Autism</u>

Hannah L. Choi[1], Rachel Powers[2], Maia C. Lazerwitz[2], Lanya T. Cai[1], Annie Brandes-Aitken[2], Robyn Chu[2], Kaitlyn J. Trimarchi[2], Rafael D. Garcia[2], Elysa J. Marco[2,3], and Pratik Mukherjee[1]

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Keywords: Neuro, fMRI (resting state), Functional Connectivity, fMRI, Sensory Processing Disorder, Sensory Over-Responsivity

Motivation: Sensory Over-Responsivity (SOR) adversely impacts over 2.5% of children, prompting a study into its neural correlates in the absence of ASD to comprehend its unique effect on brain function.

Goal(s): We test the hypothesis that SOR in non-ASD children is linked to impaired connectivity in sensory networks and alterations in higher-order, regulatory networks.

Approach: Functional brain networks are constructed and analyzed using ICA, dual regression, fractional amplitude of low-frequency fluctuations (fALFF), and regional homogeneity (ReHo).

Results: SOR children exhibit increased functional connectivity in default-mode, frontoparietal, and salience networks, alongside reduced connectivity in visual and cerebellar networks, confirming a distinctive neural profile of SOR.

Impact: This study reveals distinct functional connectivity in SOR. It establishes a basis for novel interventions and tailored medical approaches for children, with or without ASD, encouraging further investigation into the neural basis and management of sensory processing disorders.

10:03 Discussion

Anouk Schrantee

Amsterdam University Medical Center, Amsterdam, Netherlands

Power Pitch

Pitch: Interventional: MR-LINAC & Needle-Based Interventions

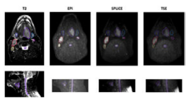
Power Pitch Theatre 1

Tuesday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Yihang Zhou & Radka Stoyanova

(no CME credit)

0443 Pitch: 8:15
Poster: 9:15
Screen 1



<u>Quantitative Assessment of Geometric Distortions in MRI-Linac Sequences for Enhanced Radiotherapy Planning</u>

Zaphanlene Kaffey[1], Sam Mulder[1], Brigid McDonald[1], Kareem Wahid[1], Serageldin Attia[1], Nicole O'Connell[2], Dan Thill[2], Alex Dresner[2], John Christodouleas[2], Mohammed Naser[1], Clifton David Fuller[1], and Brigid McDonald[1]

[1]MD Anderson, Houston, TX, United States, [2]Elekta, Houston, TX, United States

Keywords: DWI/DTI/DKI, Diffusion/other diffusion imaging techniques, Deformable Image Registration, MR-Linac, Geometric Distortion

Motivation: Geometric distortion in MRI-Linac sequences remains insufficiently characterized, impacting the precision of radiotherapy treatment planning. This study aims to quantify such distortions in EPI, TSE, and SPLICE sequences.

Goal(s): The goal of this study is to quantitatively assess and compare geometric distortion across three common MRI-Linac sequences using deformable image registration and DICE score analysis.

Approach: An in vivo study employed patient T2 and DWI B0 scans. Deformable image registration was conducted using ADMIRE and Elekta-based software, generating deformation vector fields. A Python algorithm calculated RMS values.

Results: The sequences exhibited distinct DSC scores and RMS distortions, revealing registration effectiveness and sequence-dependent variability.

Impact: These findings set the stage for future research on minimizing distortions in MRI-Linac sequences. The developed Python algorithm could be adapted for real-time monitoring, advancing the precision and safety of MRI-guided radiotherapy.

0444

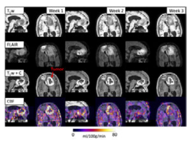
MERIT AWARD

MAGNA CUM LAUDE

Pitch: 8:15

Poster: 9:15

Screen 2



First demonstration of arterial spin labeling on a 1.5T MR-Linac for characterizing glioblastoma perfusion dynamics

Liam S. P. Lawrence[1], Brige Chugh[2,3], James Stewart[2], Mark Ruschin[2], Aimee Theriault[2], Jay Detksy[2], Sten Myrehaug[2], Pejman J. Maralani[2], Chia-Lin Tseng[2], Hany Soliman[2], Mary Jane Lim-Fat[4], Sunit Das[5], Arjun Sahgal[2], and Angus Z. Lau[1,6]

[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Department of Radiation Oncology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [3]Department of Physics, Toronto Metropolitan University, Toronto, ON, Canada, [4]Division of Neurology, Department of Medicine, Sunnybrook Health Sciences Centre, Toronto, ON, Canada, [5]Department of Surgery, St. Michael's Hospital, Toronto, ON, Canada, [6]Physical Sciences Platform, Sunnybrook Research Institute, Toronto, ON, Canada

Keywords: MR-Guided Radiotherapy, Tumor, MR-Linac, perfusion, glioblastoma

Motivation: Glioblastoma is a highly vascularized brain tumor. Changes in perfusion could guide treatment adaptation, but the dynamics of blood flow changes in glioblastoma during radiotherapy are poorly understood.

Goal(s): We sought to characterize changes in glioblastoma cerebral blood flow during radiotherapy.

Approach: We acquired twice-weekly arterial spin labeling (ASL) MRI in 22 glioblastoma patients during radiotherapy on a 1.5T MRI-linear accelerator (MR-Linac) and evaluated changes in cerebral blood flow.

Results: We provided the first demonstration of MR-Linac ASL. Tumor cerebral blood flow tended to decrease during radiotherapy. Highly-perfused tumor regions showed the greatest change.

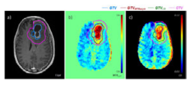
Impact: We showed that frequent perfusion imaging on MRI-linear accelerators is feasible and that blood flow in highly-perfused regions of human glioblastoma tends to decrease during radiotherapy. Radiotherapy with dose escalation to highly perfused tumor regions likely requires target adaptation.

0445

Pitch: 8:15

Poster: 9:15

Screen 3



Comparing APT-weighted MTRasym and LD-mapping for personalized radiotherapy target delineation of glioblastoma: A prospective pilot study.

Patrick L.Y. Tang[1,2,3], Marion Smits[1,2,4], Remi A. Nout[3], Caroline van Rij[1,3], Cleo Slagter[1,3], Annemarie T. Swaak-Kragten[1,3], Alejandra Méndez Romero[1,3], and Esther A.H. Warnert[1,2]

[1]Brain Tumor Center, Erasmus MC Cancer Institute, University Medical Center Rotterdam, Rotterdam, Netherlands, [2]Department of Radiology & Nuclear medicine, Erasmus MC, University Medical Center Rotterdam, Rotterdam, Netherlands, [3]Department of Radiotherapy, Erasmus MC Cancer Institute, University Medical Center Rotterdam, Rotterdam, Netherlands, [4]Medical Delta, Delft, Netherlands

Keywords: CEST / APT / NOE, Brain, Glioblastoma

Motivation: Microscopic tumor infiltration in glioblastoma cannot be depicted on conventional MRI. Therefore, the clinical target volume (CTV) for radiotherapy consists of the gross tumor volume (GTV) plus a 15-mm safety margin. This large expansion increases the risk of radiation-induced side-effects.

Goal(s): To explore the potential of APTw-CEST MRI for improved GTV delineation, ultimately enabling a CTV-margin reduction.

Approach: Radiotherapy planning MRI-acquisition included an APTw-CEST MRI-sequence. GTVs based on APTw MTR_{asym} or LD-maps were defined and compared to the conventional GTVs and CTVs.

Results: Both APTw-CEST MRI-based GTVs were similar in size, significantly larger than the GTV, and significantly smaller than the CTV.

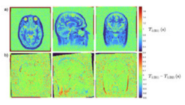
Impact: This prospective pilot study integrates APTw-CEST MRI into glioblastoma radiotherapy planning, enabling a reduction of the 15-mm CTV-margin, and construction of a personalized target area that only targets tumor infiltration. This minimizes radiation-induced side-effects and thus improves quality of life.

0446

Pitch: 8:15

Poster: 9:15

Screen 4



Toward Hypoxia Imaging for Adaptive Dose Painting: Optimization of MP2RAGE for T1 Mapping in a Low-Field 0.35T MR-Linac (MRL)

Claire Keun Sun Park[1], Noah Stanley Warner[1,2], Evangelia Kaza[1], and Atchar Sudhyadhom[1]

[1]Division of Physics and Biophysics, Department of Radiation Oncology, Brigham and Women's Hospital and Dana-Farber Cancer Institute, Harvard Medical School, Boston, MA, United States, [2]Harvard–MIT Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: MR-Guided Radiotherapy, Radiotherapy

Motivation: Stereotactic MR-guided Adaptive Radiation Therapy (SMART) 'dose painting' for hypoxia can improve treatment outcomes, but implementation on MR-Linac (MRL) faces low-field SNR challenges. Optimization of T_1-to-noise ratio at 0.35T will enable clinical implementation of oxygen-enhanced (OE)-MRI.

Goal(s): Develop and validate an optimized MP2RAGE sequence for low-field T_1 mapping, establish feasibility and evaluate reproducibility in phantoms and healthy subjects.

Approach: We optimized and validated an MP2RAGE sequence with simulations and a ground-truth phantom. T_1 mapping feasibility was established in healthy subjects, variability and reproducibility was assessed.

Results: A clinically feasible optimized low-field MP2RAGE protocol was developed, yielding accurate and reproducible T_1 mapping.

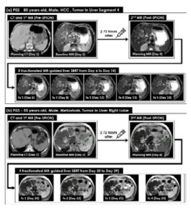
Impact: This work builds a foundation towards clinically feasible hypoxia imaging for low-field MRL. This would facilitate a paradigm shift toward MR-guided biological adaptation and dose painting, leveraging the spatial distribution of hypoxia, and improving patient outcomes in conventionally challenging-to-treat cancers.

0447

Pitch: 8:15

Poster: 9:15

Screen 5



Super-paramagnetic iron oxide nanoparticles improve liver tumor visualization throughout online MRI-guided liver stereotactic radiotherapy

Danny Lee[1], Seungjong Oh[1], and Alexander Kirichenko[1]

[1]Radiation Oncology, Allegheny Health Network, Pittsburgh, PA, United States

Keywords: MR-Guided Radiotherapy, Radiotherapy, MRI-guided radiotherapy;

Motivation: Can we provide superior liver tumor visualization for online adaptive planning? MRI enables direct visualization of tumor and organs-at-risk (OAR). However, MRI contrast agents are often required to differentiate primary and metastatic liver malignant lesions from functional hepatic parenchyma.

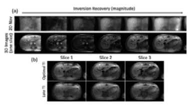
Goal(s): We employed super-paramagnetic iron oxide nanoparticles (SPION) as an MRI contrast agent.

Approach: SPION enhanced the liver-to-tumor contrast ration for rapid and accurate delineation of tumors and functional hepatic parenchyma throughout the entire treatment course.

Results: This study is the first to report the efficiency of a single SPION injection for multi-fractionated MRI-guided liver stereotactic body radiotherapy on a 1.5T Elekta MR-Linac.

Impact: A single SPION injection significantly improved the tumor-to-liver contrast, and it was maintained throughout multi-fraction MRI-guided liver SBRT to provide rapid and accurate contouring tumor lesions from functional liver parenchyma for online adaptive planning.

0448 Pitch: 8:15 Poster: 9:15 Screen 6



T1 Contrast-Augmented Single-Spoke Real-Time 4D MRI

Li Feng[1,2], Jingjia Chen[1,2], Ding Xia[3], Hersh Chandarana[1,2], and Daniel K Sodickson[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, USA, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, USA, New York University Grossman School of Medicine, New York, NY, United States, [3]BioMedical Engineering and Imaging Institute (BMEII), Icahn School of Medicine at Mount Sinai, New York, NY, United States

Keywords: MR-Guided Radiotherapy, Radiotherapy, 4DMRI, Real-Time Imaging

Motivation: 4D MRI is a powerful technique for free-breathing volumetric imaging, holding great potential for application in MRI-guided radiotherapy. Traditional 4D MRI typically requires explicit motion detection and data binning for respiratory-resolved reconstruction and commonly employs fast steady-state MRI acquisition, which may not yield optimal contrast.

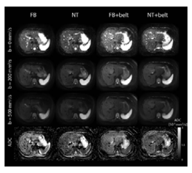
Goal(s): This work proposes a novel T contrast-augmented, free-breathing, real-time 4D MRI technique.

Approach: The proposed technique improves image contrast through highly-accelerated inversion recovery-prepared acquisition and reconstruction of real-time 4D images at a sub-second temporal resolution without requiring explicit motion compensation.

Results: T1 contrast-augmented real-time 4D MRI demonstrated improved image contrast over conventional 4D MRI with steady-state acquisition.

Impact: The contrast-augmented real-time 4D MRI technique proposed in this work can improve image contrast for free-breathing imaging without requiring explicit motion detection, data binning and respiratory motion compensation. It holds great potential for various applications, such as MRI-guided radiotherapy.

0449 Pitch: 8:15 Poster: 9:15 Screen 7



Technical validation of DWI in the abdomen using different motion compensation techniques on a 1.5T MR-Linac

Koen P.A. Baas[1], Sabine Visser[1], Vivian W.J. van Pelt[1], Damien McHugh[2], Daniela Thorwarth[3], Andreas Wetscherek[4], Tim Schakel[5], Marijn Kruiskamp[6], Jihong Wang[7], Marlies E Nowee[1], Uulke A van der Heide[1], Eric S Paulson[8], and Petra J van Houdt[1]

[1]Radiation Oncology, the Netherlands Cancer Institute, Amsterdam, Netherlands, [2]Christie Medical Physics and Engineering, The Christie NHS Foundation Trust, Manchester, United Kingdom, [3]Section for Biomedical Physics, Department of Radiation Oncology, University Hospital Tübingen, Tübingen, Germany, [4]Joint Department of Physics, The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, London, United Kingdom, [5]Radiotherapy, UMC Utrecht, Utrecht, Netherlands, [6]MR Clinical Science, Philips Healthcare, Best, Netherlands, [7]Radiation Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [8]Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, United States

Keywords: Diffusion Acquisition, Radiotherapy, ADC, MR-linac, abdomen, repeatability

Motivation: The apparent diffusion coefficient (ADC), derived from diffusion-weighted imaging (DWI), is a promising quantitative biomarker for treatment response during radiotherapy. However, DWI in the abdomen is complicated by respiratory motion.

Goal(s): To compare the repeatability of the ADC acquired with different motion compensation techniques on a 1.5T MR-linac.

Approach: A phantom and test-retest study (26 healthy volunteers) were performed, evaluating four DWI acquisitions (free breathing, navigator-triggered, and both repeated with an abdominal compression belt).

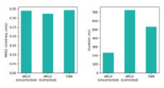
Results: From the 11 datasets analyzed so far, absolute ADC values and repeatability were comparable between the acquisitions in healthy regions of the liver, spleen and kidney.

Impact: This study initiates defining the optimal DWI acquisition strategy to measure treatment-related ADC changes of abdominal tumors on an MR-linac.

0450 Pitch: 8:15

Poster: 9:15

Screen 8



Acceleration of T2* mapping on an MR Linac using a self-supervised convolutional neural network.

Albert Ugwudike[1], Zehuan Zhang[1], Wajiha Bano[2,3], Alison Tree[4,5], Wayne Luk[1], and Andreas Wetscherek[2]

[1]Department of Computing, Imperial College London, London, United Kingdom, [2]Joint Department of Physics, The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, London, United Kingdom, [3]FinnBrain Neuroimaging Lab, University of Turku, Turku, Finland, [4]The Royal Marsden NHS Foundation Trust, London, United Kingdom, [5]Division of Radiotherapy and Imaging, The Institute of Cancer Research, London, United Kingdom

Keywords: MR-Guided Radiotherapy, Quantitative Imaging, Prostate, Radiotherapy, Relaxometry

Motivation: T_2* mapping could inform biologically-adaptive MR-guided radiotherapy, but requires improvement in processing time and precision for clinical implementation.

Goal(s): To accelerate intravoxel field inhomogeneity correction and generation of T_2* maps.

Approach: We developed a physics-informed self-supervised convolutional neural network for whole volume T_2* mapping of complex multi-echo data from an MR Linac. Bias in T_2* estimation is accounted for by calculating the additional signal decay from 3D derivatives of the field inhomogeneity map.

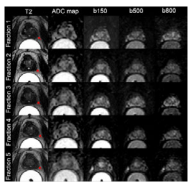
Results: Our model generates T_2* parameter maps 30% faster than an existing time-efficient algorithm. Resulting T_2* maps are less affected by noise compared to the reference.

Impact: Our AI-based algorithm is a step towards integration of whole volume T_2* mapping for hypoxia assessment into clinical MR-guided radiotherapy workflows. It could enable real-time mapping of dynamic changes, for example during an oxygen challenge and enable biologically adaptive radiotherapy.

0451 Pitch: 8:15

Poster: 9:15

Screen 9



Longitudinal ADC changes in prostate cancer patients treated with hypofractionated radiotherapy with 1.5T MR-Linac

Oi Lei Wong[1], Jing Yuan[1], Darren M.C. Poon[2], Sin Tin Chiu[3], Bin Yang[4], Cindy Xue[1], George Chiu[3], and Kin Yin Cheung[4]

[1]Research Department, Hong Kong Sanatorium and Hospital, Hong Kong, Hong Kong, [2]Comprehensive Oncology Center, Hong Kong Sanatorium and Hospital, Hong Kong, Hong Kong, [3]Department of Radiotherapy, Hong Kong Sanatorium and Hospital, Hong Kong, Hong Kong, [4]Medical Physics Department, Hong Kong Sanatorium and Hospital, Hong Kong, Hong Kong

Keywords: DWI/DTI/DKI, MR-Guided Interventions, MR-Linac

Motivation: Additional functional information from DWI is one of the major advantages of MR-Linac over conventional radiation therapy techniques, and is sparsely studied.

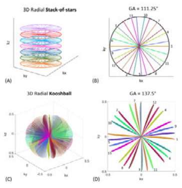
Goal(s): To monitor the ADC change during the course of hypofractionated radiation therapy in prostate cancer using a 1.5T MR-Linac.

Approach: For each patient, a prostate DWI-EPI scan was acquired immediately after each of the 5 hypofractionated radiation therapy sessions. The ADC maps were generated and compared among the fractions using the Kruskal-Wallis test.

Results: No significant ADC change among fractions might indicate that monitoring ADC alone might be insufficient to reflect the early treatment response.

Impact: Biological radiotherapy treatment planning has been proposed for decades, but was hindered by lack of tools that could provide functional information with spatial interpretation. The study results shed light on potential use of DWI for early treatment monitoring using MR-Linac.

0452 Pitch: 8:15
Poster: 9:15
Screen 10



[4D Lung MRI with Isotropic Resolution on a 1.5T MR-Linac using a Self-Navigated 3D Radial Kooshball Acquisition and Sparse Motion Reconstruction]

Can Wu[1], Sandeep Panwar Jogi[1], and Ricardo Otazo[1,2]

[1]Department of Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Department of Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States

Keywords: Lung, Lung, 4D MRI, MR-Linac, Motion, Radiotherapy, Radial

Motivation: Current 4D MRI methodology on the MR-Linac is based on stack-of-stars acquisition, which has limited resolution along the slice dimension and can compromise the performance of motion assessment.

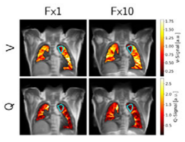
Goal(s): To develop 4D lung MRI with isotropic-resolution on a 1.5T MR-Linac using 3D radial kooshball acquisition with respiratory self-navigation.

Approach: Stack-of-stars and kooshball acquisitions were performed on a healthy volunteer. Motion-resolved 4D MRI was reconstructed using XD-GRASP and then compared in terms of image quality and motion characteristics.

Results: Stack-of-stars acquisition underestimated motion due to limited resolution in the slice dimension. Kooshball acquisition provided isotropic-resolution that allows for improved visualization of smaller pulmonary structures.

Impact: 4D MRI with isotropic spatial resolution has the potential to enhance treatment planning and adaptation for lung cancer patients receiving radiation therapy on the MR-Linac system.

0453 Pitch: 8:15
Poster: 9:15
Screen 11



[Using Ventilation and Perfusion MRI at a 0.35 T MR-Linac to Predict Radiation-Induced Pneumonitis in Lung Cancer Patients]

Rabea Klaar[1,2], Moritz Rabe[3], Anna Theresa Stüber[1,4,5], Stefanie Corradini[3], Chukwuka Eze[3], Claus Belka[3,6,7], Guillaume Landry[3], Christopher Kurz[3], and Julien Dinkel[1,2]

[1]Department of Radiology, LMU University Hospital, LMU Munich, Munich, Germany, [2]Comprehensive Pneumology Center (CPC-M), Member of the German Center for Lung Research (DZL), Munich, Germany, [3]Department of Radiation Oncology, LMU University Hospital, LMU Munich, Munich, Germany, [4]Munich Center for Machine Learning (MCML), Munich, Germany, [5]Department of Statistics, LMU Munich, Munich, Germany, [6]German Cancer Consortium (DKTK), partner site Munich, a partnership between DKFZ and LMU University Hospital Munich, Munich, Germany, [7]Bavarian Cancer Research Center (BZKF), Munich, Germany

Keywords: MR-Guided Radiotherapy, Data Analysis, low-field, MR-Linac, ventilation, perfusion, functional imaging

Motivation: Early predictors of radiation-induced pneumonitis in patients receiving MR-guided radiotherapy allowing a closer follow up and taking early countermeasures to avoid a severe disease progression have not yet been identified.

Goal(s): We aimed at finding functional MR-based biomarkers acquired during treatment that allows the prediction of radiation-induced pneumonitis (RP) for lung cancer patients directly after MR-guided radiotherapy.

Approach: For 19 patients, ventilation- and perfusion-maps were acquired using a non-contrast enhanced free-breathing technique and investigated in different regions of the irradiated lung.

Results: Changes over treatment in the ventilation around the tumor significantly separate between RP and non-RP group.

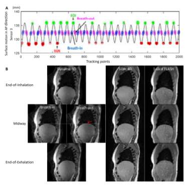
Impact: The acquisition of additional functional lung imaging during MR-guided radiotherapy requires little effort while offering the opportunity to identify lung cancer patients at risk of developing radiation-induced pneumonitis right after treatment and to take early countermeasures to avoid severe complications.

0454

Pitch: 8:15

Poster: 9:15

Screen 12



<u>Capturing Internal Target Motion with Breathing Variability Using 3D Dynamic Lung MRI</u>

Xiao Liang[1], Li Pan[2], Erez Nevo[3], Steve Roys[1], Hussain Soomro[4], Rao P Gullapalli[1], Amit Sawant[4], Thomas Ernst[1], and Jiachen Zhuo[1]

[1]Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States, [2]Siemens Medical Solutions USA Inc, Baltimore, MD, United States, [3]Robin Medical Inc., Baltimore, MD, United States, [4]Radiation Oncology, University of Maryland School of Medicine, Baltimore, MD, United States

Keywords: MR-Guided Radiotherapy, Hybrid & Novel Systems Technology, Breathing variability

Motivation: To develop an MRI technique that captures cycle-to-cycle variability and differential motion between inhalation and exhalation to enable more accurate treatment planning and real-time beam adaptation.

Goal(s): To address the challenge of acquiring sufficient volumetric data for reconstruction of 3D dynamic lung MRI while maintaining adequate spatiotemporal resolution for radiation therapy guidance.

Approach: We utilized golden angle stack-of-star acquisition and labeled each view with the breathing state captured by a surface tracking system for sharing views with similar breathing states.

Results: 3D dynamic lung imaging captured cycle-to-cycle variability and respiratory hysteresis with a nominal temporal resolution of 60.6ms per volume.

Impact: The 3D dynamic lung imaging captured cycle-to-cycle variability and respiratory hysteresis with a nominal temporal resolution of 60.6ms. It can provide more accurate motion information than 4D-MRI for radiotherapy guidance, avoiding interplay between the tumor target and organs at risk.

0455

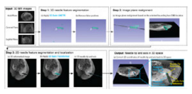
MERIT AWARD

SUMMA CUM LAUDE

Pitch: 8:15

Poster: 9:15

Screen 13



<u>Transformer-Based Automatic Pipeline for 3D Needle Localization on Intra-Procedural 3D MRI</u>

Wenqi Zhou[1], Xinzhou Li[1], Fatemeh Zabihollahy[1], David S. Lu[1], and Holden H. Wu[1]

[1]Department of Radiological Sciences, UCLA, Los Angeles, CA, United States

Keywords: MR-Guided Interventions, Segmentation

Motivation: Needle localization on 3D magnetic resonance imaging (MRI) is critical for MRI-guided percutaneous interventions, but current manual methods are time-consuming.

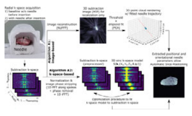
Goal(s): To develop a transformer-based pipeline for accurate and rapid automatic 3D needle localization on intra-procedural 3D MRI.

Approach: The proposed pipeline adopted a coarse-to-fine segmentation strategy by combining 3D and 2D shifted window (Swin) Transformer networks. The performance was evaluated in pre-clinical pig datasets and compared with human-annotated references.

Results: Computation time was 6 sec/volume. The median 3D needle tip and axis localization errors were 1.48 mm (1.09 pixels) and 0.98°, which were comparable to human-level accuracy.

Impact: The automatic transformer-based pipeline developed in this work achieved rapid (~6s) and accurate pixel-level 3D needle localization on intra-procedural 3D MRI. This new pipeline has the potential to improve MRI-guided percutaneous interventions.

0456 Pitch: 8:15 Poster: 9:15 Screen 14



Model-Based Rapid 3D Passive Needle Localization for Automatic Slice Positioning in MR-Guided Interventions

Jonas Frederik Faust[1,2], Daniel Polak[1], Axel Joachim Krafft[1], Peter Speier[1], Nathan Ooms[3], Jesse Roll[3], Joshua Krieger[3], Mark Edward Ladd[2,4,5], and Florian Maier[1]

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Keywords: MR-Guided Interventions, MR-Guided Interventions, needle intervention, percutaneous intervention, needle tracking, needle localization, device tracking, passive tracking, modelling

Motivation: For MR-guided needle interventions, rapid 3D needle localization enables automatic realignment of 2D real-time imaging slices with the device during the procedure.

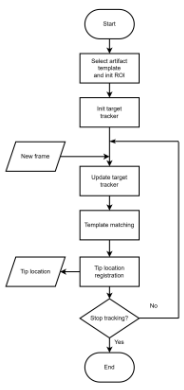
Goal(s): To investigate a model-based approach for rapid 3D needle localization that does not require prepositioned tracking slices.

Approach: 3D k-space data was radially acquired before and after needle placement. Two algorithms to extract position and orientation of the needle were introduced and compared (artifact model fit to undersampled subtraction k-space/image).

Results: Model-based rapid 3D needle localization was successfully demonstrated in-vivo (k-space-based offline localization error 4.3mm for FOV of $(256cm)^3$ in 1.1s combined acquisition and localization time using 64 k-space spokes).

Impact: Model-based rapid 3D passive needle localization shows potential to improve the workflow of MR-guided needle interventions, allowing for automatic alignment of 2D real-time imaging slices with the needle trajectory.

0457 Pitch: 8:15 Poster: 9:15 Screen 15



An Algorithm using Artifact Features for Needle Tip Localization in Interventional MRI

Shijie Hong[1], Zhao He[1], Guang-Zhong Yang[1], and Yuan Feng[1]

[1]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China

Keywords: MR-Guided Interventions, MR-Guided Interventions, localization, needle artifact

Motivation: Needle tip localization is crucial for accurate and safe image-guided intervention, especially for real-time interventional MRI.

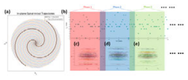
Goal(s): To develop an algorithm that utilizes artifact features of the needle tip as prior information for needle tip localization.

Approach: Combines target tracking and template matching techniques for accurate needle tip localization.

Results: The algorithm's performance has been evaluated using both simulation and physical models. Validation results demonstrate that the algorithm enables fast identification, stable tracking, and highly precise needle tip localization.

Impact: This needle tip localization method, leveraging artifact features as prior information, opens up new possibilities for the development of needle localization and tracking algorithms based on artifacts.

0458 Pitch: 8:15 Poster: 9:15 Screen 16



SPARTA-3D: 3D Real-time Tracking Solution for Interventional MRI

Yichen Hu[1], Junpu Hu[2], Zheng Zhong[1], Abraham Padua[1], Qi Liu[1], Yongquan Ye[1], and Jian Xu[1]

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Keywords: MR-Guided Interventions, MR-Guided Interventions, 3D real-time imaging

Motivation: MRI excels in exceptional soft tissue delineation and its radiation-free nature in interventional contexts. However, achieving effective 3D real-time tracking with MRI poses a significant challenge.

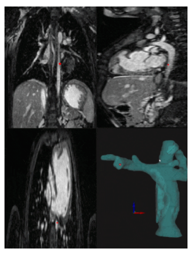
Goal(s): To facilitate 3D real-time monitoring and navigation, achieving a high temporal resolution and enhanced spatial resolution that precisely captures the movement of small interventional instruments.

Approach: We utilized a manually controlled device and employed highly accelerated golden-angle rotated spiral-in/out sequence with randomized variable density k_z encoding, along with a specifically tailored iterative reconstruction algorithm.

Results: High temporal (150 ms/phase) and spatial (0.7×0.7×1.5 mm^3) resolutions were achieved, smoothly visualizing minute movements in 3D within our phantom setup.

Impact: The SPARTA-3D approach holds the promise of revolutionizing interventional MRI by meeting the crucial demand for 3D real-time tracking and navigation. It could facilitate more rapid and less invasive procedures, opening up novel avenues in the domain of MR-guided interventions.

0459 Pitch: 8:15 Poster: 9:15 Screen 17



Feasibility of 3D Visualization and 3D Catheter Tracking for Enhanced MRI-Guidance of Cardiac Catheterization

Grzegorz Tomasz Kowalik[1], Eric Kerfoot[1], Radhouene Neji[1,2], Karl Kunze[1,2], Tracy Moon[3], Nina Mellor[3], Reza Razavi[1], Kuberan Tomasz Pushparajah[1], and Sébastien Roujol[1]

[1]King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [3]Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom

Keywords: MR-Guided Interventions, Cardiovascular

Motivation: MRI-guidance of cardiac catheterisation is currently performed using one or multiple 2D imaging planes, which may be suboptimal for catheter navigation in congenital heart disease patients with complex anatomies.

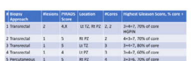
Goal(s): To develop a robust real-time 3D catheter tracking method and 3D visualisation strategy for improved MRI-guidance of cardiac catheterisation procedures.

Approach: Fast 3D screening through projection imaging combined with advanced post-processing strategies were developed for real-time 3D catheter tracking and enhanced 3D visualisation. The method was evaluated in patients.

Results: This approach was demonstrated in three patients and was able to successfully track and visualise the catheter in 3D.

Impact: Our approach show promise for enhanced catheter navigation and visualisation during MRI-guided cardiac catheterization and may contribute to reduce procedural time and outcome.

0460 Pitch: 8:15 Poster: 9:15 Screen 18



Clinical Feasibility of MRI-guided Robotic and Percutaneous In-Bore Prostate Biopsies at 0.55T

Tejinder Kaur[1], Yun Jiang[2], Nicole Seiberlich[3], Hero Hussain[2], Shane Wells[3], Elaine Caoili[2], and Vikas Gulani[3]

[1]Radiology, Univeristy of Michigan, Ann Arbor, MI, United States, [2]Radiology, University of Michigan, Ann Arbor, MI, United States, [3]University of Michigan, Ann Arbor, MI, United States

Keywords: MR-Guided Interventions, Prostate, MRI-guided intervention

Motivation: MR-guided prostate biopsies are important for sampling indeterminate lesions and are performed at 1.5 or 3T.There are potential advantages of performing interventions on lower field scanners due to their potential to decrease needle artifact width, larger bores to accommodate hardware, improved imaging in presence of metallic implants, and patient comfort. However, lesion/needle visualization, SNR, and ability to target lesions could be challenging at lower fields.

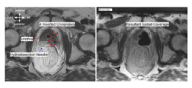
Goal(s): To assess feasibility of MRI-guided prostate biopsies on a low field scanner.

Approach: We performed 5 in-vivo biopsies and did histopathological correlation.

Results: We performed successful biopsies and high volume disease was found in all cases.

Impact: Successful lesion visualization and percutaneous and transrectal prostate biopsies are possible on high access, wide bore 0.55 T scanners, widening the clinical feasibility and utility of in-bore MRI guided intervention.

0461 Pitch: 8:15 Poster: 9:15 Screen 19



Clinical Application of Semi-Automatic Device Guidance in MR-Guided Transperineal Prostate Interventions: Biopsy and Cryoablation

Thomas Lilieholm[1], Walter F Block[1,2,3], and Erica M Knavel Koepsel[3]

[1]Medical Physics, University of Wisconsin at Madison, Madison, WI, United States, [2]Biomedical Engineering, University of Wisconsin at Madison, Madison, WI, United States, [3]Radiology, University of Wisconsin at Madison, Madison, WI, United States

Keywords: MR-Guided Interventions, Interventional Devices, Cryoablation

Motivation: In the prostate, transperineal needle placement is often assisted with trajectory guides and imaging. Improper placement necessitates needle reinsertion, increasing procedure time and complication risk. Presented here is a straightforward platform tested in multiple biopsy and cryoablation procedures. Previous work demonstrated feasibility in a single MR-guided focal biopsy.

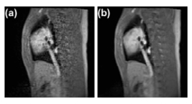
Goal(s): To demonstrate the platform's technical feasibility across greater procedural types and numbers.

Approach: The proposed techniques were performed on consented patients. These procedures included prostate cryoablations, biopsies, and fluid aspirations.

Results: 12 procedures were performed- 6 cryoablations, 5 biopsies, and 1 fluid aspiration. Technical success was achieved in every procedure.

Impact: Using the proposed methodology, all 12 prostate procedures achieved technical success. With the platform's support, a median procedure saw satisfactory needle placement in 83.7% of initial insertions, requiring no further adjustment. This can reduce procedure times and complication risks.

0462 Pitch: 8:15 Poster: 9:15 Screen 20



Enhanced Real-Time iCMR Device Visualization Using GRAPPA and DnCNN Denoising at Low Field

Yixuan Liu[1], Yu Ding[1], Yingmin Liu[1], Chong Chen[1], Ning Jin[2], Axel Joachim Krafft[3], Florian Maier[3], Aimee K. Armstrong[4], Rizwan Ahmad[1], and Orlando Paul Simonetti[1]

[1]The Ohio State University, Columbus, OH, United States, [2]Siemens Medical Solutions USA, Inc., Columbus, OH, United States, [3]Siemens Healthcare, Erlangen, Germany, [4]Nationwide Childrens Hospital, Columbus, OH, United States

Keywords: MR-Guided Interventions, Low-Field MRI, Cardiovascular Intevention

Motivation: It is challenging to achieve the spatial and temporal resolutions required for real-time interventional device visualization using low-field scanners with limited gradient performance.

Goal(s): The objective of this study is to develop a novel post-processing method capable of delivering high temporal and spatial resolution images in real-time.

Approach: We developed a method that sequentially combines GRAPPA with a DnCNN denoising network to provide highly accelerated acquisition with low-latency reconstruction. The network was trained using the OCMR dataset and evaluated using pre-clinical data.

Results: The network effectively suppressed noise with minimal latency, while preserving the original features of the image.

Impact: This method could enhance the speed and quality of real-time interventional imaging at low field, making it easier for the interventionalist to visually track devices and deploy stents and other devices.

Power Pitch

Pitch: Extending the Applications of MRI at 5T & Above

Power Pitch Theatre 2

Tuesday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

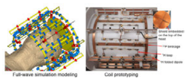
Moderators: Ye Li & Irena Zivkovic

(no CME credit)

0463 Pitch: 8:15

Poster: 9:15

Screen 21



[7 Tesla 31P Birdcage / 16-channel 1H Loop and Dipole Array integrated with Parallel Transmit System]

Bei Zhang[1], Tom Geraedts[2], Wim Prins[2], Conrad Gohl[2], Bart-Jan van den Berg[2], Paul Sanders[2], Ivan Dimitrov[2], Geert-Jan Plattel[2], Daniel Lowrance[1], Peter van der Meulen[2], and Anke Henning[1]

[1]*Advanced Imaging Research Center, UTSouthwestern Medical Center, Dallas, TX, United States,* [2]*Philips Healthcare, Best, Netherlands*

Keywords: RF Arrays & Systems, Parallel Transmit & Multiband, 31P/1H imaging, Dual-tuned array design, ultra-high field, parallel transmit system

Motivation: Integrating multinuclear applications into parallel transmit system (PTx) at ultra-high field MRI systems will provide uniform transmit field and good SNR for both proton and the x-nuclei.

Goal(s): Design, build and integrate a 7T ^{31}P/^{1}H head array into a 7T PTx system that supports multinuclear applications.

Approach: Use 8 loops and 8 folded dipoles as ^{1}H transceivers, and a birdcage as ^{31}P transceiver, for ^{31}P/^{1}H MRS and MRI in a 7T PTx system

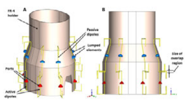
Results: Phantom and *in vivo* experimental results show that the coil can provide homogeneous and good SNR signals for both ^{31}P and ^{1}H in ROI

Impact: Elevating multinuclear studies with 7T parallel transmit system, providing uniform transmit fields and good receive sensitivity profile for both proton and x-nuclei in ROI. A potential game-changer for metabolic studies in body applications at ultra-high fields, advancing medical research.

0464 Pitch: 8:15

Poster: 9:15

Screen 22



[Using Inductively-Coupled Dipole Pairs as Array Elements for Improving Whole-Brain Coverage at 9.4T]

Kristina Popova[1], Stanislav Glybovski[1], Klaus Scheffler[2], Nikolai Avdievich[2], and Georgiy Solomakha[2]

[1]*School of Physics and Engineering, ITMO University, St. Petersburg, Russian Federation,* [2]*High-Field MR Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany*

Keywords: RF Arrays & Systems, Brain, Array, UHF, dipole, coverage

Motivation: At ultra-high fields, homogeneity of brain MRI is deteriorated by the subject-specific non-uniform distribution of RF magnetic field B_1^+.

Goal(s): To design a 9.4T eight-channel transceiver dipole array with improved homogeneity of B_1^+ in the axial direction with better whole-brain coverage.

Approach: We used an array consisting of paired passively coupled folded-end dipoles. We numerically optimized the B_1^+ homogeneity by adjusting the overlap between the folded ends of the active and passive dipoles and the load impedance of the passive one.

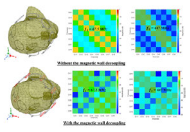
Results: The proposed array demonstrated improved B_1^+ whole-brain homogeneity including the upper C-spine compared to several state-of-the-art dipole and loop arrays.

Impact: The presented antenna element of coupled folded dipoles can be used in designing UHF array coils with improved longitudinal whole-brain coverage. Such coils can be beneficial for studies where imaging of the entire brain including the upper C-spine is required.

0465 Pitch: 8:15

Poster: 9:15

Screen 23



Eight-channel dual-tuned coaxial-transmission-line coils array for human head imaging at 10.5 Tesla

Komlan Payne[1], Yunkun Zhao[1], Aditya Ashok Bhosale[1], and Xiaoliang Zhang[1]

[1]Department of Biomedical Engineering, State University of New York at Buffalo, Buffalo, NY, United States

Keywords: Parallel Transmit & Multiband, Hybrid & Novel Systems Technology, Dual-tuned, Hybrid & Novel Systems Technology, RF Array, Parallel Imaging

Motivation: The capability of coaxial-transmission-line (CTL) RF coils to exhibit multimode operating frequencies make them versatile for applications involving dual-nuclear coil resonators for Magnetic Resonance Imaging and Magnetic Resonance Spectroscopy studies.

Goal(s): Design eight-channel dual-tuned CTL coils array for human head imaging at 10.5 Tesla and address the electromagnetic coupling issue between elements of the array.

Approach: The high impedance feature of the high-frequency mode helps to achieve sufficient decoupling for ^1H channels while the magnetic wall technique is used to decouple the low-frequency mode tuned to heteronuclear frequency.

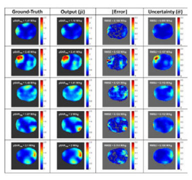
Results: A well-decoupled array of dual-tuned CTL coils is feasible for head imaging at 10.5T.

Impact: The feasibility of advanced multichannel dual-tuned RF coil array can contribute to more informative imaging and spectroscopy, which is valuable in various medical and research applications.

0466 Pitch: 8:15

Poster: 9:15

Screen 24



Local SAR and Uncertainty Estimation for Brain Imaging by Bayesian Deep Learning

E.F. Meliado[1,2,3], S. Mandija[2,4], C.A.T. van den Berg[2,4], and A.J.E. Raaijmakers[1,2,5]

[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Computational Imaging Group for MR diagnostics & therapy, Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [3]Tesla Dynamic Coils BV, Zaltbommel, Netherlands, [4]Department of Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands, [5]Biomedical Image Analysis, Dept. Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands

Keywords: Safety, Safety, specific absorption rate; local SAR; deep learning; Bayesian deep learning; uncertainty estimation

Motivation: Local SAR cannot be measured during an MRI examination. Deep learning approaches are proving to be a solution for on-line subject-specific SAR assessment.

Goal(s): The brain is the region of greatest clinical interest for ultra-high field MRI. Therefore, we apply for brain imaging a deep learning approach presented for local SAR assessment for body imaging.

Approach: The Bayesian deep-learning approach maps the relation between subject-specific complex B_1^+-maps and the corresponding local SAR distribution, and predicts the spatial distribution of uncertainty at the same time

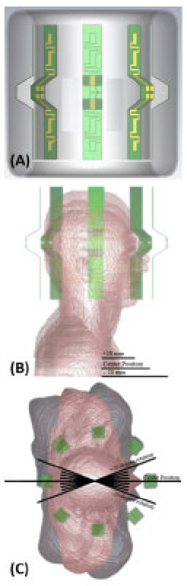
Results: The Bayesian deep-learning approach for local SAR assessment in brain outperforms the previous application for prostate imaging.

Impact: The application of Bayesian deep-learning can allow the reduction of overly conservative RF safety constraints that limit the performance of UHF-MRI. Furthermore, the joint estimation of uncertainty can help the acceptance of such methods in clinical contexts.

0467 Pitch: 8:15

Poster: 9:15

Screen 25



Assessment of the Inter-Subject Variability of Peak Local Specific Absorption Rate for a Head Coil at 10.5T

Mert Ates[1,2], Tobey Haluptzok[1], Gregor Adriany[1], Gregory J Metzger[1], Kamil Ugurbil[1], Yigitcan Eryaman[1], and Alireza Sadeghi-Tarakameh[1]

[1]*Center for Magnetic Resonance Research (CMRR), University of Minnesota, Minneapolis, MN, United States,* [2]*Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey*

Keywords: Safety, Safety

Motivation: The safety factor, which scales SAR matrices used in real-time SAR monitoring, is commonly dominated by inter-subject variability. However, the contributions from various sources to that variability have not been fully evaluated.

Goal(s): Assess the impact of different human model variations and different patient positions inside the coil, on the predicted peak local SAR for 10.5T head applications.

Approach: The SAR inter-subject variability was investigated via EM simulations of two human models along with a wide variety of head positions inside an 8-channel coil at 10.5T.

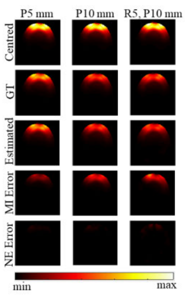
Results: The variability between head models was significantly more consequential than variations in a head model's position.

Impact: Simulating realistic scenarios with wide appropriate variables, to calculate SAR with a more accurate inter-subject variability on peak local SAR, has the potential to improve patient safety without compromising the scanning quality at ultrahigh field MRI.

0468 Pitch: 8:15

Poster: 9:15

Screen 26



Estimating Variations in SAR Calculations due to Within-Scan Patient Motion Using cGANs for Parallel RF Transmission at Ultrahigh Field MRI

Katherine Anna Blanter[1], Alix Plumley[1], Shaihan Malik[2], and Emre Kopanoglu[1]

[1]*Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom,* [2]*Life Sciences & Medicine, Biomedical Engineering & Imaging Sciences, Department of Biomedical Engineering, King's College London, London, United Kingdom*

Keywords: Safety, Safety, UHF-MRI, SAR, pTx design

Motivation: Specific absorption rate (SAR), a proxy measure for tissue heating, is affected by patient motion. SAR safety factors during MRI scanning are intentionally overconservative.

Goal(s): While designed to ensure patient safety, overconservativeness impedes the utility of scanning with parallel-transmit (pTx) 7T MRI. We aim to relieve pTx MRI from overconservativeness while maintaining patient safety.

Approach: We used deep learning to predict the location of hot-spots during head motion and applied them to a pTx design method which considers patient motion.

Results: We report that hot-spots are overcalculated almost 1.5-fold when the degree of motion is not included compared to when it is.

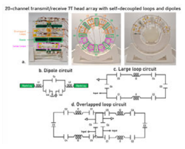
Impact: Deep learning-estimated local specific absorption rate (SAR) variations caused by patient motion may be combined with within-scan motion tracking and subject-specific SAR models to create personalized SAR supervision for patients who cannot remain still for high-performance scanning while ensuring patient-safety.

0469

Pitch: 8:15

Poster: 9:15

Screen 27



Towards dense parallel-transmit coil head array: 20-channel dipole and self-decoupled overlapped loop coil array design

Melissa Ashley Ng Tseung[1], Seng Foong Voon[1], Menglu Wu[1], and Özlem Ipek[1]

[1]School of Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom

Keywords: RF Arrays & Systems, RF Arrays & Systems

Motivation: Traditional dense transmit arrays for 7T imaging face decoupling challenges. A novel approach using self-decoupled coils can potentially overcome these limitations and enhance transmit efficiency.

Goal(s): Evaluating an in-house developed 20-element array combining dipoles with self-decoupled overlapped loop coils.

Approach: Bench measurements, electromagnetic simulations on phantom and Duke, and MRI acquisitions were conducted to investigate the coil array's performance, assessing individual channel B_1^+-map efficiencies and decoupling capacities

Results: Decoupled individual B_1^+ maps for dipoles, self-decoupled and overlapped loops were obtained for 20-channel head array using MRI measurement and simulations on phantom at 7T. S-matrix results on bench and simulations showed decoupled coil elements.

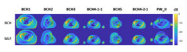
Impact: Searching for alternative and complex coil array design for transmit and receive arrays might enable for more efficient and fast imaging at MRI with high resolution to enable better diagnostics and improved treatment planning.

0470

Pitch: 8:15

Poster: 9:15

Screen 28



Tissue detail of pregnant body models needed to estimate SAR for fetal MRI

Filiz Yetisir[1,2], Esra Abaci Turk[1,2], Elfar Adalsteinsson[3], and P. Ellen Grant[1,2]

[1]Fetal-Neonatal Neuroimaging Developmental Science Center, Boston Children's Hospital, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Safety, Fetus, Electromagnetic simulations

Motivation: Due to the large variation of the body shape and size in the pregnant population, several pregnant body models are needed in fetal MRI safety studies. However, creating detailed pregnant body models is challenging.

Goal(s): Our goal is to investigate the effect of reducing maternal tissue detail on maternal and fetal SAR.

Approach: We simplified >18 maternal tissues into 3 (muscle, lung and fat) in 7 pregnant body models and quantified the change in maternal and fetal SAR.

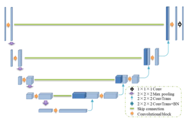
Results: The value and location of maternal and fetal SAR changes by up to 13% and 34 mm with maternal tissue detail reduction.

Impact: Simplification of maternal tissues into muscle, lung and fat changes maternal and fetal SAR (<14%) significantly less than the variation of SAR between pregnant subjects (>x2) and might provide a good trade-off between accuracy and practicality in RF safety studies.

0471 Pitch: 8:15

Poster: 9:15

Screen 29



[Rapid Specific Absorption Rate Estimation of High-Field MRI via 3D U-net Architectures for MRI Safety]

Xi Wang[1], Xiaofan Jia[1], Shao Ying Huang[2], and Abdulkadir C. Yucel[1]

[1]School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, Singapore, [2]Engineering Product and Development, Singapore University of Technology and Design, Singapore, Singapore

Keywords: Safety, Safety

Motivation: Advancements in MRI technology towards high fields demand rapid and accurate SAR estimation tools for enhancing MRI safety, currently hindered by the computational cost of conventional physics-based simulators.

Goal(s): The goal is to develop an efficient machine learning framework capable of estimating subject-specific SAR values rapidly.

Approach: The study employs 3D U-net deep learning models with their variants to achieve rapid and accurate SAR estimations.

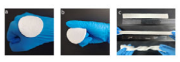
Results: The proposed neural network model provides SAR estimations within 183ms, achieving approximately 10,000x acceleration over traditional physics-based simulators, with a mean relative error of 7.6%.

Impact: The near real-time accurate SAR estimation achieved by proposed machine learning framework will allow (i) checking patient-specific SAR while patient is lying in the MRI machine and (ii) performing ultra-fast optimization and uncertainty quantification studies while designing new high-field coils.

0472 Pitch: 8:15

Poster: 9:15

Screen 30



[A high permittivity and conformable gel pad fabricated by the PVA freeze-thaw method for dielectric shimming in ultra-high-field MRI]

Mengyu Li[1], Keyi Tang[1], Shufeng Zhou[1], Zhentao Zuo[2], Huabin Zhu[3], Shanshan Shan[1], and Chunyi Liu[1]

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Keywords: Shims, Shims, high-permittivity, sfaty, hydrogel pad

Motivation: Utilize new material to fabricate high-permittivity pads for addressing the B1 inhomogeneity and safety issues in ultra-high-field MRI scanning.

Goal(s): We aim to develop a new high permittivity pad with flexibility which can fit various body shapes. Different sizes and mass proportions of barium titanate powder were explored to achieve optimized mechanical properties and desired permittivity value.

Approach: The gel pad is fabricated using the PVA freeze-thaw method, resulting in a stable gel structure that incorporates barium titanate powder, thereby possessing excellent mechanical properties and high permittivity.

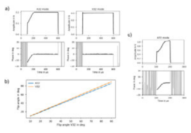
Results: Experimental results demonstrate of the gel pad's potential for clinical applications in ultra-high-field MRI scanning.

Impact: This abstract introduces a novel gel pad with high permittivity that can be conformed to different shapes of scanned objects. It highlights the potential of the gel pad in addressing safety issues in ultra-high-field MRI scanning.

0473 Pitch: 8:15

Poster: 9:15

Screen 31



<u>Impact of RF imperfections on MRF-based and reference B1+ mapping methods with a commercial 1Tx/32Rx head coil</u>

Max Lutz[1], Berk Silemek[1], Frank Seifert[1], Christoph Stefan Aigner[1], Stephan Orzada[2], Lance DelaBarre[3], Tobias Schaeffter[1,4,5], and Sebastian Schmitter[1,2,3]

[1]Physikalisch-Technische Bundesanstalt, Braunschweig and Berlin, Germany, [2]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [3]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [4]Einstein Center Digital Future, Berlin, Germany, [5]Department of Biomedical Engineering, Technical University of Berlin, Berlin, Germany

Keywords: System Imperfections, System Imperfections: Measurement & Correction

Motivation: Magnetic Resonance Fingerprinting (MRF) and preparation-based reference B_1^+ mapping approaches yielded an unexpected B_1^+ offset.

Goal(s): Identify the origin of the B_1^+ offset.

Approach: Pick-up coil measurements to evaluate the actual RF pulse shape using a commercial 1Tx/32Rx head-coil at 7T.

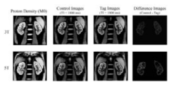
Results: For the preparation-based B_1^+ mapping method with rectangular pulses, longer RF rise times (~100 µs) and phase variations (~10°) were observed. Furthermore, during the 21s-long MRF acquisition using sinc-pulses, an increased RF amplitude (~2.5%) was observed. By incorporating the measured RF alterations, the B_1^+ offset could be substantially reduced.

Impact: Unidentified effects of the RF transmission such as deviation in envelope and temporal instability affect measurements. Characterizing the RF transmission enables quantification and correction of these deviations.

0474 Pitch: 8:15

Poster: 9:15

Screen 32



<u>Comparison of Renal ASL Signal-to-noise Ratio and Corticomedullary Contrast between 3T and 5T MRI</u>

Xiangwei Kong[1], Yanbin Li[2], Mingyan Wu[2], Xinzhen Zhang[3], Chen Chen[4], Xinyue Jiang[1], and Jeff Lei Zhang[1]

[1]School of Biomedical Engineering, ShanghaiTech University, Shanghai, China, [2]Central Research Institute, UIH Group, Shanghai, China, [3]United Imaging Healthcare, Shanghai, China, [4]Application Feature Solution, UIH Group, Shanghai, China

Keywords: High-Field MRI, Arterial spin labelling

Motivation: As the most promising method for measuring tissue perfusion, ASL suffers from low signal-to-noise ratio (SNR), with tagged blood typically causing only few percent of signal difference.

Goal(s): Explore if the use of 5T MRI could lead to higher SNR and CNR for renal ASL than 3T.

Approach: We performed FAIR-EPI on the kidneys of three healthy subjects at 6 inversion times on both 3T and 5T systems. SNR and CNR of difference images were calculated and compared.

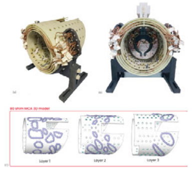
Results: SNR at 5T was 10.72±2.81, higher than 7.75±2.65 (P = 0.008) at 3T, and CNR were 9.08±4.08 and 6.53±2.14 (P=0.029), respectively.

Impact: 5T ASL provides difference images with higher SNR and CNR to allow faster acquisition and better corticomedullary differentiation while maintaining comparable image quality.

0475 Pitch: 8:15

Poster: 9:15

Screen 33



A 48-channel multi-coil shim array for B0 inhomogeneities correction in the NHP brain at 7T.

Elias Djaballah[1], Anojan Uthayakumar[2], Martin Bouchet [1], André Kalouguine[1], Alexis Amadon[2], and Qi ZHU[1]

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Keywords: Shims, High-Field MRI, non-human primate, B0 shimming, fMRI

Motivation: Functional MRI faces challenges due to B0 field inhomogeneities, which are amplified in non-human primate studies, especially at ultra-high fields.

Goal(s): Our aim was to develop a Multi-Coil Array (MCA) specifically designed for whole brain shimming of non-human primates.

Approach: A semi-heuristic approach was used to design an MCA, based on the Principal Components Analysis of subject-optimal stream functions. The MCA was then constructed and used to image an in-vivo NHP brain.

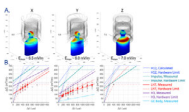
Results: The designed MCA effectively reduced B0 inhomogeneities in the primate brain, resulting in significant improvements in B0 homogenization and enhanced image quality in functional MRI images at 7T.

Impact: The development of a Multi-Coil Shim Array designed specifically for non-human primates significantly improves functional MRI image quality by effectively reducing B0 inhomogeneities. This advancement could pave the way for more accurate and detailed primate brain studies at ultra-high fields.

0476 Pitch: 8:15

Poster: 9:15

Screen 34



Development of the H12 insertable head gradient set designed for 10.5T and optimized for both peripheral nerve stimulation and magnet heating

Brian Rutt[1], Peter Roemer[2], Andrew Alejski[3], Trevor Wade[3], Matthew Bester[3], Koray Ertan[4], Alexander Bratch[5], Gregor Adriany[5], and Kamil Ugurbil[5]

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Keywords: Gradients, Gradients, Peripheral nerve stimulation, magnet heating

Motivation: Two interactions between gradient coils and their environment severely limit imaging performance: stimulation of peripheral nerves in human subjects and deposition of heat energy into the superconducting main magnet leading to helium loss or quench. This heating increases significantly for higher B_0 and gradient switching frequencies.

Goal(s): To address the above limitations by recasting the gradient design problem in a unique way to simultaneously minimize *both* of these interactions.

Approach: Using these new methods, we designed and modeled a head gradient coil: H12.

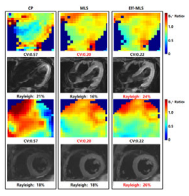
Results: We achieved >1.4 fold PNS improvement and >6 fold lower magnet heating compared to existing state-of-the-art head gradient coils.

Impact: Our method allows the design and real-world use of stronger and faster-switching gradients than any in existence, while minimizing peripheral nerve stimulation and excessive magnet heating. The potential impact is especially high for head gradients operating at ultra high field.

0477 Pitch: 8:15

Poster: 9:15

Screen 35



Efficient RF Shimming Strategies for Cardiac MRI at 5T

Jiaxu Li[1,2,3], Nan Li[1,2], Liqiang Zhou[4], Zhenhua Shen[4], Shengping Liu[3], Xiaoliang Zhang[5], and Ye Li[1,2]

[1]Paul C. Lauterbur Imaging Research Center, Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]Key Laboratory for Magnetic Resonance and Multimodality Imaging of Guangdong Province, Shenzhen, China, [3]Chongqing University of Technology, Chongqing, China, [4]United Imaging Healthcare, Shanghai, China, [5]Department of Biomedical Engineering, State University of New York at Buffalo, New York, NY, United States

Keywords: Parallel Transmit & Multiband, Parallel Transmit & Multiband, SAR;RF Shimming;CMR;

Motivation: Enhance RF shim efficiency, reduce power, and provide uniformity for ultra-high field cardiac imaging.

Goal(s): To significantly enhance excitation efficiency, reduce excitation power, and mitigate the risk of SAR exceeding safe levels, while minimizing loss of uniformity.

Approach: Optimizing excitation intensity and uniformity through joint loss function and validating the approach with simulation models and in vivo imaging.

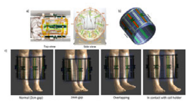
Results: The research results indicate that, when compared to MLS, the proposed Eff-MLS leads to an average 3.3% reduction in CV, while improving safety excitation efficiency by 442.26% in the simulation model. Similar effects were also observed in in-vivo experiments.

Impact: By enhancing RF shim efficiency and reducing the required excitation power while maintaining uniformity, this approach paves the way for more precise, high-resolution cardiac imaging at ultra-high field strengths. The potential impact includes broader applications of ultra-high field CMR.

0478 Pitch: 8:15

Poster: 9:15

Screen 36



Local SAR comparison of leg positioning in 16-channel proton/sodium dipole/loop array for 7T MRI

Menglu Wu[1], Jessica M Winfield[2,3], Pete Lally[4,5], and Ozlem Ipek[1]

[1]King's College London, London, United Kingdom, [2]Department of Physics, The Royal Marsden NHS Foundation Trust, Sutton, United Kingdom, [3]Division of Radiotherapy and Imaging, The Institute of Cancer Research, London, United Kingdom, [4]Department of Bioengineering, Imperial College London, London, United Kingdom, [5]London Collaborative Ultra high field System (LoCUS), London, United Kingdom

Keywords: Safety, Safety

Motivation: Sodium(^{23}Na)/proton(^{1}H) MRI of the extremities have great potential in diagnosis and treatment of musculoskeletal conditions and oncology applications (e.g.soft-tissue sarcomas).

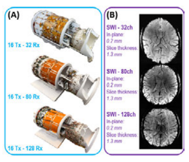
Goal(s): Assessing the performance of a novel 16-channel ^{1}H/^{23}Na MRI coil across varied leg positions and establish safe RF power limits for clinical applications.

Approach: Electromagnetic simulations to analyse coil performance in four leg positions. SAR_{10g} levels were compared across configurations while maintaining B_1^+ field efficacy.

Results: The coil showed consistent B_1^+ performance across all tested positions. The highest SAR levels occurred with calf-to-coil contact, aligning with predictions. Safe RF power limits were established, supporting the coil's clinical potential for extremity imaging

Impact: This study validates an innovative 16-channel ^{1}H/^{23}Na coil, setting benchmarks for safe RF power limits, and enhancing disease characterisation, enabling clinical research in musculoskeletal pathologies and soft-tissue sarcoma in the extremities.

0479 Pitch: 8:15 Poster: 9:15 Screen 37



Evaluation of a Numerical Approach Alternative to MR Thermometry in the Safety Validation of Multi-Channel RF Coils

Alireza Sadeghi-Tarakameh[1], Simon Schmidt[1], Matt Waks[1], Russell L Lagore[1], Nur Izzati Huda Zulkarnain[1], Xiaoping Wu[1], Gregor Adriany[1], Gregory J Metzger[1], Kamil Ugurbil[1], and Yigitcan Eryaman[1]

[1]*Center for Magnetic Resonance Research (CMRR), University of Minnesota, Minneapolis, MN, United States*

Keywords: Safety, Safety

Motivation: The existing safety validation process for multi-channel RF coils requires MR thermometry tests, which are difficult to carry out.

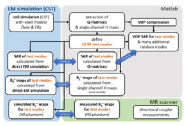
Goal(s): To propose an alternative approach to MRT in the validation process of multi-channel RF coils.

Approach: The simulated B_1^+ error was measured and propagated to the SAR error using Monte-Carlo simulations. To validate this approach MRT experiments were conducted with a 16-channel body coil at 10.5T, and the measured SAR errors were compared against the predicted ones.

Results: For two different excitation patterns, measured SAR errors were 36% and 40%, while predicted SAR errors were 49% and 46%, respectively.

Impact: The new strategy presented replaces MR Thermometry in the safety validation process of multi-channel RF coils. This approach can simplify and accelerate the development and testing of innovative multi-channel RF coils which are essential for UHF MRI applications.

0480 Pitch: 8:15 Poster: 9:15 Screen 38



SAR safety procedure for self-built pTx human head RF array coils at 9.4T

Felix Glang[1], Dario Bosch[1,2], Georgiy Solomakha[1], Jonas Bause[1], Nikolai I Avdievich[1], and Klaus Scheffler[1,2]

[1]*Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*Department for Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany*

Keywords: Safety, High-Field MRI, SAR, EM simulation

Motivation: Ensuring subject safety, in particular to limit tissue heating, is a critical aspect of self-developed pTx RF array coils for UHF applications.

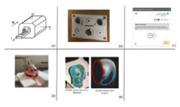
Goal(s): Establishing a dependable workflow for accurate simulation, data processing and realization of online supervision of power deposition.

Approach: The workflow relies on cross-comparisons of EM simulation results and intermediate processing steps based on representative excitation modes, and on comparison of measured and simulated field maps.

Results: Consistency was achieved in all cross-comparison steps. Residual discrepancies between measured and simulated B_1^+ maps require further investigation, but their safety implications can be addressed by an appropriate safety factor.

Impact: A reliable workflow for EM simulation, subsequent data processing, and realization of online SAR monitoring for home-built RF human head array coils at 9.4T is presented. This is an essential building block to ensure subject safety in experimental UHF studies.

0481 Pitch: 8:15 Poster: 9:15 Screen 39



Safety of Implanted Auditory Prostheses at 7T

Guy Fierens[1,2,3], Matthew Clemence[4], Nicolas Verhaert[3,5], Richard Bowtell[6,7], and Rebecca Susan Dewey[6,7,8]

[1]Cochlear Technology Centre Belgium, Mechelen, Belgium, [2]Laboratory of Soft Matter and Biophysics, Department of Physics and Astronomy, KU Leuven, Leuven, Belgium, [3]Research group Experimental Otorhinolaryngology, Department of Neurosciences, KU Leuven, Leuven, Belgium, [4]Philips Healthcare N. V., Best, Netherlands, [5]Department of Otolaryngology, Head and Neck Surgery, University Hospitals Leuven, Leuven, Belgium, [6]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [7]National Institute for Health Research (NIHR) Nottingham Biomedical Research Centre, Nottingham, United Kingdom, [8]Hearing Sciences, Division of Mental Health and Clinical Neurosciences, School of Medicine, University of Nottingham, Nottingham, United Kingdom

Keywords: Safety, Safety, Prostheses, active auditory implants

Motivation: While scanning individuals with active hearing implants (e.g., cochlear implants) at 1.5 and 3 T has become commonplace, scanning these patients at ultra-high field strengths (e.g., 7 T) is likely to be associated with an increased risks of damaging the device or causing soft-tissue damage, pain, and/or discomfort.

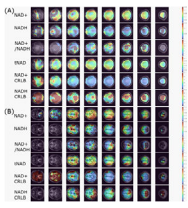
Goal(s): To evaluate the safety of three different active hearing implants in the 7 T MR environment.

Approach: Five potential interactions between the devices and the MR environment were assessed using industry-recommended practices for 1.5/3 T.

Results: Preliminary findings show no adverse effects within the predefined test conditions.

Impact: While scanning individuals with active hearing implants at 1.5/3 T has become commonplace, 7 T is associated with significantly greater safety risks. This study is the first to provide some confidence in the safety of such implants at 7 T.

0482 Pitch: 8:15 Poster: 9:15 Screen 40



Whole brain mapping of NAD at 7T using a 31P 32-channel array coil

Zhiwei Huang[1,2], Mark Widmaier[1,2], Daniel Wenz[1,2], Uzay Emir[3], and Lijing Xin[1,2]

[1]CIBM Center for Biomedical Imaging (CIBM), Ecublens, Switzerland, [2]Animal Imaging and Technology, Ecole Polytechnique Fédérale de Lausanne (EPFL), Ecublens, Switzerland, [3]School of Health Sciences, College of Health and Human Sciences, Purdue University, West Lafayette, IN, United States

Keywords: Spectroscopy, Spectroscopy, 31P MRSI, NAD+, NADH

Motivation: Nicotinamide adenine dinucleotide (NAD) is vital in cellular metabolism, existing in an oxidized (NAD+) and reduced (NADH) form. Its submillimolar concentration in the human brain makes its whole brain mapping challenging.

Goal(s): To explore the feasibility of whole-brain NAD mapping in human.

Approach: 31P MRSI data were acquired from two volunteers using a 31P 32-channel array coil at 7T. Metabolites were quantified with LCModel.

Results: 3D whole-brain NAD maps were acquired with decent SNR within 45min. The measured NAD level and NAD+/NADH ratio were stable across two subjects and aligned with previous single-voxel studies.

Impact: Our preliminary data demonstrated the feasibility of whole-brain NAD mapping in humans at 7T, which offers the potential to study regional-specific bioenergetics under different pathological conditions.

Power Pitch

Pitch: Nuts & Bolts: Technical Advances in MSK

Power Pitch Theatre 3

Tuesday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Ek Tsoon Tan & Linda Heskamp

(no CME credit)

0483

MERIT AWARD SUMMA CUM LAUDE

Pitch: 8:15

Poster: 9:15

Screen 41

Advances in Musculoskeletal Imaging: The Potential of Wireless Metasurface Coils.

Daniel Markus Düx[1,2], Robert Kowal[2], Simon Schröer[1], Holger Maune[3], Oliver Speck[2,4], Frank Wacker[1,2], Marcel Gutberlet[1,2], and Bennet Hensen[1,2]

[1]Institute of Diagnostics and Interventional Radiology, Hannover, Germany, [2]Research Campus STIMULATE, Otto-von-Guericke University, Magdeburg, Germany, [3]Chair of Microwave and Communication Engineering, Otto-von-Guericke University, Magdeburg, Germany, [4]Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Germany

Keywords: Other Musculoskeletal, MSK

Motivation: Musculoskeletal imaging (MSK) traditionally employs specific coil designs for distinct anatomical areas. Metasurface coils (MC) are innovative, light-weighted, and wireless coils promising for MSK imaging.

Goal(s): Primary objective of the MC was similar image quality but better patient comfort compared to standard coils.

Approach: Signal-to-noise ratios (SNRs) in elbow, knee, foot and hand imaging of conventional coils were compared with the MC.

Results: The MC showed improvement in SNR values for hand and foot. Imaging of knee and elbow was improved as well, but with less SNR near the spine coil. The MC's design streamlined positioning, maneuverability and can improve patient comfort.

Impact: Metasurface coils promise transformative benefits for future musculoskeletal imaging, matching the image quality of standard coils with increased flexibility and patient comfort. Their versatility allows compatibility across MRI vendors, only depending on the field strength of the designated coil.

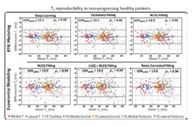
0484

MERIT AWARD MAGNA CUM LAUDE

Pitch: 8:15

Poster: 9:15

Screen 42



Improving Accuracy and Repeatability of Cartilage T2 Mapping in the OAI Dataset through Extended Phase Graph Modeling

Marco Barbieri[1], Anthony A Gatti[1], and Feliks Kogan[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States

Keywords: Osteoarthritis, Osteoarthritis, Cartilage, MSK, Quantitative Imaging, Data Processing

Motivation: Current methods for T_2 fitting in the OAI dataset are based on exponential models, which are inherently sub-optimal as they do not account for stimulated echoes and B_1 inhomogeneities.

Goal(s): To study whether EPG-Model fitting methods improve accuracy and repeatability of T_2 mapping in the OAI dataset compared to conventional methods.

Approach: We set up three EPG modelling approaches: nonlinear-least-square, dictionary matching, and deep learning. We used simulations and data from the OAI dataset to evaluate accuracy, repeatability.

Results: We found that EPG-based methods had higher accuracy and repeatability than exponential-based methods commonly used to compute T_2 maps in the OAI dataset.

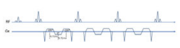
Impact: We have demonstrated that EPG-based methods improved accuracy and repeatability of T_2 mapping in the OAI dataset over the commonly used mono-exponential fitting methods. This permits more robust analysis of T_2 information in the OAI dataset, especially in longitudinal analyses.

0485

Pitch: 8:15

Poster: 9:15

Screen 43



Fast spin-echo triple-echo dixon (fTED) for fat suppression at 0.5T in the presence on knee implant.

Sajith Rajamani[1], Harsh Kumar Agarwal[1], Arjun Narula[2], Uday Patil[3], and Ramesh Venkatesan[1]

[1]GE HealthCare, Bangalore, India, [2]Narula Diagnostics, Rohtak, India, [3]Manipal Hospital, Bangalore, India

Keywords: Whole Joint, Low-Field MRI

Motivation: Fat saturation in musculoskeletal MRI at 0.5T in the presence of knee implants.

Goal(s): Echo spacing requirement of Fast spin-echo triple-echo Dixon (fTED) renders it as a preferred option for fat suppression even in the presence of implants without significant scan time penalty.

Approach: Commercially available fTED MRI was used to acquire 3 echoes (intra echo spacing of 6.71msec) between two consecutive refocusing pulses of FSE data acquisition at 0.5T research MRI system.

Results: Good quality fat suppression was observed in PD fat saturation knee MRI over 3 patients with knee implants.

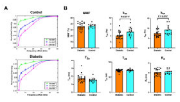
Impact: Low and mid field MRI can benefit from fTED algorithm for fat suppression where water and fat are resonating in close proximity (in Hz) of each other without significant scan time penalty.

0486

Pitch: 8:15

Poster: 9:15

Screen 44



Ultrashort echo time quantitative magnetization transfer (UTE-qMT) MRI distinguishes human diabetic bones from healthy ones

Soo Hyun Shin[1], Dina Moazamian[1], Arya Suprana[1,2], Eddie Fu[1,3], Saeed Jerban[1], Hyungseok Jang[1], Charles Ginsberg[4], Susan V Bukata[5], Yajun Ma[1], Eric Y. Chang[1,3], and Jiang Du[1,2,3]

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Keywords: Bone, Diabetes, Bone

Motivation: There is no standardized method to probe bone quality, a key determinant of bone fracture risk of type 2 diabetes patients.

Goal(s): We tested whether UTE quantitative MT (UTE-qMT) imaging and UTE-based water pool measurement can distinguish diabetic bones from healthy ones.

Approach: Twenty-two ex vivo human diabetic bones and 13 healthy ones were scanned with UTE-MT, proton density UTE, and inversion recovery UTE sequences to measure qMT parameters and fractions of pore and bound water pools.

Results: The proton exchange rates from UTE-qMT showed a significant decrease in diabetic bones.

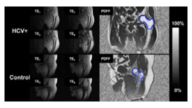
Impact: The proton exchange rate measured via UTE-qMT can distinguish diabetic bones from healthy ones. UTE-qMT may provide insight into molecular-scale bone quality that explains the increased fracture risk in type 2 diabetes patients despite the increased bone mineral density.

0487

Pitch: 8:15

Poster: 9:15

Screen 45



Hepatitis C virus infection is associated with elevated bone marrow adiposity in the proximal femur: A preliminary study

Brandon Clinton Jones[1], Makayla Clark[1], Brian-Tinh Duc Vu[1], Nada Kamona[1], Sisi Tang[1], Rasleen Kaur Grewal[1], Christiana Louise Cottrell[1], Vincent Lo Re[1], and Chamith Sudesh Rajapakse[1]

[1]*Radiology, University of Pennsylvania, Philaelphia, PA, United States*

Keywords: Bone, Infectious disease, Hepatitis C

Motivation: Hepatitis C (HCV) has been linked to osteoporosis and elevated risk of fracture in retrospective studies.

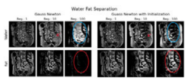
Goal(s): To perform the first investigation of bone marrow adiposity in a cohort of patients with chronic HCV infection.

Approach: A total of 33 patients with HCV and 42 age-, sex-, and race-matched HCV-uninfected controls were recruited for MRI. Proximal femur bone marrow adiposity was assessed via chemical-shift-encoded MRI from multi-echo gradient-echo sequences.

Results: The HCV group had elevated marrow adiposity in the proximal femur (80.4 ± 6.6% vs 74.9 ± 9.1%, P=0.0045) compared to controls, suggesting impairment of the trabecular network.

Impact: HCV was associated with elevated bone marrow adiposity compared to uninfected controls. MRI quantification of hip fat fraction enables investigation into the pathogenesis of increased fracture risk for patients with Hepatitis C infection.

0488 Pitch: 8:15 Poster: 9:15 Screen 46



Robust single-point UTE Dixon imaging.

Mateo Rodrigo Argudo Arrieta[1], Kilian Weiss[2], Christof Boehm[1], Georg C. Feuerriegel[1], Alexandra S. Gersing[1], Dimitrios C. Karampinos[1], and Anh T. Van[1]

[1]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Philips GmbH Market DACH, Munich, Germany

Keywords: Bone, Bone, Fat & Fat/Water Separation

Motivation: A recent approach solved the unwanted phase estimation in single point Dixon imaging using an iterative optimization method.

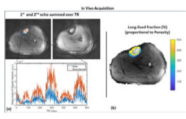
Goal(s): The goal of this work is to properly initialize the previously proposed iterative optimization approach for a more robust water-fat separation.

Approach: The iterative optimization method is initialized with the result of the polynomial fit of the signal phase and its derived water and fat signals.

Results: By initializing the Gauss Newton method with the result of a polynomial fit of the signal phase, better and more robust water fat separation can be achieved in sUTE Dixon imaging.

Impact: The proposed polynomial fit initialization has improved water-fat separation quality and its robustness against regularization parameters while reducing the number of optimization iterations.

0489 Pitch: 8:15 Poster: 9:15 Screen 47



Feasibility of Bone Porosity Assessment Using Dual-Echo uTE-MR Fingerprinting

Marco Barbieri[1], Congyu Liao[1,2], Xiaozhi Cao[1,2], Yang Yang[3], Kawin Setsompop[1,2], and Feliks Kogan[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Electrical Engineering, Stanford University, Stanford, CA, United States, [3]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States

Keywords: Bone, Bone, MSK, Quantitative Imaging, MR Fingerprinting, Data Processing

Motivation: Bone porosity is crucial for bone strength, yet standard multi-echo uTE-GRE techniques are too time-consuming for clinical use. uTE MR Fingerprinting (MRF) has not been tested for porosity assessment. If feasible it may offer faster porosity mapping for clinical applications.

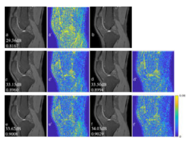
Goal(s): Assessing the feasibility of using dual-echo 3D-uTE-MRF to measure porosity through simulations and preliminary in vivo testing.

Approach: A dual-echo 3D-uTE-MRF sequence was tested for porosity accuracy and precision against standard multi-echo uTE-GRE via simulations. In-vivo, a volunteer's tibia was imaged to demonstrate the technique's preliminary viability.

Results: In simulations, dual-echo uTE-MRF outperformed uTE-GRE, but in-vivo applications, despite feasibility, need further development.

Impact: We demonstrated the feasibility of a dual-echo uTE MRF approach for measuring bone porosity trough simulation and a preliminary in-vivo acquisition.

0490 Pitch: 8:15 Poster: 9:15 Screen 48



Denoising of 3D Fast Spin Echo Magnetic Resonance Imaging Using Multi-channel Three-dimensional Convolutional Neural Network

Shutian ZHAO[1,2,3,4], Fan XIAO[3,4], James F. Griffith[3,4], and Weitian CHEN[3,4]

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Keywords: Skeletal, MSK

Motivation: Three-dimensional (3D) Fast Spin Echo (FSE) magnetic resonance imaging (MRI) can be acquired with high spatial resolution but at a cost of reduced signal-to-noise ratio (SNR). Deep-learning methods are promising for denoising in MRI.

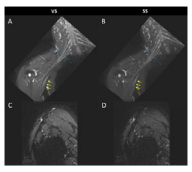
Goal(s): The existing 3D denoising convolutional neural networks (CNNs) can be further improved with the sturcture to extract high dimensional features.

Approach: We developed a deep-learning approach based on multi-channel 3D CNN to utilize inherent noise information embedded in multiple number-of-excitation (NEX) acquisition.

Results: The proposed method achieves improved denoising performance compared to the current state-of-the-art denoising methods in both slice-by-slice 2D and 3D metrics of PSNR and SSIM.

Impact: The proposed network can realize a denoised effect with details well preserved for clinically achievable 2-NEX MR images. This shows great potential for 3D MRI, fast imaging, and low-feild MRI that demanding for noise suppression.

0491 Pitch: 8:15 Poster: 9:15 Screen 49



3D Turbo-Spin-Echo with VERSE Excitation Improves SNR for Brachial Plexus Magnetic Resonance Neurography

Xiaoying Cai[1], Guido Buonincontri[2], Nicolas Groß-Weege[2], Peter Kollasch[3], Michelle Akerman[4], Alto Stemmer[2], Ek Tsoon Tan[4], and Darryl B. Sneag[4]

[1]Siemens Medical Solutions USA, Inc., New York, NY, United States, [2]Siemens Healthineers AG, Erlangen, Germany, [3]Siemens Medical Solutions USA, Inc., Rochester, MN, United States, [4]Department of Radiology and Imaging, Hospital for Special Surgery, New York, NY, United States

Keywords: Neurography, MSK, pulse sequence design, neurography, peripheral nerves

Motivation: The conventional slab-selective 3D TSE approach for brachial plexus magnetic resonance neurography (MRN) has a longer echo spacing for the first refocusing pulse and hence violates CPMG conditions. The signal available can decrease significantly due to field inhomogeneities.

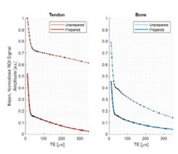
Goal(s): We aimed to improve slab-selective 3D TSE for brachial plexus MRN.

Approach: We incorporated the variable-rate selective excitation (VERSE) method to shorten the excitation pulse duration and eliminate the need for the first long-echo-spacing refocusing module.

Results: The 3D TSE with VERSE excitation achieved higher SNR in both phantom and in-vivo experiments.

Impact: The proposed 3D TSE using VERSE excitation improved slab-selective imaging in brachial plexus MRN with higher SNR when compared to the conventional approach.

0492 Pitch: 8:15 Poster: 9:15 Screen 50



Direct MRI of Collagen

Jason Daniel van Schoor[1], Markus Weiger[1], Emily Louise Baadsvik[1], and Klaas Paul Pruessmann[1]

[1]Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland

Keywords: Bone, MSK, Collagen

Motivation: Diseases in the musculoskeletal system are often characterized by a change in collagen structure and content. Such diseases are common and methods to evaluate collagen are integral in diagnosis and monitoring. Currently, indirect techniques are used for MRI of collagen due to its extremely short T_2.

Goal(s): To directly image collagen.

Approach: Bone and tendon specimens, as well as an in-vivo hand, are imaged using advanced short-T_2 techniques. The rapidly decaying signal is captured at different echo times, and image subtraction is used to isolate the signal of interest.

Results: Direct collagen MRI was successfully performed with decent SNR and resolution.

Impact: Direct MRI of collagen is reported with the potential for improved evaluation of the collagen structure and content with possible applications in diagnosis and monitoring of collagen-related diseases.

0493

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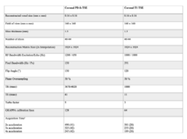
Poster: 9:15

Screen 51



[Accelerated high-resolution deep learning reconstructed turbo spin echo MRI of the knee at ultra-high field strength]

Adrian Alexander Marth[1,2], Georg Feuerriegel[3], Sophia Samira Goller[3], Stefan Sommer[1,4], Reto Sutter[3], Daniel Nanz[1], and Constantin von Deuster[1,4]

[1]Swiss Center for Musculoskeletal Imaging, Balgrist Campus AG, Zurich, Switzerland, [2]Balgrist University Hospital, Zurich, Switzerland, [3]Department of Radiology, Balgrist University Hospital, Zurich, Switzerland, [4]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Zurich, Switzerland

Keywords: Whole Joint, Joints

Motivation: High-resolution 7T-MRI using Turbo-Spin-Echoes requires high acceleration factors for reasonable scan times. Deep-Learning (DL) algorithms enable increased data under-sampling compared to state-of-the-art reconstructions.

Goal(s): To explore the feasibility of undersampled data acquisition in combination with DL-reconstruction for high-resolution T1- and PD-weighted knee MRI.

Approach: Volunteers underwent twofold, threefold and fourfold-accelerated 7T knee MRI with and without DL image reconstruction. Three readers rated various aspects of image quality.

Results: Image quality was rated significantly superior for fourfold-accelerated DL reconstructed images compared to images without DL reconstruction, while compared to twofold and threefold accelerated images, no image quality difference was observed.

Impact: This study successfully employed DL reconstructions at ultra-high field strength with promising results regarding image quality compared to conventional image reconstruction. Therefore, DL reconstructions at fourfold acceleration allows an efficient reduction in acquisition time, while still delivering high-quality images.

0494

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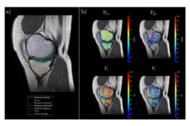
Poster: 9:15

Screen 52



[Macromolecule Exchange and Non-Exchange Protons Multiparametric Imaging of Knee: using ZAP/CEST and T2* Mapping with δTE Ultra-Short TE.]

Vadim Malis[1], Diana Vucevic [1], Won C Bae[1,2], Yoshimori Kassai[3], and Mitsue Miyazaki[1]

[1]Radiology, UC San Diego, La Jolla, CA, United States, [2]VA San Diego Healthcare System, San Diego, CA, United States, [3]Canon Medical, Ōtawara-shi, Japan

Keywords: Whole Joint, Joints, UTE, ZAP, CEST

Motivation: The study addresses the need for knee injury diagnosis by advancing MRI techniques to capture both structural and biochemical tissue characteristics.

Goal(s): The goal is to develop advanced MRI biomarkers by integrating Z-spectrum/CEST with UTE techniques, improving visualization of knee structures for detection of injuries and pathologies

Approach: We used novel Z-spectrum/CEST and UTE sequences to characterize proton exchange and obtain detailed T_2* mapping, aiming to reveal precise biochemical and ultrastructural knee tissue details.

Results: Findings demonstrate improved T_2* mapping and proton characterization in knee tissues, suggesting potential biomarkers for early pathology identification, although further validation is necessary for clinical application.

Impact: Multiparametric imaging of macromolecular exchange and non-exchange protons using ZAP/CEST MRI and UTE imaging with tight intervals δTE offers detailed knee tissue visualization, with potential for developing precise diagnostic biomarkers.

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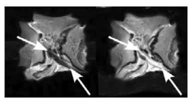
Screen 53



Collagen Fibre Direction Estimation Using a Prototype Rotatable Low Field Scanner

Harry Lanz[1], Karyn Elizabeth Chappell[2], John McGinley[1], Chinmay Gupte[3], Dimitri Amiras[3], and Mihailo Ristic[1]

[1]Mechanical Engineering, Imperial College London, London, United Kingdom, [2]Imperial College London, London, United Kingdom, [3]Department of Surgery & Cancer, Imperial College London, London, United Kingdom

Keywords: Tendon/Ligament, Joints, Magic angle, collagen, PCL, ACL, soft registration

Motivation: Certain types of tendon and ligament pathologies are hard to diagnose using conventional MRI. This can lead to invasive procedures or under-informed decisions regarding treatment.

Goal(s): The goal of this research is to develop a novel scanner and image analysis techniques in order to assess tendon/ligament structure and health non-invasively.

Approach: Tendons/ligaments contain collagen fibres that produce different signal intensities at different B0 orientations, this is the "magic angle effect". We have developed a rotatable scanner to reorient B0 to exploit this effect.

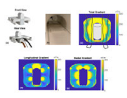
Results: This study shows successful tendon structure estimation of a bovine PCL using our scanner and image processing techniques.

Impact: The results of this study provide a foundation to begin testing our methodology in-vivo. Our successful fibre estimation in a bovine PCL has shown our scanner captures the magic angle effect and our processing techniques can estimate collagen fibre directions.

0496 Pitch: 8:15

Poster: 9:15

Screen 54



A Pilot Study of Insert Nonlinear Diffusion Gradient Coil on Calf Imaging

Horace Z. Zhang[1], Nahla M H Elsaid[2], Terence Nixon[1,2], R. Todd Constable[1,2], Albert J. Sinusas[1,2,3], and Gigi Galiana[1,2]

[1]Department of Biomedical Engineering, Yale University, New Haven, CT, United States, [2]Department of Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [3]Department of Cardiology, Yale University, New Haven, CT, United States

Keywords: Diffusion Acquisition, Diffusion/other diffusion imaging techniques, Nonlinear diffusion gradient

Motivation: A flexible light-weight nonlinear gradient coil was recently proposed and the feasibility for diffusion imaging is to be studied.

Goal(s): To get EPI imaging on calf with the presence of the nonlinear diffusion gradient coil

Approach: We design the experiment, processing pipeline, and an ADC map is shown as preliminary quantitative validation.

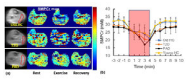
Results: This study demonstrates the feasibility of diffusion imaging using an insert diffusion gradient coil.

Impact: This study demonstrates the feasibility of diffusion imaging using an insert diffusion gradient coil, paving the way for further application of muscle and nerve imaging on the lower extremities with high gradient strength.

0497 Pitch: 8:15

Poster: 9:15

Screen 55



[Skeletal Muscle phosphocreatine assessment in diabetes and peripheral arterial disease with 1H MRI: a feasibility study]

Ryan Wahidi[1], Ran Li[2], Mohammed A Zayed[3], Mary K Hastings[4], Jiadi Xu[5], Yi Zhang[6], Clay F Semenkovich[7], and Jie Zheng[8]

[1]Radiology, Washington University in, Saint Louis, MO, United States, [2]Washington University in Saint Louis, Saint Louis, MO, United States, [3]Surgery, Washington University in Saint Louis, Saint Louis, MO, United States, [4]Program for Physical Therapy, Washington University in Saint Louis, Saint Louis, MO, United States, [5]Radi, John Hopkins University, Baltimore, MD, United States, [6]Biomedical Engineering, Zhejiang University, Hangzhou, China, [7]Medicine, Washington University in Saint Louis, Saint Louis, MO, United States, [8]Radiology, Washington University in Saint Louis, Saint Louis, MO, United States

Keywords: Functional/Dynamic, Metabolism, diabetes, peripheral arterial disease, perfusion

Motivation: Both Type 2 Diabetes Mellitus (T2D) and peripheral artery disease (PAD) are linked to impaired mitochondrial function in peripheral tissue that may precede micro-vascular disorders.

Goal(s): The goal is to demonstrate the feasibility of ^{1}H-based MRI for dynamic quantification of skeletal muscle PCr (SMPCr) concentration in vivo on a 3T clinical MRI system, in healthy controls, T2D, and PAD.

Approach: Dynamic ^{1}H-based PCr imaging was developed and evaluated in human subjects in a rest-exercise-recovery protocol, based on Chemical Exchange Saturation Transfer (CEST) technique.

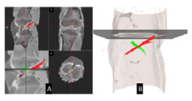
Results: Reproducibility of PCr measurement and declines in measures of mitochondria function in aging and diseases are demonstrated.

Impact: The ^{1}H MRI technique was able to measure differences in assessing mitochondrial function in people with T2D and PAD, without additional hardware. This technical development may allow early diagnosis of complications associated with various peripheral disorders.

0498 Pitch: 8:15

Poster: 9:15

Screen 56



[UTE-Based DW-SSFP for Musculoskeletal MRI]

Kwan-Jin Jung[1]

[1]Beckman Institute, Biomedical Imaging Center, University of Illinois at Urbana-Champaign, Urbana, IL, United States

Keywords: Tendon/Ligament, Tendon/Ligament, DW-SSFP

Motivation: Fiber tracking of ligaments suffer from a low signal due to their fast T2 relaxation during a long echo time in spin-echo EPI diffusion sequences.

Goal(s): Shorten the echo time of the diffusion sequence and acquire in 3D.

Approach: Use a 3D spiral-in readout in a DW-SSFP sequence.

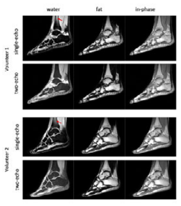
Results: The 3D spiral-in readout features an enhanced signal, shorter TR or TE, a wider interval for diffusion gradients, reduced geometric distortion, and a minimized echo time shift. It is demonstrated for tracts of knee ligaments using *ex vivo* hind limbs of piglets.

Impact: The proposed diffusion imaging sequence provides a high sensitivity to musculoskeletal tissue with short T2 relaxation times. This will be useful in studying the muscles, tendons, ligaments, and cartilage.

0499 Pitch: 8:15

Poster: 9:15

Screen 57



[Single point Dixon for water-fat separation in musculoskeletal TSE imaging]

Anh T Van[1], Kilian Weiss[2], Mateo Argudo[1], Christof Boehm[1], Georg C Feuerriegel[1], Alexandra S Gersing[1], and Dimitrios C Karampinos[1]

[1]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Philips GmbH Market DACH, Hamburg, Germany

Keywords: Other Musculoskeletal, Fat, Bone, Fat/Water separation

Motivation: TSE Dixon imaging is highly desired in clinical musculoskeletal imaging for its versatile contrasts. However, conventional Dixon imaging needs at least two different echo times, resulting in prolonged scan time.

Goal(s): To develop a single point Dixon imaging technique for TSE acquisition (sTSE-Dixon) that provide fat-separated, water-separated and in phase images from a single echo time acquisition.

Approach: Shifted single echo TSE acquisition was combined with smoothness-constrained non-linear inverse water fat problem.

Results: High quality water-separated, fat-separated and in phase images comparable to those obtained with conventional two-point Dixon were achieved from a single echo time shifted TSE acquisition.

Impact: In this work, a single echo time TSE sequence can deliver three image sets that are of great clinical need, including fat-separated images (comparable to standard T1-weighted), water-separated images (comparable to STIR), in-phase images (comparable to standard T2-weighted)

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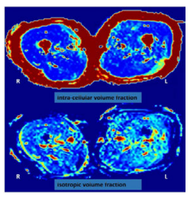
Poster: 9:15

Screen 58



[Application of diffusion microstructure imaging in thigh muscle]

Yiou Wang[1], Ziru Qiu[2,3], Kan Deng[4], Queenie Chan[5], Zhongping Zhang[4], Xinyuan Zhang[2,3], and Xiaodong Zhang[1]

[1]The Third Affiliated Hospital of Southern Medical University, Guangzhou, China, [2]School of Biomedical Engineering, Southern Medical University, GuangZhou, China, [3]Guangdong Provincial Key Laboratory of Medical Image Processing and Guangdong Province Engineering Laboratory for Medical Imaging and Diagnostic Technology, Southern Medical University, Guangzhou, China, [4]Philips Healthcare, Guangzhou, China, [5]Philips Healthcare, Hong Kong, China

Keywords: Muscle, Aging, thigh muscle, Fat/Water Separation

Motivation: Diffusion microstructure imaging (DMI) obtains the distribution of three microstructure compartments of each voxel[1], and more specifically understands the microstructure integrity of tissues.

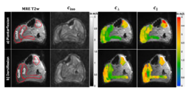
Goal(s): Quantitative detection of the correlation between the microstructure parameters of thigh muscle and its fat infiltration degree and its relationship with the body composition of healthy individuals.

Approach: We used DMI and mDIXON quant sequences to measure microstructural parameters and fat fraction (FF) of thigh muscle in healthy individuals, and to assess the value of DMI in thigh muscle imaging.

Results: DMI parameters differed significantly during aging and were significantly correlated with intramuscular FF.

Impact: The change of DMI parameters is a sensitive indicator of the physiological changes of muscle fiber structure during aging, which may suggest the microstructure characteristics of local metabolic changes in the body during aging.

0501 Pitch: 8:15 Poster: 9:15 Screen 59



Quantification of the anisotropic biomechanical properties of the lower leg muscles during muscle contraction using MR elastography and DTI

Mahsa Salimi Majd[1], Heiko Tzschätzsch [2], Yang Yang[1], Tom Meyer[1], Steffen Görner[1], Noah Jaitner[1], Alison Agres[3], Jürgen Braun[1], Ingolf Sack [1], and Jing Guo[1]

[1]Department of Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Institute of Medical informatics, Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]Berlin Institute of Health Julius Wolff Institut - Center for Musculoskeletal Biomechanics and Regeneration, Charité - Universitätsmedizin Berlin, Berlin, Germany

Keywords: Elastography, Elastography, MSK, MRE, anisotropic MRE, lower leg muscle,......

Motivation: Determining the in vivo mechanical properties of synergist muscles is challenging.

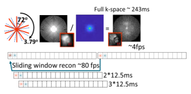
Goal(s): In this study, we developed an anisotropic inversion method for MR elastography (MRE) to quantify biomechanical parameter changes in lower leg muscles during passive plantarflexion and dorsiflexion.

Approach: Based on DTI and multifrequency MRE in 13 male volunteers, stiffness reconstruction was performed after aligning MRE with DTI coordinate systems. Isotropic shear wave speed (c_{iso}) and anisotropic shear wave speed, parallel ($c_{\parallel}$) and perpendicular ($c_{\perp}$) to the fiber orientation were obtained.

Results: Our findings showed significant changes of biophysical properties during muscle movements, particularly $c_{\parallel}$ and $c_{\perp}$ are more sensitive than c_{iso}.

Impact: Anisotropic muscle stiffness measured by DTI-MRE provides a consistent biomarker sensitive to changes in muscle structure and alignment altered by passive muscle movements such as plantarflexion and dorsiflexion.

0502 Pitch: 8:15 Poster: 9:15 Screen 60



Multiband Real-Time MRI at high frame rate (80fps) for studying the kinematics of joint movement in health and disease.

Isaac Watson[1], Elisa Zamboni[2], James McStravick[3], Fabio Zambolin[3], Martin Trefzer[1], Angelika Sebald[4], Jamie S McPhee[3], and Aneurin James Kennerley[3]

[1]School of Physics, Engineering and Technology, University of York, York, United Kingdom, [2]School of Psychology, University of Nottingham, Nottingham, United Kingdom, [3]Sports and Exercise Sciences, Manchester Metropolitan University, Manchester, United Kingdom, [4]York Cross-disciplinary Centre for Systems Analysis, University of York, York, United Kingdom

Keywords: Whole Joint, Data Acquisition, Real Time MRI

Motivation: Our research addresses the need for improved imaging techniques to assess joint kinematics in orthopedic and neuro-pathological conditions, with a focus on osteoarthritis.

Goal(s): The goal of this project is to investigate the capability of real-time MRI to assess joint mobility and function to aid clinical diagnosis and health/exercise research.

Approach: We use a multi-band real-time MRI sequence, capturing joint movement at 80 frames per second in various body parts, including the mouth, temporo-mandibular joint, thumb, knee, and foot/ankle.

Results: We demonstrate the feasibility of real-time MRI, offering detailed kinematic information while retaining soft tissue contrast.

Impact: Our real-time MRI technique, capturing joint motion at 80 frames per second, can empower clinical diagnostics and health research related to joint kinematics. It offers precise, dynamic insights into joint function, potentially improving patient care and advancing scientific understanding.

Study Group Business Meeting

Low-Field MRI Business Meeting

Room 324 Tuesday 9:15 - 10:15

(no CME credit)

Plenary Session

Tuesday Plenary

Organizers: Nivedita Agarwal, Karin Markenroth Bloch

Plenary Hall (Hall 603-604) Tuesday 10:30 - 12:00 *Moderators:* Nivedita Agarwal & Karin Markenroth Bloch

10:30 NIBIB New Horizons Lecture: Random Walks Toward an In Vivo MR Microscope

Ileana Jelescu[1]

[1]Lausanne University Hospital, Switzerland

10:50 Mild Traumatic Brain Injury Is Not Very Mild!

Yvonne Lui[1]

[1]*NYU School of Medicine, United States*

11:10 Imaging Preclinical Models of mTBI

Inga Koerte[1]

[1]*Ludwig-Maximilians-Universität, Munich, Germany*

11:30 Advances in mTBI: Opportunities & Gaps in MRI

David Wright[1]

[1]*Monash University, Melbourne, Australia*

Other

Gold Corporate Symposium Canon Medical

Plenary Hall (Hall 603-604) Tuesday 12:15 - 13:15

(no CME credit)

Study Group Business Meeting

Metabolomics & Metabolomic Imaging Business Meeting

Room 303-304 Tuesday 13:30 - 14:30

(no CME credit)

Other

Clinical Translation Challenge: Unmet Needs

Summit 2 Tuesday 13:30 - 15:30

(no CME credit)

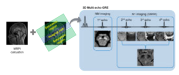
13:30 Introduction

13:40 Description of Needs: Parkinson's Disease

Rahul Guarav[1], Kelly Leyden[2]

[1], [2]

9020 13:44 Simultaneous neuromelanin and nigrosome1 imaging using a single 3D multi-echo GRE sequence



Sung-Min Gho[1], Hwan Heo[1], A Leum Lee[2], and Jeongwon Jo[1]

[1]*Heuron, Seoul, Korea, Republic of,* [2]*Department of Radiology, Soonchunhyang University Bucheon Hospital, Bucheon, Korea, Republic of*

Motivation: Neuromelanin and nigrosome1 imaging are each instrumental in diagnosing Parkinson's disease but have been utilized separately due to constraints like extended scan time.

Goal(s): To propose a 3D multi-echo GRE sequence for simultaneous imaging of neuromelanin and nigrosome1 that can be executed in a clinical setting (~5min).

Approach: The previously suggested protocols for neuromelanin and nigrosome1 imaging were modified. DL-based analyses are employed for the automated detection and segmentation of neuromelanin, and for identifying the nigrosome1 regions.

Results: The proposed method yields reliable estimates of neuromelanin-related volumes and identifies the nigrosome1 regions within a clinically acceptable scan time.

Impact: A simultaneous neuromelanin and nigrosome1 imaging protocol was implemented within a practically feasible scan time. It achieved robust visualization of the loss of the swallow tail sign and demonstrated strong sensitivity to changes in the neuromelanin signal.

13:53 Parkinson's Disease - Accuracy of AI-Driven Susceptibility Map-Weighted MRI Analyses to Differentiate Neurodegenerative from Non-Neurodegenerative Parkinsonism

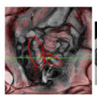
Elon Wallert

Amsterdam UMC

14:02 Description of Needs: Gastrointestinal Motility

Sofieke de Jong

9021 14:06 Challenge examples: Visualisation of shear from cine MRI for detection of gastrointestinal adhesions




David Atkinson[1] and Stuart Taylor[1]

[1]*Centre for Medical Imaging, University College London, London, United Kingdom*

Keywords: Gastrointestinal Motility

Motivation: Further examples and methodology extending our abstract to the Unmet Needs Challenge on Gastrointestinal Motility [1].

Goal(s): Localisation of regions of bowel that are affected by adhesions.

Approach: We previously proposed that regions of reduced shear may correspond to bowel motility hindered by adhesions [1]. Shear was calculated from coronal cine frames and presented as red colour overlays. Here we present further examples and add a linked-cursor that links regions of restricted motility to impressions of tethering in axial structural images, e.g. angulated bowel loops.

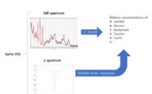
Results: Descriptive exemplars are presented.

Impact: Adhesions cannot be directly seen in MRI but tethering may be apparent in structural and motility images. The proposed post-processing methods use readily available MR sequences and Results suggest further investigation to validate observations and to assess potential clinical benefit.

14:15 Description of Needs: Central Nervous System Lactate

Julie Harreld

9022 14:19 Calculation of metabolite concentrations using linear combination of CEST Z-spactra -- a study on 9.4 T rodent datasets



Yifan Li[1], Teng Gong[1], Wentao Jia[2], Yuqing Wang[3], Lele Ma[1], Nan Gao[1], and Xiaolei Song[1]

[1]*Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China,* [2]*Department of Information Science and Technology, Northwest University, Xi'an, China,* [3]*Nonhuman Primate Research Center, Tsinghua University, Beijing, China*

Motivation: Lactate can be detected by both MRS and CEST. Compared to MRS, CEST imaging is faster due to its high sensitivity, but the low specificity limits it to qualitative study.

Goal(s): If deriving reliable quantitative maps from CEST Z-spectra is possible, the lactate imaging can be accelarated significantly.

Approach: On our rodent MRS and CEST dataset, we calculated the concentrations of lactate (and other metabolites) from single voxel MRS data as gold standard, and performed regression between them with the mean CEST Z-spectra of the same VOI.

Results: Preliminary results show lactate concentrations can be estimated by linear combination of Z-spectra.

Impact: Our preliminery work may provide a new insight into faster lactate imaging, that is, using a faster but less quantitative modality like CEST to acquire images and building the correlation of it with more reliable quantitative values.

14:28 Description of Needs: Amyloid Tau Proteins

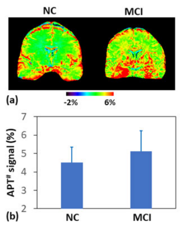
Nandor Pinter

14:32 Amyloid Tau Proteins - MR Fingerprinting for Quantification of Brain Amyloid Burden: from Development To Prospective Multi-Site External Validation

Shohei Fujita

Athinuola A. Martinos Center for Biomedical Imaging Center

9023 14:41 Protein-based Amide Proton Transfer MRI Signal as a biomarker for AD Immunotherapy Monitoring



Jinyuan Zhou[1], Jingpu Wu[2], Jieru Wan[2], Munendra Singh[2], Puyang Wang[2], Hye-Young Heo[2], and Shanshan Jiang[2]

[1]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States, [2]Johns Hopkins University, Baltimore, MD, United States

Motivation: Rigorous monitoring is clearly needed to fully evaluate efficacy of new anti-amyloid therapeutics against AD.

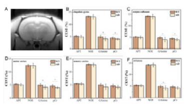
Goal(s): To evaluate the value of protein-based APT MRI in monitoring AD immunotherapy efficacy and characterizing adverse events.

Approach: Both animal AD models and human subjects were studied, and a novel APT acquisition and quantitative analysis approach (EMR-APT) was used.

Results: The average APT signals were significantly higher in AD mice than in wild-type controls. Similarly, the MCI patients demonstrated significantly higher APT signals, compared to the normal controls.

Impact: A unique and innovative biomarker-stratified approach developed in this work will aid in assessing treatment efficacy accurately and identifying adverse events early.

9024 14:50 Early detection of Alzheimer's disease in a transgenic rat model using CEST MRI



Teng Gong[1], Nan Gao[1], Wentao Jia[2], Yifan Li[1], and Xiaolei Song[1]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, Tsinghua University, Beijing, China, [2]Department of Information Science and Technology, Northwest University, Xi'an, China

Motivation: There is a lack of effective MR tool for early diagnosis of AD.

Goal(s): To assess the value of CEST MRI for early detection of AD using a transgenic rat model.

Approach: CEST MRI scans for 10 AD rats and 9 age-matched wide-type (WT) controls were performed on 9.4T animal MR scanner. CEST signals were quantified using Lorentzian Difference, with signals at multiple frequency offsets quantified.

Results: Compared with WT rats, pCr and G-amine signals in several brain regions of AD rats were significantly decreased, which is expected to be used as biomarkers for early detection of AD.

Impact: The study provides evidence for early detection of AD in transgenic rat brains using in vivo CEST MRI and may promote clinical translation.

14:59 Amyloid Tau Proteins - Topological Network Analysis & Virtual Brain Modelling Combined to Portray Subject-Specific Profiles of Dementia Stages

Anita Monteverdi

IRCCS Mondino Foundation

15:08 Discussion & Conclusion

Weekday Course

Psychological & Chronic Brain Trauma

Organizers: Candace Fleischer, Christin Sander, Wietske van der Zwaag, Leon Janse van Rensburg

Summit 1 Tuesday 13:30 - 15:30 *Moderators:* Lu Lu & Ona Wu

13:30 Neuroimaging in childhood trauma: Exploring the hidden effects through large-scale MRI Studies

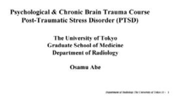
Karen Caeyenberghs[1]

[1]Deakin University, Burwood, Australia

Keywords: Neuro: Brain, Neuro: White matter, Neuro: Brain Connectivity

Numerous MRI studies have linked behavioral deficits to different properties of brain regions, fibre pathways, and brain networks in children with traumatic brain injury. While promising, these MRI studies have revealed weak to moderate relationships. In this presentation, I will outline new directions associated with the examination of brain-behavior relationships in pediatric TBI: (i) participation in large-scale consortia to obtain larger and more diverse samples; (ii) employ specific brain and behavioral metrics (using advanced models and ecological momentary assessments); (ii) conduct integrated network analyses to examine complex relationships; and (iv) use tools to deal with the large heterogeneity in lesions.

14:00



Post-Traumatic Stress Disorder (PTSD)

Osamu Abe[1]

[1] *The University of Tokyo, Japan*

Keywords: Neuro: Brain, Neuro: Brain Connectivity

The most robustly identified findings in PTSD include hyperactivation of the amygdala and dorsal anterior cingulate cortex, hypoactivation of the ventromedial prefrontal cortex, and atrophy of the hippocampus. These brain changes are thought to impair fear learning, threat detection, contextual processing, executive function, and emotional regulation in PTSD. The triple-network model of PTSD proposes that the disorder is characterized by hypoactivation of the default mode network and central executive network and hyperactivation of the salience network (SN). This imbalance is thought to lead to the symptoms of PTSD, such as re-experiencing, avoidance, and negative alterations in mood and cognition.

15:00

Coma

Nadya Pyatigorskaya[1]

[1] *ICM, Paris, France*

15:30

Mild Traumatic Brain Injury

Michael Zeineh[1]

[1] *Stanford University, CA*

Oral

Application of AI to Clinical Neuroradiology

Hall 606 | Tuesday 13:30 - 15:30 | *Moderators:* Christopher Filippi & Franklyn Howe

13:30

Introduction

Christopher Filippi
Tufts University School of Medicine, Boston, MA, United States

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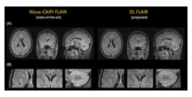
0503 13:42



Ultrafast Deep Learning vs. Wave-CAIPI 3D FLAIR for Clinical Evaluation and Quantitative Assessment of White Matter Lesions

Shohei Fujita[1,2], Marcel Dominik Nickel[3], Wei-Ching Lo[4], Bryan Clifford[4], John Conklin[1,2], and Susie Y. Huang[1,2,5]

[1] *Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States,* [2] *Department of Radiology, Harvard Medical School, Boston, MA, United States,* [3] *Siemens Healthcare GmbH, Erlangen, Germany,* [4] *Siemens Medical Solutions, Boston, MA, United States,* [5] *Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States*

Keywords: Multiple Sclerosis, Neuro

Motivation: Deep learning (DL) reconstructions show promise in accelerating MRI yet have not been extensively validated clinically, particularly for 3D sequences.

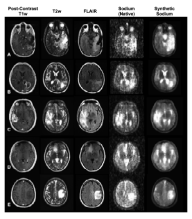
Goal(s): To evaluate the diagnostic quality of DL-based 3D FLAIR compared to Wave-CAIPI-accelerated FLAIR in a clinical setting.

Approach: This prospective study included 26 patients undergoing evaluation for demyelinating disease with Wave-CAIPI-FLAIR and a resolution-matched 6-fold-under-sampled Cartesian FLAIR acquisition with DL reconstruction.

Results: DL-FLAIR reduced scan time (1:53 vs. 2:50) and showed better image quality with higher SNR/CNR, greater lesion conspicuity, and reduced noise compared to Wave-CAIPI-FLAIR, with high agreement in lesional and regional brain volumes between both methods.

Impact: Deep learning reconstruction of 3D-FLAIR provides 30% less acquisition time and improved subjective image quality compared to a state-of-the-art accelerated technique. The excellent agreement in quantitative lesion and regional brain volumes suggests robustness for use in clinical and research studies.

0504 13:54 [High-Resolution Sodium MRI of Human Gliomas at 3T Using Physics-Based Generative AI]



Catalina Raymond[1], Thorsten Feiweier[2], Bryan Clifford[3], Heiko Meyer[2], Xiaodong Zhong[4], Fei Han[3], Alfredo L. Lopez Kolkovsky[1], Nicholas S. Cho[1], Francesco Sanvito[1], Sonoko Oshima[1], Noriko Salamon[5], Richard Everson[6], Timothy F. Cloughesy[7], and Benjamin M. Ellingson[1,4,6]

[1]Radiological Sciences, UCLA Brain Tumor Imaging Laboratory, Los Angeles, CA, United States, [2]Siemens Healthcare GmbH, Erlangen, Germany, [3]Siemens Medical Solutions USA, Boston, MA, United States, [4]Radiological Sciences, Magnetic Resonance Research Laboratories, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, CA, United States, [5]Radiological Sciences, David Geffen School of Medicine, University of California, Los Angeles, CA, United States, [6]Neurosurgery, David Geffen School of Medicine, University of California, Los Angeles, CA, United States, [7]Neurology, David Geffen School of Medicine, University of California, Los Angeles, CA, United States

Keywords: Tumors (Post-Treatment), Non-Proton, Sodium

Motivation: Sodium MRI is a promising technique for understanding the brain tumor microenvironment. However, sodium MRI at 3T suffers from extremely low SNR, resulting in compromised resolution and long acquisition times.

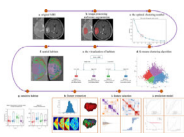
Goal(s): Our goal is to create a high-resolution sodium MRI at 3T using generative AI to improve biological characterization, treatment monitoring, and surgical planning for brain tumor patients.

Approach: We developed a physics-informed synthetic dataset to train an anatomically-constrained GAN for high-resolution neuroimaging of brain tumors.

Results: When applied to brain tumor patients' images, the synthetic-sodium MRI improved resolution, SNR, and correlated with expression of sodium-proton exchanger (NHE1) on image-guided biopsy.

Impact: High-resolution sodium neuroimaging at 3T using physics-informed anatomically-constrained GAN has the potential to make multinuclear MRI feasible in the clinical environment, leading to conceivable improvements in diagnosis, monitoring, treatment, and our understanding of the biology of brain tumors.

0505 14:06 [MRI-derived Vascular Permeability and Cell Density Habitats for Prediction of Isocitrate Dehydrogenase Mutation in Gliomas]



Ping Liu[1], Wanyi Zhen[1], and Guihua Jiang[1]

[1]Department of Medical Imaging,, Guangdong Second Provincial General Hospital, Guangzhou, China

Keywords: Tumors (Pre-Treatment), Brain, Glioma, Habitat imaging

Motivation: Accurate preoperative identification of isocitrate dehydrogenase (IDH) mutation is crucial for improving patients' management in clinical practice. Intratumor heterogeneity in gliomas limits the accurate determination of IDH mutation to some extent.

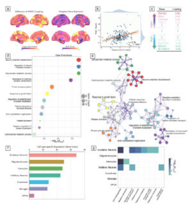
Goal(s): T1-CE-derived BBB permeability and DWI-derived cell density habitat imaging may enable more precise prediction of IDH mutation by parcellating similar voxels using a clustering method.

Approach: We developed and validated imaging habitats based on T1-CE and DWI to predict IDH mutation by localized mapping of tumor heterogeneity.

Results: The damaged vascular and hypocellular imaging habitat performed best and robust to predict the IDH mutation, and was considered as the sensitive habitat.

Impact: Fully recognizing and exploiting this heterogeneity can contribute to improving the prediction accuracy of IDH mutation status, providing more precise treatment and management strategies, and ultimately improving survival and quality of life.

0506 14:18



Classifiers for ADHD Based on Gray-White Matter Structural Connectivity Couplings and Corresponding Transcriptional Signatures

Nanfang Pan[1], Yajing Long[1], Ying Chen[1], and Qiyong Gong[1]

[1]*West China Hospital of Sichuan University, Chengdu, China*

Keywords: White Matter, Brain Connectivity, Transcriptome

Motivation: The research aims to uncover intricate gray-white matter structural connectivity (GWSC) patterns and associated gene expression profiles in ADHD.

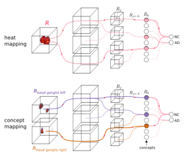
Goal(s): Develop machine-learning classifiers based on GWSC to distinguish ADHD from controls, bridging its gap with gene expression to unveil neurobiological mechanisms.

Approach: Utilize T1-weighted and diffusion-weighted MRI data to construct GWSC networks. Employed four machine-learning classifiers for classification. Analyzed transcriptomes from the Allen Human Brain Atlas to link with gene expression.

Results: Classifiers achieved over 75% accuracy, with Gaussian-kernel SVM leading at 82.6%. Ventromedial prefrontal cortex emerged as a key contributor. Transcriptome analysis identified enrichment in "neuron projection development."

Impact: These findings empower clinicians with accurate ADHD classifiers and pinpoint the ventromedial prefrontal cortex as a hub. The revelation of gene expression nuances in neuron projection development advances targeted interventions, fostering a shift towards more personalized and effective ADHD treatments.

0507 14:30



Explainable concept mappings underlying deep learning brain disease classification

Christian Tinauer[1], Maximilian Sackl[1], Anna Damulina[1], Reduan Achtibat[2], Maximilian Dreyer[2], Frederik Pahde[2], Sebastian Lapuschkin[2], Reinhold Schmidt[1], Stefan Ropele[1], Wojciech Samek[2,3,4], and Christian Langkammer[1]

[1]*Medical University of Graz, Graz, Austria,* [2]*Fraunhofer Heinrich Hertz Institute, Berlin, Germany,* [3]*Technische Universität Berlin, Berlin, Germany,* [4]*BIFOLD – Berlin Institute for the Foundations of Learning and Data, Berlin, Germany*

Keywords: Alzheimer's Disease, Relaxometry, xAI, Explainable, Deep Learning

Motivation: While recent studies show high accuracy in the classification of Alzheimer's disease using deep neural networks, the underlying learned concepts have not been investigated.

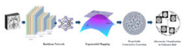
Goal(s): To systematically identify the concepts learned by the deep neural network for model validation.

Approach: Using R2* maps we separated Alzheimer's patients (n=117) from healthy controls (n=219) by using a deep neural network and systematically investigated the learned concepts using Concept Relevance Propagation (CRP).

Results: In line with established histological findings, highly relevant concepts were primarily found in and adjacent to the basal ganglia.

Impact: The identification of concepts learned by deep neural networks for disease classification enables validation of the models and improves reliability.

0508 14:42



Few-shot Learning Approach for Differentiation of Atypical Parkinsonian Syndromes Using Susceptibility Weighted Imaging

Won June Choi[1], Jin Hwang Bo[2], Jae-Hyeok Lee[2], and Jin Kyu Gahm[3]

[1]Department of Information Convergence Engineering, Pusan National University, Busan, Korea, Republic of, [2]Department of Neurology, Pusan National University Yangsan Hospital, Yangsan, Korea, Republic of, [3]School of Computer Science and Engineering, Pusan National University, Busan, Korea, Republic of

Keywords: Parkinson's Disease, Machine Learning/Artificial Intelligence, Few-shot learning

Motivation: Recent research indicates that various atypical Parkinsonian syndromes (APSs) exhibit distinct and subtle patterns of iron accumulation in the globus pallidus and putamen, typically detected through susceptibility-weighted imaging (SWI).

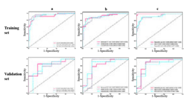
Goal(s): We propose a novel automated framework for distinguishing between APSs, specifically MSA-P and PSP, in SWI allowing the model to learn from a small amount of labeled data.

Approach: We combined T1-weighted and SWI to create a Hybrid Contrast Image, facilitating precise registration. Furthermore, we used Hyperbolic Few-shot contrastive learning for similarity-based.

Results: The model achieved a balanced accuracy of approximately 94.29%, demonstrating its superior robustness compared to other models and distance metrics.

Impact: Our proposed approach demonstrated the potential to classify specific APS with high performance using a small amount of labeled data. Furthermore, it can be extended to apply not only to binary-classification of specific APS but also to the entire APS.

0509 14:54



MRI-Based Machine Learning Fusion Models to Distinguish Encephalitis and Gliomas

Fei Zheng[1], Ping Yin[1], Yujian Wang[1], Wenhan Hao[1], Qi Hao[1], Xuzhu Chen[2], and Nan Hong[1]

[1]Peking University people' hospital, Beijing, China, [2]Beijing Tiantan Hospital, Beijing, China

Keywords: Neuroinflammation, Brain, Encephalitis · Gliomas · Magnetic resonance imaging

Motivation: Encephalitis and glioma can appear very similar in atypical cases. However, their treatment protocols differ significantly. As such, distinguishing between these two diseases is crucial.

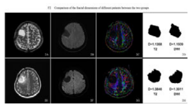
Goal(s): Our objective is to assess and compare the performance of various machine learning (ML) techniques in discriminating between encephalitis and glioma in atypical cases.

Approach: We compare the performance of the classical machine learning (CML) model and the deep learning (DL) model, and assess the effectiveness of utilizing radiomics features extracted from both CML and DL in distinguishing encephalitis from glioma in atypical cases.

Results: ML models can distinguish between encephalitis and glioma in atypical cases.

Impact: Surgery is commonly considered as the initial treatment for glioma, while non-operative therapy is the primary approach for managing encephalitis. Precise identification of glioma and encephalitis facilitates physicians in avoiding misdiagnosis and delays in treatment.

0510 15:06



Preoperative personalized 3D printing technology enhanced glioblastoma patient survival by improving fractal dimensions of wound surface

huaze xi[1] and junlin zhou[1]

[1]*The Second Hospital of Lanzhou University, lanzhou, China*

Keywords: Tumors (Post-Treatment), Tumor, Radiomics; fractal dimensions; 3D-printing technology

Motivation: This study sought to forecast the prognosis of glioblastoma patients by conducting a retrospective analysis of their fractal dimensions (FD) from postoperative multimodal MRI and radiomics features within surgical regions. Additionally, it aimed to assess the potential for improving clinical therapeutic outcomes using preoperative personalized three dimensional (3D)-printing technology.

Goal(s): Exploring whether personalised 3D-printing technology can improve surgical precision and thus prolong survival in glioblastoma patients

Approach: Using questionnaires, radiomics, and FD to evaluate whether preoperative 3D-printing technology improves postoperative outcomes and survival

Results: The FD of surgical regions was associated with overall survival, and preoperative 3D-printing improves patient prognosis and prolongs survival

Impact: Multimodal magnetic resonance imaging radiomics and fractal dimension can predict patient survival by analyzing postoperative images, while personalized 3D printing technology can improve surgical accuracy, reduce the fractal dimension of the surgical regional, and prolong the overall survival of patients

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Oral

Slipping & Sliding: Imaging of Articular Cartilage

Nicoll 1 | Tuesday 13:30 - 15:30 | *Moderators:* Edwin Oei & Hector Lise de Moura

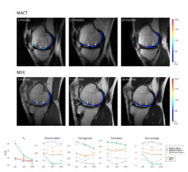
13:30 Introduction

Edwin Oei

Erasmus MC - University Medical Center, Netherlands

0511 13:42

MERIT AWARD SUMMA CUM LAUDE



TEXTURE ANALYSIS OF CARTILAGE REPAIR TISSUE MATURATION - COMPARISON OF TWO CARTILAGE REPAIR METHODS AND CORRELATION WITH MOCART 2.0

Veronika Janacova[1,2], Vladimir Juras [1], Pavol Szomolanyi[1,3], Diana Sitarcikova[1], Alexandra Kirner[4], and Siegfried Trattnig[1,2,5,6]

[1]*High Field MR Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria,* [2]*CD Laboratory for MR Imaging Biomarkers (BIOMAK), Vienna, Austria,* [3]*Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia,* [4]*TETEC Tissue Engineering Technologies AG, Reutlingen, Germany,* [5]*Austrian Cluster for Tissue Regeneration, Ludwig Boltzmann Institute for Experimental and Clinical Traumatology, Vienna, Austria,* [6]*Institute for Clinical Molecular MRI in the Musculoskeletal System, Karl Landsteiner Society, Vienna, Austria*

Keywords: Cartilage, Cartilage, Repair, Tissue, Maturarion

Motivation: To monitor patients after cartilage repair surgery, non-invasive imaging techniques are needed.

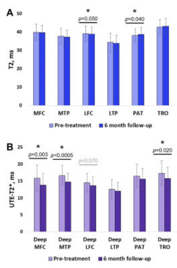
Goal(s): Study aimed to monitor cartilage repair tissue for up to two years post-surgery using GLCM analysis of T_2 maps to assess tissue structure and correlate it with the morphological MOCART 2.0 score.

Approach: 37 patients underwent either matrix-associated autologous chondrocyte transplantation or microfracturing. ROI's were drawn onto T_2 maps at three time-points. GLCM features, mean T_2 and MOCART 2.0 scores were calculated and analysed.

Results: We found correlations between GLCM features and the MOCART 2.0 score, with significant changes in texture of the repair tissue over time for transplant patients.

Impact: This study reveals a correlation between GLCM and MOCART 2.0 in autologous chondrocyte transplantation and microfracturing. Only chondrocyte transplants showed significant tissue development over time, indicating complex maturation. These findings will impact patient monitoring in clinical trials after cartilage repair.

0512 13:54



Platelet Rich Plasma Effects on Knee Cartilage and Osteoarthritis Symptoms: T2, UTE-T2* and Patient Reported Outcomes Over 6-months Follow-Up

Ashley Anne Williams[1,2], Daniella Asare[2], Holly L Torres[2], and Constance R Chu[1,2]

[1]Orthopaedic Surgery, Stanford Univesity, Stanford, CA, United States, [2]Joint Preservation Center, Palo Alto Veterans Healthcare System, Palo Alto, CA, United States

Keywords: Osteoarthritis, Cartilage, UTE-T2*

Motivation: Clinical evidence of structural benefits to cartilage from Platelet Rich Plasma (PRP) injections to treat knee osteoarthritis is lacking.

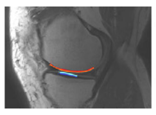
Goal(s): Our goal was to use T2 and UTE-T2* relaxation times to assess cartilage structural improvements following PRP therapy.

Approach: Patient reported outcomes, T2 and UTE-T2* maps were acquired before and 6 months after completion of PRP treatment in 50 patients with symptomatic knee osteoarthritis.

Results: On average, participants reported symptomatic improvements following PRP. Significant changes to cartilage T2 and UTE-T2* were also observed. Improvements in patient-reported knee function and stiffness correlated to concurrent decreases in both T2 and UTE-T2*.

Impact: qMRI evaluation of the clinical efficacy of PRP treatment of symptomatic knee OA shows that changes to patient reported knee function associate with concurrent changes to cartilage structure assessed with T2 and UTE-T2*.

0513 14:06



Positive Effect of Weight Loss on Knee Articular Cartilage – a Three-Year Follow-Up Using T2 Relaxation Time

Eetu Mäkelä[1], Victor Casula[1], Ahti Kemppainen[1], Marianne Haapea[2], and Miika T Nieminen[1,3]

[1]Research Unit of Health Sciences and Technology, University of Oulu, Oulu, Finland, [2]Research Service Unit, Oulu University Hospital, Oulu, Finland, [3]Department of Radiology, Oulu University Hospital, Oulu, Finland

Keywords: Cartilage, Osteoarthritis, Relaxometry

Motivation: Weight loss has been shown to be beneficial for knee symptoms and reducing cartilage degeneration.

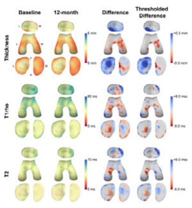
Goal(s): To examine the impact of weight-loss in obese subjects on articular cartilage in the tibiofemoral joint using T2 relaxation time mapping.

Approach: Knees of 65 obese patients undergoing either bariatric surgery or conservative weight loss regimens were imaged at 3T before and three years after treatment. Changes in T2 were assessed in tibiofemoral cartilage.

Results: A reduction in body mass index (BMI) was associated with shortened T2 values in tibia, indicating that weight loss may result in improved cartilage quality.

Impact: The findings provide supporting evidence for the benefits of weight loss for cartilage health and have relevance in the context of osteoarthritis prevention and treatment.

0514 14:18 [Longitudinal Assessment of Cartilage Thickness, T1ρ and T2 Changes in Patients with Mild Osteoarthritis using MRI and 3D Surface-Based Analysis]



Dimitri Kessler[1], James MacKay[1,2], Stephen McDonnell[3], Jennifer O'Callaghan[3], Andrew Grainger[4], Alexandra Roberts[5], Robert Janiczek[6], Andrew Patterson[7], Sarah Lee[8], Andrew McCaskie[3], Martin Graves[1,4], Joshua Kaggie[1], and Fiona Gilbert[1]

[1]*Department of Radiology, University of Cambridge, Cambridge, United Kingdom,* [2]*Norwich Medical School, University of East Anglia, Norwich, United Kingdom,* [3]*Division of Trauma and Orthopaedics, Department of Surgery, University of Cambridge, Cambridge, United Kingdom,* [4]*Department of Radiology, Cambridge University Hospitals NHS Foundation Trust, Addenbrooke's Hospital, Cambridge, United Kingdom,* [5]*Antaros Medical, Uppsala, Sweden,* [6]*Janssen Research and Development, Spring House, PA, United States,* [7]*Clinical Imaging, GSK, London, United Kingdom,* [8]*Amallis Consulting LTD, London, United Kingdom*

Keywords: Osteoarthritis, Osteoarthritis

Motivation: Osteoarthritis (OA) leads to cartilage degradation and pain, impacting patients' lives. MRI allows detailed cartilage assessment; however, limited sensitivity hinders early-phase clinical trials developing disease-modifying treatments.

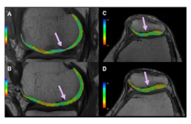
Goal(s): To apply 3D cartilage surface mapping in a homogeneous patient group over 12 months.

Approach: Combined morphological and compositional cartilage MRI with 3D surface-based analysis to assess longitudinal changes within patients with mild OA.

Results: Bi-directional cartilage thickness, T1ρ, and T2 alterations exceeding measurement errors were observed after 12 months. Medial femorotibial cartilage thinned, while lateral tibial cartilage thickened. Cartilage thickness changes correlated negatively with T1ρ and T2 changes in tibial and patellar cartilage.

Impact: The results and methods presented can improve understanding of early structural and compositional changes in cartilage, monitoring disease progression and assessing the effectiveness of therapeutic interventions in OA.

0515 14:30 [Longitudinal assessment of autologous knee chondrocyte implantation using DL T2 Mapping and DOSMA framework]



Laura Carretero[1,2], Maggie Fung[3], Bruno Astuto A. Nunes[4], Rupsa Bhattacharjee[5], Valentina Pedoia[5], Sharmila Majumdar[5], Akshay Chaudhari [6], Arjun Divyang Desai[6], Feliks Kogan[6], Elena Rodríguez[7], Juan Manuel López-Alcorocho[7], Eugenia Sánchez[7], Isabel Guillén[7], Pedro Guillén[7], Florian Wiesinger[1], Norberto Malpica[2], and Mario Padrón[7]

[1]*GE HealthCare, Munich, Germany,* [2]*LAIMBIO, Rey Juan Carlos University, Madrid, Spain,* [3]*GE HealthCare, New York, NY, United States,* [4]*GE HealthCare, San Ramon, CA, United States,* [5]*Department of Radiology and Biomedical Imaging, University of California, San Francisco (UCSF), San Francisco, CA, United States,* [6]*Radiology, Stanford University, Stanford, CA, United States,* [7]*Clinica CEMTRO, Madrid, Spain*

Keywords: Cartilage, Quantitative Imaging

Motivation: Clinical adoption of quantitative MRI for cartilage repair monitoring is hindered by a lack of standardization in acquisition and tedious image analysis.

Goal(s): Our goal was to longitudinally assess high-density autologous chondrocyte implantation (HD-ACI) in the knee using a fast and robust DL T2 mapping technique, correlating with clinical outcome.

Approach: 15 HD-ACI patients (treated in femoral/patellar compartments) were longitudinally imaged and processed with a semi-automated pipeline, enabling a standardized regional analysis at a layer level.

Results: DL T2 map reflected longitudinal significant changes in deep layer. Significant T2 decrease in femoral HD-ACI within the first follow-up year, correlated with good clinical progression.

Impact: The demonstrated feasibility of DL T2 mapping coupled with a semi-automatic analysis to monitor changes after HD-ACI repair, allows for further investigation of the underlying biology of quantitative findings; advancing its adoption as cartilage healing biomarker in the clinical setting.

0516 14:42

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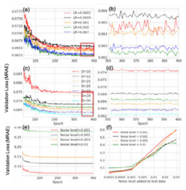


Fine-Tuning Deep Learning Model For Quantitative Knee Joint Mapping with MR Fingerprinting

Xiaoxia Zhang[1,2], Marcelo V.W. Zibetti[1,2], Hector L.de Moura[1,2], Anmol Monga[1,2], and Ravinder R. Regatte[1,2]

[1]*Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States,* [2]*Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States*

Keywords: Cartilage, MR Fingerprinting, Knee cartilage, Deep learning

Motivation: Estimating MRF quantitative parameters with neural networks (NNs) is faster than dictionary-matching methods (DMs), and it has the advantage of providing continuously distributed parameters.

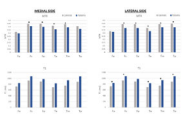
Goal(s): We investigate different aspects of NN training and evaluate its quantitative MRF performance and compare them with DMs.

Approach: We exploit how training data sizes, noise levels, and SVD compression sizes affect the MRF performance of the NNs and compare them with DMs.

Results: The NN provides a faster way of multi-parametric mapping from NIST/ISMRM phantom and knee joint MRF data sets with comparable performance to DMs.

Impact: Well-tuned NN is much more efficient for quantitative MRF, particularly for the knee joint. Besides computational speed, fine-tuning can also increase the performance and robustness to noise.

0517 14:54



Quantitative MRI of cartilage in ACL reconstructed patients using 3D ultrashort echo time T1 (UTE-T1) and magnetization transfer ratio (UTE-MTR)

Bhavsimran S Malhi[1], Livia T Silva[1], Melissa L Silva[1], Jiyo S Athertya[1], Dina Moazamian[1], Yajun Ma[1], Saeed Jerban[1], Eric Y Chang[1], Susan V Bukata[1], Dana C Covey[1], Christine B Chung[1], and Jiang Du[1]

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

Keywords: Cartilage, Quantitative Imaging

Motivation: Post traumatic osteoarthritis is a common complication of ACL injury. There is limited research on the early degenerative changes in cartilage of ACL injured knees.

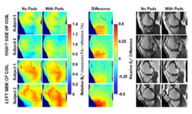
Goal(s): To develop novel biomarkers for identifying early cartilage damage in ACL reconstructed knees.

Approach: We employed ultrashort echo time magnetization transfer ratio (UTE-MTR) and UTE-T1 sequence to study the knee articular cartilage in ACL reconstructed patients.

Results: UTE-T1 and UTE-MTR can be used as quantitative biomarkers for assessing cartilage damage. Reduced MTR and increased T1 values indicate cartilage damage which is otherwise not appreciated on morphological imaging.

Impact: UTE-T1 and UTE-MTR sequences can detect early cartilage damage, which could help us better understand the development of post-traumatic osteoarthritis.

0518 15:06 [B1+ Inhomogeneity Correction with Dielectric Padding for Improved MR T2 and T1ρ Quantification in Knee Cartilage and Meniscus at 7 Tesla]



Stefan Zbyn[1,2,3], Richard Lartey[1,2], Ahmet H. Ok[1,3], Jeehun Kim[1,2], Ajay Nemani[4], Carl S. Winalski[1,2,3], and Xiaojuan Li[1,2,3]

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Keywords: Cartilage, Cartilage, Osteoarthritis, High-Field MRI, Quantitative Imaging, Relaxometry

Motivation: MR T2 and T1ρ mapping showed great promise for reliable detection and follow-up of knee osteoarthritis, however, $B1^+$ inhomogeneities in knee 7T MRI often lead to signal loss and biased quantification.

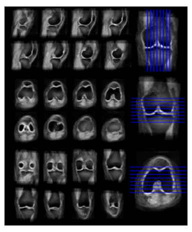
Goal(s): Present study therefore evaluates the effect of high-permittivity dielectric padding on the $B1^+$ field distribution and the reproducibility of T2 and T1ρ quantification in knee cartilage and meniscus.

Approach: Twelve subjects received scan-rescan at 7T to quantify B0, $B1^+$, T2, T1ρ, and reproducibility changes associated with dielectric padding.

Results: Dielectric pads positioned over tibia showed improved $B1^+$ homogeneity and reproducibility of T2 and T1ρ quantification in cartilage and meniscus at 7T.

Impact: Improved reproducibility of T2 and T1ρ MRI in cartilage and meniscus with dielectric padding at 7T could facilitate its clinical translation at ultra-high field and improve patient's follow-up for the noninvasive evaluation of new prevention and treatment strategies for osteoarthritis.

0519 15:18 [The Association of Cartilage Volume with Knee Pain in Osteoarthritis: An Atlas-Based vs Native Approach]



Edward J Peake[1,2] and Dorothee P Auer[1,2]

[1]NIHR Nottingham Biomedical Research Centre, University of Nottingham, Nottingham, United Kingdom, [2]Radiological Sciences, Mental Health and Clinical Neuroscience, School of Medicine, University of Nottingham, Nottingham, United Kingdom

Keywords: Cartilage, Cartilage

Motivation: This research investigates the limited association between cartilage volume and knee pain in osteoarthritis, potentially confounded by anatomical variability.

Goal(s): To enhance the correlation between MRI-derived cartilage volumes and Western Ontario and McMaster Universities Osteoarthritis (WOMAC) pain scores using a knee atlas for image registration.

Approach: Using data from the Osteoarthritis Initiative, MRIs of subjects with OA were registered to an anatomical template. The atlas-based measurements were compared with traditional methods to assess the impact on correlation with WOMAC pain scores.

Results: Atlas registration resulted in more consistent cartilage volume measures, reducing variability, and doubling the correlation with WOMAC pain scores.

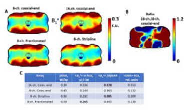
Impact: In knee osteoarthritis the registration of MRIs to an anatomical template significantly increases the association between cartilage volumes and osteoarthritis pain scores, enabling more accurate and sensitive detection of pain-related cartilage changes, potentially influencing OA management and therapy development.

Oral

Ultra-Challenging Ultra-High Field Applications

Nicoll 2 | Tuesday 13:30 - 15:30 | *Moderators:* Maxim Zaitsev & Lukas Winter

0520 13:30



Toward Densely Populated Dipole Arrays for Human Prostate Imaging at 7T: 8Tx16Rx Coaxial-End Dipole Array

Georgiy Alekseevich Solomakha[1], Markus May[2,3], Oliver Kraff[2], Klaus Scheffler[1,4], Harald Quick[2,3], and Nikolai Ivanovich Avdievich [1]

[1]High-Field MR Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Duisburg-Essen, Essen, Germany, [3]High-Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany, [4]Department for Biomedical Magnetic Resonance, University of Tübingen, Tuebingen, Germany

Keywords: RF Arrays & Systems, Body, Dipoles, Arrays, RF-shimming, SNR, SAR

Motivation: To improve SNR and the SAR-performance in prostate imaging at 7T using a densely populated coaxial-end dipole array.

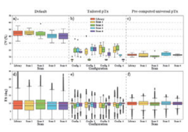
Goal(s): To numerically optimize and evaluate an 8Tx/16Rx coaxial-end dipole array for prostate imaging at 7T.

Approach: Geometry of a coaxial-end element was optimized to minimize peak SAR and improve coverage. In transmission, 16 coaxial-end dipoles were combined into 8 pairs. This further reduced pSAR. 8-element fractionated dipole and stripline arrays were simulated for comparison.

Results: Optimized 8Tx/16Rx coaxial-end dipole array improved SNR in prostate compared to all other 8-element arrays. SAR-performance of the developed array was better than that of other dipole arrays.

Impact: We demonstrated that densely populated 16-element coaxial-end dipole array improved SNR in the prostate by at least 10% compared to 8-element arrays. In addition, combining 16 elements in 8 pairs during transmission improved SAR-performance in comparison to the 8-channel array.

0521 13:42



Reproducibility of tailored and universal non-selective excitation pulses at 7T for human cardiac body imaging: A 3-year and an inter-day study

Manuel Fernando Sánchez Alarcón[1,2], Sebastian Dietrich[1], Jean Pierre Bassenge[1,2], Jeanette Schulz-Menger[2], Sebastian Schmitter[1,3,4], and Christoph Stefan Aigner[1]

[1]Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany, [2]Charité – Universitätsmedizin Berlin, Berlin, Germany, [3]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

Keywords: RF Pulse Design & Fields, High-Field MRI, Reproducibility, Universal pulse, 7T, pTx

Motivation: Addressing the issue of reduced spatial variability in flip angle (FA) patterns in ultra-high field 3D imaging of the human heart for inter-year and inter-day studies, ensuring a high level of reproducibility.

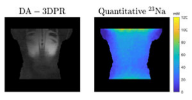
Goal(s): Find the correct RF parallel transmission (pTx) excitation scheme that reduces FA spatial variability in 7T 3D imaging of the human heart for long-term and short-term studies.

Approach: Default, tailored pulses (TP), and pre-computed universal pulses (UP) were evaluated to optimize FA homogeneity in B_1^+ datasets across three years.

Results: The study highlights UPs' robustness in managing FA variations across subjects and coil placements in 3D body imaging at 7T.

Impact: This study confirms pre-computed UPs' suitability for 7T cardiac flip angle homogenization. Different MRI operators maintained consistent RF performance across three years and inter-day tests, with no significative differences in scans at various coil positions for both tests.

0522 13:54



Quantitative Abdominal Sodium MRI Combined with 32-Channel Proton pTx MRI at 7T in a Large Field-of-View

Anna K. Scheipers[1,2], Stephan Orzada[1], Johannes Grimm[1,2], Jana Losch[1,2], Thomas M. Fiedler[1], Armin M. Nagel[1,3], Sebastian Schmitter[1], Mark E. Ladd[1,2,4], and Tanja Platt[1]

[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Faculty of Physics and Astronomy, Heidelberg University, Heidelberg, Germany, [3]University Hospital Erlangen, Institute of Radiology, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany, [4]Faculty of Medicine, Heidelberg University, Heidelberg, Germany

Keywords: High-Field MRI, Quantitative Imaging, 23Na, Sodium, parallel transmit (pTx), TIAMO, tissue sodium concentration (TSC), 7T whole-body coils, Body, Data Acquisition, High-Field MRI, Hybrid & Novel Systems Technology, Kidney, Liver, Multi-Contrast, Non-Proton, Whole Body

Motivation: ^{23}Na MRI enables the quantification of the tissue sodium concentration. A large field-of-view is beneficial for abdominal MRI, especially if several organs are of interest. Due to lower resolution compared to ^{1}H MRI, ^{23}Na MRI is less suited for segmentation.

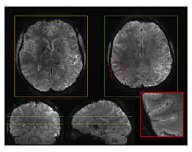
Goal(s): To combine large field-of-view ^{1}H and quantitative abdominal ^{23}Na MRI in the same position at 7T.

Approach: Employing a custom-built ^{23}Na radiofrequency coil and reference vial setup together with a 32-channel proton pTx array to allow dual-nuclei MRI in the same position.

Results: Combination of large field-of-view ^{1}H and quantitative ^{23}Na MRI of the human torso is feasible at 7T in ≤42min.

Impact: This work shows the feasibility of combined ^{1}H and ^{23}Na imaging at 7T in a large field-of-view both under free breathing, laying the ground work for an accurate evaluation of the tissue sodium concentration in several organs at once.

0523 14:06



Opening new horizons with the first human brain in vivo experiments at 11.7T

Franck Mauconduit[1], Vincent Gras[1], Alexis Amadon[1], Aurelien Massire[2], Caroline LeSter[1], Denis Le Bihan[1], Michel Luong[3], Michel Bottlaender[4], Alexandre Vignaud[1], and Nicolas Boulant[1]

[1]University Paris-Saclay, CEA, CNRS, BAOBAB, NeuroSpin, Gif-sur-yvette, France, [2]Siemens Healthcare SAS, Courbevoie, France, [3]IRFU, CEA, Gif-sur-yvette, France, [4]University Paris-Saclay, CEA, Uniact, NeuroSpin, Gif-sur-yvette, France

Keywords: High-Field MRI, High-Field MRI

Motivation: Ultra-high magnetic field MRI offers new opportunities due to its higher SNR and CNR.

Goal(s): After receiving the authorization for scanning 20 adult healthy volunteers on the whole-body Iseult MRI scanner, we performed a preliminary MRI investigation to acquire the first brain images at 11.7T.

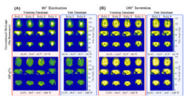
Approach: Using a homemade multi-transmit multi-receive head coil and parallel transmission, 3D anatomical images were acquired with multiple sequences and tissue contrasts at high resolution.

Results: In this study, high quality whole brain images acquired at 11.7T on the Iseult MRI scanner are presented for the first time to the MR community.

Impact: Showing for the first time in vivo brain images acquired at 11.7T on the whole-body Iseult MRI scanner, this study reveals first potential and challenges of such systems to the ultra-high field MR community.

0524 MERIT AWARD MAGNA CUM LAUDE

14:18



[Universal Design of Multiphoton Parallel Transmission (MP-pTx) Pulses for Uniform, High-Flip Angle Excitations]

John M Drago[1,2,3], Bastien Guerin[2,3], and Lawrence L Wald[2,3,4]

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Keywords: High-Field MRI, Brain

Motivation: Contrast in high-field MRI is complicated by the spatially non-uniform transmission profile of birdcage coils.

Goal(s): We create “universal” pulses for spatially-uniform excitations using multiphoton parallel transmission (MP-pTx).

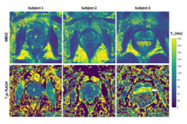
Approach: MP-pTx operates a B_z shim array in the kHz range to supplement birdcage excitation. We extend this framework to arbitrary flip angles and a universal design (a population of B_1^+ and ΔB_0 maps) using spinor-domain, Bloch dynamics representation.

Results: Universal MP-pTx pulses have 11.3%, and 16.3% flip angle NRMSE for 90º and 180º pulses played on test subjects not used for training, compared to 24.5% and 25.3% with conventional birdcage.

Impact: Universal MP-pTx pulses will allow users to mitigate flip angle inhomogeneity present in the brain at 7 T using precomputed pulses without SAR concerns beyond that of a conventional birdcage transmit coil or subject-specific calculations.

0525

14:30



[T2 Mapping of the Prostate at 7 Tesla: A Feasibility Study]

Gabriele Bonanno[1,2,3], Bernd Jung[3,4], Roland Kreis[2,3], Sebastian Schmitter[5,6,7], Verena C Obmann[3,4], Tobias Kober[8,9,10], and Tom Hilbert[8,9,10]

[1]*Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Bern, Switzerland, Bern, Switzerland,* [2]*Magnetic Resonance Methodology, Institute of Diagnostic and Interventional Neuroradiology, University of Bern, Bern, Switzerland, Bern, Switzerland,* [3]*Translational Imaging Center (TIC), Swiss Institute for Translational and Entrepreneurial Medicine, Bern, Switzerland, Bern, Switzerland,* [4]*Dept. of Diagnostic, Interventional and Pediatric Radiology, Inselspital, Bern University Hospital, Switzerland, Bern, Switzerland,* [5]*Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, Berlin, Germany,* [6]*Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, Heidelberg, Germany,* [7]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, Minneapolis, MN, United States,* [8]*Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland, Lausanne, Switzerland,* [9]*Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, Lausanne, Switzerland,* [10]*LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, Lausanne, Switzerland*

Keywords: High-Field MRI, Prostate

Motivation: T_2 relaxometry has shown potential to distinguish cancer from prostate tissue at 3T. Despite potential gains in resolution, it has been little explored at ultra-high field due to challenging B_1^+ homogeneity and efficiency.

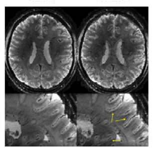
Goal(s): To investigate feasibility of prostate T_2 mapping at 7T using a robust RF shimming procedure.

Approach: We evaluated conventional 2D multi-echo spin echo and an optimized 3D T_2-prepared segmented-FLASH sequence.

Results: Spin-echo T_2 maps showed good quality but required long acquisition times for limited coverage. The T_2-prepared FLASH sequence showed similar values while providing higher scan efficiency, lower SAR, and whole-organ coverage at the cost of higher motion sensitivity.

Impact: Quantitative T_2 mapping at ultra-high field is challenging due to acquisition time and SAR restrictions, especially in the pelvic area. The methods investigated here may be used in future routine to detect and grade prostate cancer.

0526 14:42



[Motion-robust high-resolution multi-echo 3D gradient echo imaging of the human brain at 10.5 tesla using 80 receive channels]

Jiaen Liu[1,2], Peter van Gelderen[3], Jacobus de Zwart[3], Jeff Duyn[3], Andrea Grant[4], Edward Auerbach[4], Matt Waks[4], Russell Lagore[4], Lance Delabarre[4], Alireza Sadeghi Tarakameh[4], Yigitcan Eryaman[4], Gregor Adriany[4], Kamil Ugurbil[4], and Xiaoping Wu[4]

[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [2]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [3]Advanced MRI section, NINDS, NIH, Bethesda, MD, United States, [4]CMRR, Radiology, Medical School, University of Minnesota, Minneapolis, MN, United States

Keywords: High-Field MRI, High-Field MRI, multi-parametric mapping; motion and field correction

Motivation: There is an increasing interest in T_2^*-related contrast at ultrahigh field for increased signal-to-noise and contrast-to-noise ratios.

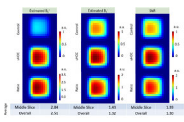
Goal(s): To demonstrate the feasibility and utility of high-resolution T_2^*-weighted brain MRI at 10.5 tesla by combining a motion-robust multi-echo gradient-echo method with a high-channel-count RF coil.

Approach: Images were collected at 0.5-mm isotropic resolution using a custom 80-channel receive (80Rx) coil and used for quantitative R_2^* and susceptibility mapping.

Results: Our method effectively eliminated artifacts from motion, producing quality images and multi-parametric maps. Parallel imaging performance was improved using the 80Rx coil relative to the commercial 7-tesla Nova 32Rx coil.

Impact: The demonstrated feasibility and utility of motion-robust high-resolution multi-echo gradient echo imaging in humans at 10.5 tesla may shed light on future optimal implementation of anatomic T_2^*-weighted brain MRI at ultrahigh field, paving the way for many neuroscience applications.

0527 14:54



[Remarkably enhanced B1 and SNR with uHDC ceramics integrated with novel RF transreceiver array for 2H, 17O, and 1H imaging of human brain at 10.5T]

Soo Han Soon[1,2], Matt Waks[1], Xin Li[1], Hannes M. Wiesner[1], Xiao-Hong Zhu[1], and Wei Chen[1,2]

[1]Center of Magnetic Resonance Research (CMRR), Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Department of Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States

Keywords: RF Arrays & Systems, Parallel Transmit & Multiband, High Permittivity Material (HPM), ultrahigh Dielectric Constant (uHDC) Material, MRSI, UHF, Ultrahigh field, Broadband RF Coil

Motivation: ^{2}H and ^{17}O MRSI are useful to study brain energy metabolism, however, have low imaging sensitivity.

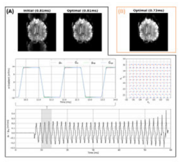
Goal(s): To develop a RF coil engineering solution offering superior performance for human brain ^{1}H MRI, ^{2}H and ^{17}O MRSI at UHF.

Approach: We constructed a novel RF transreceiver array coil, which can operate at ^{1}H, ^{2}H and ^{17}O resonant frequencies at 10.5T. The integration of ultrahigh dielectric constant (uHDC) ceramics enhanced RF transmission field (B_1^+) and SNR.

Results: The new array coil functioned well for performing multinuclear imaging, and the integrated uHDC technology remarkably enhanced B_1^+ and SNR for performing ^{2}H and ^{17}O MRSI.

Impact: In this study, we introduce and demonstrate an advanced RF array coil integrated with the uHDC material enabling imaging of three important nuclei (^{1}H, ^{2}H and ^{17}O) signals with superior performance aiming for human brain applications at UHF of 10.5T.

0528 15:06



[Non-idealized system (NIS) optimization of EPI sequences at ultra-high field.]

Daniel West[1], Felix Glang[2], Jonathan Endres[3], David Leitão[1], Sarah McElroy[4], Moritz Zaiss[2,3,5], Jo Hajnal[1,6], and Shaihan Malik[1,6]

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Keywords: System Imperfections, Pulse Sequence Design

Motivation: MRI scanners are built under the assumption of near perfect responses of each subsystem. Computing advances mean that this may no longer be necessary, enabling exploration of cheaper, efficient alternatives.

Goal(s): To allow high-performance scanning with less emphasis on hardware performance, reducing costs and improving access.

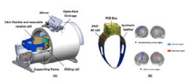
Approach: We consider non-idealized system optimization where hardware imperfections are built into a forward model used to optimize pulse sequences via the MR-zero framework. We experimentally demonstrate NIS using measured GIRFs from a 7T system to optimize EPI sequences.

Results: NIS optimization produces sequences that substantially reduce image artefacts even for scenarios that previously exceeded hardware constraints.

Impact: NIS optimization embraces gradient system imperfections, discovering novel acquisition strategies to inherently mitigate them. Although demonstrated on a state-of-the-art 7T scanner, the concept of including imperfections directly into sequence design offers a means to maximize performance of any scanner hardware.

0529 15:18

MERIT AWARD MAGNA CUM LAUDE



[Design of an Open-transmit / 24-channel flexible receiver head coil for MRI/fMRI of somatosensory and motor cortex at 5T]

Zidong Wei[1,2,3], Zhilin Zhang[4], Qiaoyan Chen[1,3], Cuiting Wang[2], Xiaoliang Zhang[5], Xin Liu[1,3], Jinglong Wu[4], Hairong Zheng[1,3], and Ye Li[1,3]

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Keywords: High-Field MRI, High-Field MRI

Motivation: Functional magnetic resonance imaging (fMRI) is a non-invasive in vivo functional mapping technique, which afforded a high-quality glimpse of the cortex.

Goal(s): Sampling brain activity across cortical layers by using proposed RF coil

Approach: The Open-Face birdcage coil was designed by removing and adjusting the legs of the 16-rung high-pass birdcage coil. The 24ch flexible receive array was designed for high spatiotemporal-resolution MRI/fMRI at cortical region.

Results: In this study, we designed and constructed an open-transmit and 24 channel flexible receiver head coil assembly for human somatosensory and motor cortex in vivo cortical imaging on a whole body 5T scanner.

Impact: SNR maps, T2* weighted images and fMRI images were acquired with the proposed coil assembly, which were compared with those using a quadrature birdcage transmit/48-channel receiver coil assembly.

Oral

BOLD Characteristics: Of Mice & Men

Nicoll 3 | Tuesday 13:30 - 15:30 | *Moderators:* Natalia Petridou & Zhifeng Liang

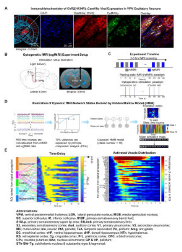
13:30 Introduction

Natalia Petridou

UMC Utrecht, Netherlands

0530 13:42

MERIT AWARD SUMMA CUM LAUDE



Single-pulse optogenetic perturbation of thalamo-cortical networks reveals functional architecture of rsfMRI networks

Linshan Xie[1,2], Xunda Wang[1,2], Xuehong Lin[1,2], Teng Ma[1,2,3], Junjian Wen[1,2], Peng Cao[3], Alex T L Leong[1,2], and Ed X Wu[1,2,4]

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Keywords: Functional Connectivity, fMRI (resting state), functional connectivity, neuroscience, brain connectivity

Motivation: A current overarching challenge in neuroscience is to establish an integrated understanding of brain circuits and networks, particularly the interactions of neural populations across various spatiotemporal scales that give rise to functions and behavior.

Goal(s): We posit that dissecting rsfMRI dynamics under direct single-pulse optogenetic modulation of thalamo-cortical networks will reveal critical insights into the functional architecture of rsfMRI networks.

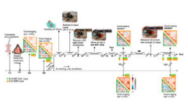
Approach: We deployed a computational approach (i.e., Gaussian PCA-HMM) to examine the organization of rsfMRI networks before and upon single-pulse stimulation of thalamus.

Results: We demonstrated a significant role of the basal forebrain and hypothalamus in regulating the transient dynamics of rsfMRI networks.

Impact: The ability to directly perturb and model dynamics of rsfMRI networks present an unprecedented opportunity to understand brain-wide and higher-order circuits/networks, and their functions, which are difficult to probe using traditional behavioral and/or cognitive tasks and other neuroimaging approaches.

0531 13:54

MERIT AWARD MAGNA CUM LAUDE



Biphasic training for awake imaging using a dual-imaging system reveals neurovascular uncoupling and anesthesia effects in healthy mice

Francesca Mandino[1], Xilin Shen[1], Gabriel Desrosiers-Gregoire[2], David O'Connor[1], Bandhan Mukherjee[1], Yonghyun Ha[1], An Qu[1], John Onofrey[1], Xenophon Papademetris[1], Mallar Chakravarty[2], Stephen M Strittmatter[1], and Evelyn Lake[1]

[1]Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [2]McGill, Montreal, QC, Canada

Keywords: Small Animals, Brain Connectivity, awake rodent imaging

Motivation: Most of rodent-fMRI is acquired under anesthesia, to minimize motion and stress. However, anesthesia hinders mouse-to-human translatability, since most of human fMRI is conducted whilst awake.

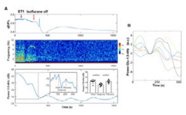
Goal(s): Here we aim to develop a biphasic protocol for conducting awake rodent-fMRI in mice and simultaneously recording mesoscopic calcium imaging data.

Approach: The animals undergo a first training and a refresher a few weeks later. Brain function is analyzed in simultaneous fMRI and mesoscopic calcium imaging measurements.

Results: Having a refresher training improves motion in the scanner. The two measures of brain function show interesting patterns over time, with partial agreement and some clear disagreement.

Impact: Rodent-fMRI is typically done under anesthesia to minimize stress and motion. This limits mouse-human translatability (since humans are usually scanned awake). Here, we develop a biphasic approach to train mice to awake imaging, using simultaneous fMRI and Calcium imaging measures.

0532 14:06



The application of multi-modal fMRI to investigate coma induction induced by Endothelin-driven brainstem injury

Weitao Man[1,2], Xiaochen Liu[1], Zeping Xie[1], Lidia Gomez-Cid[1], Yuanyuan Jiang[1], and Xin Yu[1]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Department of Neurosurgery, Beijing Tsinghua Changgung Hospital, School of Clinical Medicine, Tsinghua University, Beijing, China

Keywords: Functional Connectivity, Brain Connectivity

Motivation: This study aimed to create a reproducible coma animal model and develop neuroimaging techniques to illustrate underlying mechanisms during coma induction.

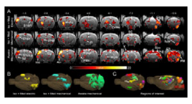
Goal(s): To investigate brain dynamic changes during coma induction and to identify the key regulatory brain regions involved in the process.

Approach: We induced a brainstem coma in rats, optimizing surgical procedures and utilizing multi-modal fMRI techniques. We recorded Glu signals and BOLD fMRI simultaneously during coma induction.

Results: The study revealed specific Glu-oscillations before coma induction and identified certain subcortical nuclei as potential key regulatory brain regions for inducing coma. These findings could enhance our understanding of coma-related brain state changes.

Impact: The optimized coma model and multi-modal imaging techniques in this study offer a deeper understanding of coma dynamics. The identification of specific regulatory brain regions and Glutamate oscillations may pave the way for improved clinical strategies and patient outcomes.

0533 14:18



Whisker pad stimulation elicits brain-wide cross-sensory activation in awake rats measured with zero echo time fMRI

Jaakko Paasonen[1], Juha Valjakka[1,2], Raimo A Salo[1], Ekaterina Paasonen[1], Shalom Michaeli[2], Silvia Mangia[2], and Olli Gröhn[1]

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Keywords: Task/Intervention Based fMRI, fMRI (task based), awake, rat, multisensory

Motivation: Sensory research has typically focused on one system at a time, and basic mechanisms related to interactions between sensory systems remain poorly understood.

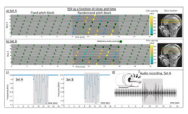
Goal(s): To detect and characterize brain-wide cross-sensory interplay, and to study how non-core circuits react to varying input into the core circuit.

Approach: Classical whisker pad stimulation in head-fixed awake and anesthetized rats in combination with a large number of fMRI measurements.

Results: We detected cross-sensory brain-wide activations to whisker pad stimulation. The activation profile of many non-core regions differed from that of the core circuit. Importantly, some features of cross-sensory interplay were not visible under anesthesia.

Impact: Cross-sensory activations are gaining increasing attention in imaging studies. Previously, multisensory interplay may have gone unnoticed, as the focus has been in the primary pathway. Our results also emphasize the importance of avoiding anesthesia in preclinical cross-sensory research.

0534 14:30 [Bebop-EPI (BEeping BOld Pulse sequence) – employing inherent acquisition acoustics to generate auditory stimuli for auditory fMRI]



Rita Schmidt[1] and Amir Seginer[2]

[1]Department of Brain Sciences, Weizmann Institute of Science, Rehovot, Israel, [2]Life Sciences Core Facilities, Weizmann Institute of Science, Rehovot, Israel

Keywords: fMRI Acquisition, fMRI (task based), Auditory stimuli

Motivation: With improved scanning methods and SNR, auditory response studies in functional MRI require well-defined stimuli but are encumbered by the acoustic noise from the acquisition gradients and by the temporal inaccuracy of the external audio source.

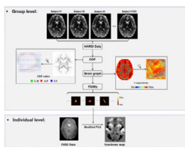
Goal(s): Our goal was to use the acoustic noise generated by the MRI gradients to circumvent an external source for auditory fMRI.

Approach: We implemented BEBOP (BEeping BOld Pulse sequence) EPI which enables varying the echo spacing, and thus pitch, per slice and per repetition and so provides a platform for auditory fMRI.

Results: An fMRI feasibility study at 7T was successfully implemented, measuring auditory-motor responses.

Impact: We demonstrated a new approach that simultaneously generates auditory stimuli and measures their BOLD response. The new approach offers high temporal accuracy of the auditory tasks due to the MRI gradients' high temporal precision.

0535 14:42 [Measure the synchrony of fMRI signals on group-averaged fiber architectures]



Yuhao Chen[1,2], Luying Li[3], Huilou Liang[4], Miaoqi Zhang[4], Wenjing Zhang[1,2], Su Lui[1,2], Zhipeng Yang[3], and Yu Zhao[1,2]

[1]Department of Radiology and Huaxi MR Research Center (HMRRC), Functional and Molecular Imaging Key Laboratory of Sichuan Province, West China Hospital, Sichuan University, Chengdu, Sichuan, China, [2]Research Unit of Psychoradiology, Chinese Academy of Medical Sciences, Chengdu, Sichuan, China, [3]College of Electronic Engineering, Chengdu University of Information Technology, Chengdu, Sichuan, China, [4]GE HealthCare MR Research, Beijing, China

Keywords: fMRI Analysis, Data Analysis, Synchrony

Motivation: Fiber architecture-informed synchrony mapping (FAISM) has been proposed to capture task-evoked nonlinear brain activations, which involves image acquisitions of fMRI and high angular resolution diffusion image MRI (HARDI) with a long scan time and thus limits its applications.

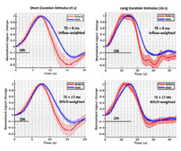
Goal(s): The aim of this study is to modify the FAISM approach to mapping brain activation without time-consuming acquisitions of the HARDI data.

Approach: Hence, group-averaged fiber structures were used to replace the individual data to perform a fast FAISM.

Results: This approach demonstrates a high reproducibility at an individual level, which suggests that it can be used for reliable detections of nonlinear brain activation.

Impact: This approach is expected to serve as a standardized tool to measure neural activations with nonlinear hemodynamic responses.

0536 14:54



Investigating timing of BOLD fMRI responses in individual cortical vessels to short and long stimulus durations

Divya Varadarajan[1,2], Sebastien Proulx[1,2], Paul Wighton[1,2], Zhangxuan Hu[1,2], Jingyuan E Chen[1,2], Saskia Bollmann[3], Avery J. L. Berman[4], and Jonathan R. Polimeni[1,2,5]

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Keywords: fMRI Acquisition, fMRI, Vessels, Vascular, Gray Matter, Oxygenation, fMRI (task based), fMRI Acquisition, fMRI Analysis, Hemodynamics

Motivation: Typical fMRI data observes hemodynamics from multiple vascular compartments in each voxel, however understanding the link between neuronal and vascular dynamics will require vessel-specific measurements.

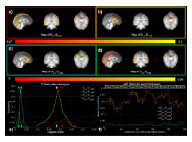
Goal(s): To investigate the timing and amplitude of hemodynamic responses within individual arteries and veins of the human cortex and assess how they change with stimulus duration.

Approach: We applied single-vessel fMRI with multiple echoes to separate inflow and BOLD components, and distinguished intravascular and extravascular dynamics in and around arteries and veins.

Results: We observed faster dynamics in arteries, and a post-stimulus undershoot in all vessels, potentially providing new insights into hemodynamics in the human brain

Impact: Knowledge about hemodynamics within individual vascular compartment is provided by invasive microscopy in small-animal models, and less is known about hemodynamics in humans. Here we present vessel-specific measurements of hemodynamics in humans and reveal unexpected features in the fMRI response.

0537 15:06



Assessment of the macrovascular contribution to resting-state fMRI functional connectivity at 3 Tesla

Xiaole Zhong[1,2], Yunjie Tong[3], and J. Jean Chen[1,2,4]

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Keywords: fMRI Analysis, fMRI (resting state)

Motivation: Resting-state fMRI (rs-fMRI) based functional connectivity (fcMRI) is widely used to image neuronal networks, but it could be biased by the contribution of macrovasculature.

Goal(s): This study aims to provide a better understanding of vascular rs-fMRI contributions and their interpretation.

Approach: Our study evaluated macrovascular contributions to experimental rs-fcMRI data.

Results: We found both arteries and veins to substantially modulate fcMRI metrics. We also found that vascular-driven fcMRI spatial variance was disproportionately high given the low vascular voxel count. In particular, veins contribute more to connectivity strength than arteries, while arteries contribute more to spatial variance than veins.

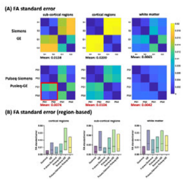
Impact: The macrovasculature was previously shown to modulate functional connectivity and reduce its neuronal specificity, but a systematic analysis is still lacking. This study demonstrates macrovascular contributions at 3 Tesla and paves the way for the correction of bias in rs-fMRI.

Oral

Quality Methods & Approaches for Multi-Site Studies

Room 325-326 | Tuesday 13:30 - 15:30 | *Moderators:* Penny Hubbard Cristinacce & Nandita DeSouza

0538 13:30



Improved across-scanner reproducibility using vendor-agnostic diffusion sequences

Qiang Liu[1,2], Lipeng Ning[1], Imam Ahmed Shaik[1], Borjan Gagoski[3], Berkin Bilgic[4,5], William Grissom[6], Jon-Fredrik Nielsen[7], Maxim Zaitsev[8], and Yogesh Rathi[1]

[1]Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States, [2]School of Biomedical Engineering, Southern Medical University, Guangzhou, China, [3]Fetal-Neonatal Neuroimaging and Developmental Science Center, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States, [4]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [5]Department of Radiology, Harvard Medical School, Boston, MA, United States, [6]Department of Biomedical Engineering, Case School of Engineering, Case Western Reserve University, Cleveland, OH, United States, [7]fMRI Laboratory and Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [8]Division of Medical Physics, Department of Radiology, University Medical Center Freiburg, Freiburg, Germany

Keywords: Diffusion Acquisition, Diffusion Tensor Imaging

Motivation: The reproducibility of diffusion MRI (dMRI) data collected at multiple sites can be affected by differences between MRI scanners, especially scanners from different manufacturers.

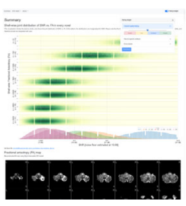
Goal(s): To develop vendor-neutral dMRI pulse sequences using our *Pulseq* development platform and reduce the inter-scanner variability between scanners from different vendors.

Approach: Using a diffusion phantom and with three human subjects, we tested inter-scanner variability using *Pulseq* and vendor-specific product sequences. We report inter-scanner variations using standard error for mean diffusivity and fractional anisotropy.

Results: *Pulseq* sequence yielded dramatically better results (>2x reduction in variability) enhancing the reliability of dMRI measurements across scanners.

Impact: The vendor-neutral *Pulseq*-diffusion sequence has the potential to harmonize data acquisition and improve the robustness of diffusion MRI, making it an invaluable tool for advancing multi-site studies.

0539 13:42



Harnessing QA/QC protocols for diffusion MRI neuroimaging workflows with MRIQC

Teresa Gomez[1], Yibei Chen[2], Céline Provins[3], Christopher J Markiewicz[4], Ariel Rokem[1], and Oscar Esteban[3]

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Keywords: Software Tools, Software Tools, QA/QC

Motivation: Reliable neuroimaging pipelines require the implementation of robust QA/QC protocols.

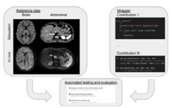
Goal(s): Developing an extension of *MRIQC* for the QA/QC of diffusion MRI data.

Approach: We build on MRIQC's infrastructure to generate individual visual reports of dMRI images and define new image quality metrics (IQMs).

Results: We developed a minimal processing pipeline for whole-brain dMRI data of human adults. The processing pipeline generates individual visual reports for the QA of unprocessed inputs. The pipeline also extracts IQMs to train automated decision-making, following MRIQC's established pattern.

Impact: MRIQC is a widely-adopted tool for the QA/QC of unprocessed MRI data. However, support for dMRI was previously lacking. This MRIQC extension will improve QA/QC of dMRI by bringing it to the highest standards and will facilitate the implementation of rigorous protocols in multimodal neuroimaging.

0540 13:54



[Towards Reproducible Intravoxel Incoherent Motion (IVIM) Analysis: The ISMRM Open Science Initiative for Perfusion Imaging]

Oscar Jalnefjord[1,2], Ivan A. Rashid[3,4], Daan Kuppens[5,6], Merel van der Thiel[7,8], Petra van Houdt[9], Paulien HM Voorter[7,8], Eric T Peterson[10], and Oliver Gurney-Champion[5,6]

[1]Department of Medical Radiation Sciences, Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden, [2]Department of Medical Physics and Biomedical Engineering, Sahlgrenska University Hospital, Region Västra Götaland, Gothenburg, Sweden, [3]Medical Radiation Physics, Department of Translational Medicine, Lund University, Malmö, Sweden, [4]Radiation Physics, Department of Hematology, Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden, [5]Department of Radiology and Nuclear Imaging, Amsterdam UMC location University of Amsterdam, Amsterdam, Netherlands, [6]Imaging and Biomarkers, Cancer Center Amsterdam, Amsterdam, Netherlands, [7]Department of Radiology & Nuclear Medicine, School for Mental Health & Neuroscience, Maastricht University Medical Center, Maastricht, Netherlands, [8]School for Mental Health & Neuroscience, Maastricht University, Maastricht, Netherlands, [9]Department of Radiation Oncology, Netherlands Cancer Institute, Amsterdam, Netherlands, [10]Biosciences, Neuroscience Program, SRI International, Menlo Park, CA, United States

Keywords: Software Tools, Perfusion, Reproducible research

Motivation: Lack of validated and open-source intravoxel incoherent motion (IVIM) post-processing and fitting code is hindering reproducible research, limiting the validation and large-scale roll-out of IVIM imaging.

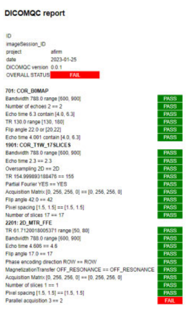
Goal(s): To create an open-source code repository for IVIM-related code.

Approach: Scientists interested in IVIM are encouraged to upload their code to our open-source code repository built by the ISMRM OSIPI task force 2.4, where automated testing and evaluation based on reference data are used to enable quality control of the code.

Results: As of November 2023, 19 code contributions have been submitted by 6 different institutes, all passing automated testing.

Impact: The work of ISMRM OSIPI task force 2.4 enables an open-source platform for validated code relevant to intravoxel incoherent motion (IVIM) imaging, thus reducing duplicate development, improving reproducibility, and serving as a benchmark for future methods.

0541 14:06



[Automated Quality Control for Multi-Vendor, Multi-Centre Renal Imaging Studies]

Alexander J Daniel[1], Martin Craig[1,2], David L Thomas[3,4,5], Iosif Mendichovszky[6,7], Steven Sourbron[8], David M Morris[9], Andrew N Priest[6,7], Charlotte E Buchanan[1], and Susan T Francis[1,2]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Nottingham Biomedical Research Centre, Nottingham University Hospitals NHS Trust and the University of Nottingham, Nottingham, United Kingdom, [3]Neuroradiological Academic Unit, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [4]Dementia Research Centre, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [5]Wellcome Centre for Human Neuroimaging, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [6]Department of Radiology, Addenbrooke's Hospital, Cambridge, United Kingdom, [7]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [8]Department of Infection, Immunity and Cardiovascular Disease, University of Sheffield, Sheffield, United Kingdom, [9]Centre for Cardiovascular Science, University of Edinburgh, Edinburgh, United Kingdom

Keywords: Software Tools, Software Tools, Standardisation, Quality Control

Motivation: It is critical that MRI data acquired in multi-site, multi-vendor studies conforms to a standardised acquisition protocol.

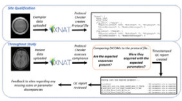
Goal(s): To develop XNAT tools to highlight scans that do not conform to a specified protocol or are of insufficient quality, enabling rapid correction of errors before future scans.

Approach: Multi-site DICOM data is uploaded to XNAT after acquisition, by integrating software tools with this database, investigators are informed if data does not conform.

Results: DICOM-QC, a tool to automatically compare DICOM metadata to predefined values, and ImageSNR-QC to calculate image SNR, applied here to a multi-site kidney study.

Impact: This work outlines two tools that integrate with XNAT, DICOM-QC and ImageSNR-QC, which can be used by any investigators running large studies to ensure uploaded data conforms to the study protocol, ensuring consistency over sites, vendors, and repeated longitudinal scans.

0542 14:18



[A repository-integrated tool for monitoring imaging protocol compliance in a multi-centre whole-body MRI myeloma study]

Sam Keaveney[1,2], Damien J McHugh[3,4], Mihaela Rata[1,2], Alina Dragan[1], Matthew Blackledge[1,2], Erica Scurr[1], Jessica M Winfield[1,2], Dow-Mu Koh[1,2], Simon J Doran[1,2], Michael Berks[4], James PB O'Connor[2,4,5], Alexander King[6], Winston J Rennie[7], Suchi Gaba[8], Priya Suresh[9], Paul Malcolm[10], Amy Davis[11], Anjumara Nilak[12], Aarti Shah[13], Sanjay Gandhi[14], Mauro Albrizio[15], Arnold Drury[16], Guy Pratt[17], Gordon Cook[18,19], Sadie Roberts[18], Andrew Hall[18], Matthew Jenner[6], Sarah Brown[18], Martin Kaiser[20,21], Penny L Hubbard Cristinacce[4], and Christina Messiou[1,2]

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Keywords: Software Tools, Translational Studies, Standardisation, reproducibility, QA/QC, multi-centre studies

Motivation: Standardisation of imaging protocols in multi-centre studies is challenging, which can hamper clinical translation.

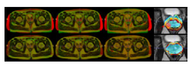
Goal(s): This study aimed to develop and demonstrate a software tool that automatically assesses imaging protocol compliance.

Approach: The tool was containerised and integrated into an imaging repository. It was applied to a dataset from a whole-body MRI (WB-MRI) myeloma study, which included 174 examinations acquired across 10 sites with scanners from three manufacturers.

Results: The software successfully identified some parameters and sites where persistent deviations occurred, although 88% of examinations were conducted according to the relevant clinical guidelines with good overall compliance to site-specific protocols.

Impact: Repository-integrated software is presented for automated monitoring of imaging protocol compliance to support standardisation in multi-centre studies and clinical translation. A multi-centre whole-body MRI study demonstrates good compliance that could have been improved further with proactive monitoring using this tool.

0543 14:30



[Integrated Registration and Harmonization Framework for Quantitative T2-weighted MRI Analysis following Prostate Cancer Radiotherapy]

Evangelia I. Zacharaki[1], Adrian L. Breto [1], Ahmad Algohary [1], Veronica M. Wallaengen[1], Sanoj Punnen [1], Matthew C. Abramowitz [1], Alan Pollack[1], and Radka Stoyanova[1]

[1]University of Miami, Miami, FL, United States

Keywords: Data Processing, Quantitative Imaging, Prostate Cancer

Motivation: The reliable evaluation of T2-weighted MRI (T2w) signal change in prostate cancer following radiotherapy (RT) is challenging due to deformations (physiological and RT-related) and scanner/protocol acquisition variability.

Goal(s): To develop an automated and reproducible methodology for quantification of T2w signal change in longitudinal studies following RT.

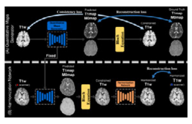
Approach: The methodology includes T2w image intensity harmonization and deformable registration of post-RT to pre-RT images for automated detection of prostate, peripheral zone and tumor volume.

Results: The repeatability in T2w intensity estimation improved following the automatic registration relative to manual contours; and the quantitative changes of T2w reached significance when pre- and post-RT series were compared.

Impact: The developed methodology allows to automatically detect ROIs in post-RT MRI exams, reduces data acquisition-related variation and improves imaging features' repeatability, thereby enables the quantitative characterization of RT-induced changes in T2w.

0544 14:42

MERIT AWARD MAGNA CUM LAUDE



[PhyCHarm : Physics-Constrained Deep Neural Networks for Multi-Scanner Harmonization]

Gawon Lee[1], Junhyeok Lee[1], Dong Hye Ye[2], and Se-Hong Oh[1]

[1]Biomedical Engineering, Hankuk University of Foreign Studies, Yongin-si, Korea, Republic of, [2]Computer Science, Georgia State University, Atlanta, GA, United States

Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence, Data Harmonization, Bloch equation

Motivation: The MR scanner effect in a multi-site dataset can affect bias in statistical analysis or reduce generality in deep neural networks.

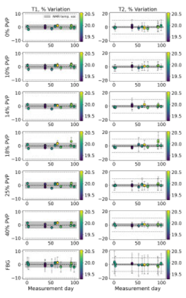
Goal(s): We aim to suggest a MR physics-informed harmonization framework (PhyCHarm) that generates consistent quantitative maps and harmonized T1w images.

Approach: We introduce a Quantitative Maps Generator and a Harmonization Network to be trained with a constraint loss based on a signal equation.

Results: PhyCHarm shows the highest evaluation scores in both networks and consistent segmentation accuracy in the downstream task (FSL FAST GM and WM segmentation).

Impact: PhyCHarm works based on the Bloch equation. PhyCHarm enables us to reduce scanner effects efficiently in the dataset before conducting test/retest, longitudinal, or multi-site studies. It can be helpful to ensure deep neural networks' generality.

0545 14:54



[How frequently should we use a phantom for QA? A preliminary assessment]

Kalina V Jordanova[1], Stephen E Ogier[1], Stephen E Russek[1], Cassandra M Stoffer[1], Guido Buonincontri[2], Mathias Nittka[2], and Kathryn E Keenan[1]

[1]NIST: National Institute of Standards and Technology, Boulder, CO, United States, [2]Siemens Healthcare GmbH, Erlangen, Germany

Keywords: Phantoms, Precision & Accuracy, Quality Assurance, MR Fingerprinting, Quantitative Imaging, Relaxometry, Measurement & Correction

Motivation: Currently, we do not know how frequently quality assurance (QA) should be performed on an MRI scanner to detect changes that impact quantitative measurements.

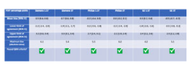
Goal(s): Our goal is to determine the frequency of QA measurements needed during the course of a quantitative *in vivo* study to have confidence in the *in vivo* measurements.

Approach: Phantom quantitative QA measurements were made immediately before or after the *in vivo* measurements over the duration of a repeatability study.

Results: All quantitative phantom measurements had variation well below 10 % over the course of the 99 day study.

Impact: We now know that for measurements using magnetic resonance fingerprinting on this system, QA using phantom measurements is only necessary at the start and end of an *in vivo* study when the study duration is less than approximately 3 months.

0546 15:06



[Testing the Quantitative Imaging Biomarkers Alliance (QIBA) PDFF Profile in the Liver: Results from 416 Scanners at 1.5T and 3T]

Adrienne G. Siu[1], Mary Jean Solywoda[1], Tom Davis[1], Matthew D. Robson[1], and Roberto Salvati[1]

[1]Perspectum, Oxford, United Kingdom

Keywords: Quantitative Imaging, Validation, Liver, Phantoms

Motivation: The Quantitative Imaging Biomarkers Alliance (QIBA) PDFF Profile describes the expected performance of an imaging technique when measuring PDFF. However, the expected performance in phantoms was determined in one phantom on 27 scanners and may not be applicable widely.

Goal(s): We tested the hypothesis that the QIBA PDFF bias criteria (mean:within ±5.0%, maximum:within ±7.0% (percentage points)) cannot be attained at scale with multiple phantoms on >400 scanners.

Approach: We calculated the QIBA PDFF criteria using phantom data from 416 scanners across three vendors at 1.5T and 3T.

Results: All six combinations of scanner vendor and field strength passed the QIBA PDFF criteria.

Impact: The hypothesis that the QIBA PDFF bias criteria cannot be maintained with multiple phantoms on >400 scanners was disproven in a novel dataset with 416 scanners, strongly suggesting that it is possible to achieve this level of performance at scale.

15:18 Discussion

Penny Cristinacce

The University of Manchester, Manchester, United Kingdom

Oral

Cancer Biomarkers: Bench to Bedside

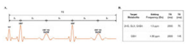
Room 331-332 Tuesday 13:30 - 15:30 *Moderators:* Ravikanth Balaji

13:30 Introduction

Oman Ravikanth Balaji

Sultan Qaboos Comprehensive Cancer Care & Research Centre

0547 13:42 **Detecting IDH1 Mutations in Gliomas: Insights from J-Difference Editing MEGA-PRESS 1H-MRS**



Jia Guo[1,2], Angeliki Mela[3], Zhonghui Qie[2], Yanting Yang[2], Aayushi Mahajan[4], Nelson Humala[4], and Peter D Canoll[3]

[1]*Department of Psychiatry, Columbia University, New York, NY, United States,* [2]*Zuckerman Institute, Columbia University, New York, NY, United States,* [3]*Department of Pathology and Cell Biology, Columbia University, New York, NY, United States,* [4]*Department of Neurological Surgery, Columbia University, New York, NY, United States*

Keywords: Tumors (Pre-Treatment), Tumor, IDH1 mutation, glioma, MEGA-PRESS, 2-Hydroxyglutarate, glutamate, GABA, glutathione

Motivation: Detecting isocitrate dehydrogenase 1 (IDH1) mutations via in vivo MRI can significantly aids glioma diagnosis and treatment strategies.

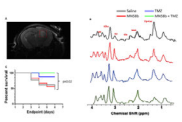
Goal(s): To investigates the use of MEGA-PRESS sequences to non-invasively charaterize the metabolic profile of IDH1 mutation glioma.

Approach: We measured 2-hydroxyglutarate (2HG), glutamate+glutamine (GLX), GABA and glutathione (GSH) inside the glioma from an IDH1(R132H)-mutant and an IDH1-wildtype murine models.

Results: The results unveil distinctive metabolic changes in IDH1 mutation tumors, including elevated 2HG, GLX/GABA ratio, and reduced GSH. These findings offer potential biomarkers for precise diagnosis and therapeutic strategies, highlighting the significant role of MEGA-PRESS in the studies of glioma.

Impact: The study identifies 1H MRS-based biomarkers for non-invasive detection of IDH1 mutation tumors using the MEGA-PRESS sequence. It provides insights into metabolic changes and neurochemical imbalances, aiding early diagnosis, treatment guidance, and monitoring, thus advancing precision oncology.

0548 13:54 **1H MR spectroscopy and IVIM-DWI to evaluate the effect of a choline kinase inhibitor and temozolomide therapy in a mouse model of glioblastoma**



Tareq Alrashidi*[1], Sourav Bhaduri*[2,3], Elisabeth Non Gash[1], Mohesh Moothanchery[1], Christopher Ball[1], Mahon Maguire[1], Lorenzo Ressel[4], and Harish Poptani[1]

[1]*University of Liverpool, Liverpool, United Kingdom,* [2]*Symbiosis Centre for Medical Image Analysis, Symbiosis International (Deemed University), Pune, India,* [3]*Institute for Advancing Intelligence (IAI), TCG CREST, Kolkata, India,* [4]*Department of Veterinary Anatomy Physiology and Pathology, University of Liverpool, Chester, United Kingdom*

Keywords: Small Animals, Cancer, MRS, IVIM, treatment response

Motivation: There is a lack of comprehensive understanding regarding the impact of choline kinase inhibition and standard chemotherapy on preclinical GBM models.

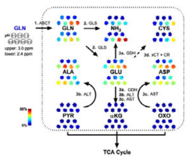
Goal(s): The primary goal of this study was to elucidate the treatment response mechanism in a preclinical GBM mouse model.

Approach: MRS and IVIM-DWI were used for monitoring metabolic and microstructural changes in a preclinical GBM model by single or combination therapy with a choline kinase inhibitor and TMZ.

Results: Our findings indicate that the combination therapy is the most effective treatment regimen. This study contributes to a better understanding of treatment response mechanisms and underscores the potential of non-invasive MRI methods.

Impact: Targeting ChoKα inhibition and the damage of DNA replication (TMZ) promises to be an alternative in the treatment of GBM. This research also highlights the importance of MRS and IVIM-DWI as promising non-invasive methods to assess therapeutic effects on GBM.

0549 14:06



<u>Imaging glutamine utilization in a prostate cancer xenograft model</u>

Yuki Hodo[1], Caitlin M Tressler[1], Behnaz Ghaemi[1], Aliyah S Webster[2], Yuguo Li[3], Martin G Pomper[1], Jeff WM Bulte[1], Peter CM van Zijl[1,3], and Aline Thomas[1]

[1]Johns Hopkins University, Baltimore, MD, United States, [2]Spelman College, Atlanta, GA, United States, [3]Kennedy Krieger Institute, Baltimore, MD, United States

Keywords: Biomarkers, Cancer, Prostate, Metabolism

Motivation: MRI agents that can monitor abnormal glutamine utilization, a hallmark of many aggressive cancers, are not clinically available.

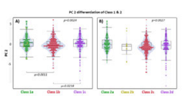
Goal(s): We investigated the utility of glutamine as a chemical exchange saturation transfer (CEST) agent to evaluate its utilization.

Approach: Phantoms revealed contrast differences between glutamine and its metabolic products. Dynamic CEST images (*in vivo*) were acquired in 2 prostate cancer xenograft models after intravenous injection of glutamine. MALDI (matrix-assisted laser desorption/ionization) images of the same tumors (*ex vivo*) were collected for validation.

Results: CEST and MALDI images could distinguish prostate tumors derived from cell lines with known differences in glutamine utilization.

Impact: The potential of CEST (chemical exchange saturation transfer) MRI to evaluate glutamine utilization was evaluated in preclinical prostate cancer models (DU-145 and LNCaP). CEST enhancement images upon infusion of glutamine could distinguish tumors that differed in glutamine utilization.

0550 14:18



<u>Predictions of Human Prostate Cancer with MRS Metabolomics from Biopsies After More Than 5-Year Follow-Up</u>

Ella Zhang[1], Jiaqi Lu[1], Jonathan X. Zhou[1], Chin-lee Wu[1], Adam S. Feldman[1], and Leo L. Cheng[1]

[1]Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

Keywords: Prostate, Cancer, Metabolomics, metabolomic imaging, nuclear magnetic resonance, spectroscopy, prostate cancer, MRI-US fusion, biopsy

Motivation: Evaluations of prostate cancer (PCa) with traditional transrectal ultrasound (TRUS) and multiparametric MRI-ultrasound (mpMRI-US) fusion biopsies may produce false-positives or false-negatives, thereby preventing optimal and timely treatments.

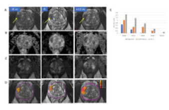
Goal(s): To evaluate PCa metabolomics from TRUS and fusion biopsy cores using magnetic resonance spectroscopy (MRS) to identify potential metabolomic biomarkers for better characterization of PCa.

Approach: Using ex vivo MRS, we measured 432 prostate biopsy cores from patients suspicious of PCa between 4/2006 and 10/2018.

Results: MRS metabolomics could differentiate between benign and malignancy, reflect malignant status from benign cores, and allowed for predictions of future PCa from benign biopsies.

Impact: Our results demonstrate that MRS-based metabolomic evaluations have the potential to detect PCa years earlier than standard TRUS and fusion biopic techniques, and improve PCa active surveillance based on prostate biology.

0551 14:30 [The Role of Quantitative Imaging for Early Detection of Prostate Cancer Progression in Patients on Active Surveillance]



Isabella M Kimbel[1], Veronica Wallaengen[1], Evangelia I. Zacharaki[1], Adrian L. Breto[1], Ahmad Algohary[1], Sandra M. Gaston[1], Oleksandr N. Kryvenko[2], Patricia Castillo[3], Matthew C. Abramowitz[1], Alan Pollack[1], Sanoj Punnen[4], and Radka Stoyanova[1]

[1]Radiation Oncology, University of Miami, Miami, FL, United States, [2]Pathology, University of Miami, Miami, FL, United States, [3]Radiology, University of Miami, Miami, FL, United States, [4]Urology, University of Miami, Miami, FL, United States

Keywords: Prostate, Prostate

Motivation: Patients on Active Surveillance (AS) for prostate cancer have a high risk of cancer progression to treatment. There is a need for additional tools to risk stratify AS patients.

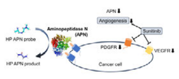
Goal(s): To evaluate the Habitat Risk Score (HRS) method for automatic identification of lesions for early detection of AS progressors in a prospective trial.

Approach: HRS was assessed in patients that progressed in the 1st, 2nd or 3rd year of AS.

Results: In 40% of the patients, HRS identified a dominant lesion that was not targeted during biopsy. The study illustrates the quantitative power of HRS as compared to PIRADS.

Impact: Integrating Habitat Risk Score (HRS) in Active Surveillance for prostate cancer has the potential to significantly reduce the number of surveillance biopsies. HRS facilitates the detection of progression through assignment of robust biopsy targets and quantification of tumor habitat changes.

0552 14:42 [A Newly Designed Hyperpolarized Aminopeptidase N Probe Sensitively Detects Early Therapeutic Responses Heterogeneously on Pancreatic Tumors]



Norikazu Koyasu[1], Hiroyuki Yatabe[2], Yoichi Takakusagi[3], Yutaro Saito[2], Shinske Sando[2], Murali C. Krishna[1], and Kazutoshi Yamamoto[1]

[1]National Institutes of Health, Bethesda, MD, United States, [2]The University of Tokyo, Tokyo, Japan, [3]National Institutes for Quantum and Radiological Science and Technology, Chiba, Japan

Keywords: Probes & Targets, Hyperpolarized MR (Non-Gas)

Motivation: Molecular imaging is a promising methodology for diagnosing cancer and monitoring treatments by *noninvasively* visualizing the alternations of cancer metabolisms.

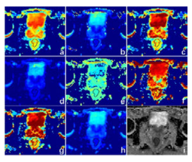
Goal(s): A framework for developing novel dissolution Dynamic Nuclear Polarization(dDNP) probes is needed to overcome their limited availabilities for *in vivo* and clinical applications.

Approach: dDNP-metabolic MRI successfully monitors therapeutic responses in spatiotemporal enzymatic activities particularly at earlier stages before the volumetric changes can be observed.

Results: In this presentation, we will demonstrate a model case for a rationally designed novel dDNP probe, aminopeptidase-*N*(CD13), which allows us to detect heterogenetic treatment responses with an anti-angiogenic/antitumor drug, sunitinib, at the earlier stages in tumors.

Impact: This work exhibits a framework that a rationally designed hyperpolarized MR probe targeted to a highly-selective enzymatic activity, aminopeptidase-*N*, leads to monitor early therapeutic responses on cancer tissues *in vivo* and to observe tumor heterogeneity in their treatment responses *non-invasively*.

0553 14:54 Assessing pathological prognostic factors of resectable rectal cancer: comparison of a monoexponential model and multiple advanced DWI models



Mi Zhou[1], Meining Chen[2], Qin Zhang[3], and Hongyun Huang[1]

[1]Department of Radiology, Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [2]MR Research Collaboration, Siemens Healthineers, Chengdu, China, [3]MRI clinical application, Customer Service Department, Siemens Digital Medical Technology Co., LTD, Shanghai, China

Keywords: Biomarkers, Diffusion/other diffusion imaging techniques

Motivation: Diffusion-weighted imaging (DWI) can help to predicti rectal cancer prognosis; however, inconsistencies in its effectiveness necessitate exploring advanced DWI models to improve diagnostic accuracy.

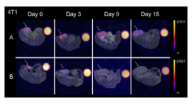
Goal(s): We investigated the value of the stretched exponential (SEM), fractional-order calculus (FROC), and continuous-time random-walk (CTRW) models in assessing prognostic factors for rectal cancer.

Approach: This study included 181 rectal cancer patients with using traditional and advanced DWI models to explore correlations between DWI parameters and histopathological indicators.

Results: The parameters of advanced DWI models were significantly correlated with histopathological prognostic factors. CTRW-α was the superior predictor for histological type and pT stage.

Impact: Our study demonstrates the value of CTRW model in predicting prognostic factors for rectal cancer. Utilizing these noninvasive and accurate advanced DWI models before surgery can help physicians to make appropriate surgical plan to help patients achieve better prognosis.

0554 15:06 Magnetic resonance imaging of macrophage response to radiation therapy



Harrison Yang[1], Brock Howerton[2], Francesc Marti[1], Reuben Adatorwovor[1], and Fanny Chapelin[2]

[1]University of Kentucky, Lexington, KY, United States, [2]University of California San Diego, San Diego, CA, United States

Keywords: Biomarkers, Contrast Agent

Motivation: Cellular response to cancer treatment is difficult to track in real time. Standard practice involves immunostaining of a biopsied tumor, but this is severely limited by a number of factors.

Goal(s): Non-invasive imaging methods such as MRI could obviate the need for biopsies and serve as a biomarker of radiation therapy efficacy.

Approach: This study aimed to observe macrophage response in a mouse model by use of a fluorine nanoemulsion and ^{19}F MRI.

Results: It was shown that macrophage recruitment can be quantified through MRI. Moreover, the findings suggest that macrophage response to radiation therapy is dependent on several factors including tumor origin.

Impact: Our results demonstrate the potential of ^{19}F MRI to non-invasively track macrophages during radiation therapy and its prognostic value with regards to tumor growth. This technique will be extremely beneficial in future analysis of inflammation's role in tumor recurrence.

15:18 Discussion

Oman Ravikanth Balaji

Sultan Qaboos Comprehensive Cancer Care & Research Centre, United States

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Oral

MR Elastography

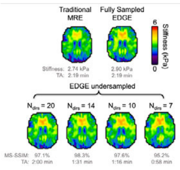
Room 334-336 | Tuesday 13:30 - 15:30 | *Moderators:* Ralph Sinkus & Meiyun Wang

13:30 Introduction

Ralph Sinkus

LVTS, U1148, INSERM, Paris, France / King's College London, UK, France

0555 13:42 [Acceleration of Magnetic Resonance Elastography using a Novel Distributed Encoding Technique]



Mary K Kramer[1], Alex M Cerjanic[2], Matthew DJ McGarry[3], and Curtis L Johnson[1]

[1]Biomedical Engineering, University of Delaware, Newark, DE, United States, [2]Massachussetts General Hospital, Cambridge, MA, United States, [3]Dartmouth College, Hanover, NH, United States

Keywords: Elastography, Elastography

Motivation: Magnetic resonance elastography (MRE) data quality is susceptible to poor data quality from subject motion and long scan times.

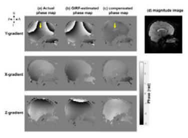
Goal(s): A novel sampling technique and estimation scheme was developed and implemented to improve flexibility and acquisition time of MRE.

Approach: The technique utilizes non-traditional sampling directions in an optimized encoding matrix to collect data efficiently to be used in a novel algorithm for estimating harmonic displacement fields. This allows for acquisition acceleration or flexibility in the data sampled to be rejected in post-processing if it is distorted.

Results: Scans were acquired 2.3x faster than standard methods with 95.2% multiscale structural image similarity.

Impact: A novel sampling and estimation scheme demonstrated here can be used to improve the application of magnetic resonance elastography. This is accomplished through prospective reduction in sampling, reducing acquisition time, and retrospective volume rejection, circumventing distortion introduced by subject motion.

0556 13:54 [Gradient impulse response function-based phase compensation for wavelet MR elastography on a compact 3T scanner]



Daehun Kang[1], Yi Sui[1], Yuan Le[1], Ziying Yin[1], Myung-Ho In[1], John Huston III[1], Yunhong Shu[1], and Matt A Bernstein[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States

Keywords: Artifacts, System Imperfections: Measurement & Correction, gradient impulse response function

Motivation: High-performance asymmetric gradient systems have the potential to produce high-spatial-order eddy-current-induced magnetic fields that can impact phase-based applications such as wavelet MRE using large-magnitude motion-encoding bipolar gradient pulses.

Goal(s): Removal of the gradient-system-induced high-order phase deviation in the wavelet MRE phase map.

Approach: Gradient impulse response functions (GIRFs) can be used to characterize the gradient system. We introduce a GIRF-based phase compensation approach to alleviate the high-order phase deviations resulting from imperfections in the gradient system, along with practical recommendations, including the use of a tailored set of GIRFs.

Results: The phase inhomogeneity in wavelet-MRE phase map improved with the GIRF-based compensation.

Impact: The proposed GIRF-based phase compensation approach offers the potential to enhance phase image quality and accuracy, addressing imperfections in the gradient system, which is a challenge not fully resolved by alternative methods like concomitant field correction and pre-emphasis gradient modification.

0557 14:06

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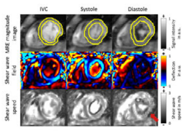


Time-resolved multifrequency cardiac MR elastography of the in-vivo human heart using a segmented gradient echo spiral sequence.

Matthias Anders[1], Carsten Warmuth[1], Tom Meyer[1], Heiko Tzschätzsch[2], Josef Pfeuffer[3], Jeanette Schulz-Menger[4,5,6,7], Jürgen Braun[2], and Ingolf Sack[1]

[1]Department of Radiology, Charité – Universitätsmedizin Berlin, Berlin, Germany, [2]Institute of Medical Informatics, Charité – Universitätsmedizin Berlin, Berlin, Germany, [3]Application Development, Siemens Healthcare GmbH, Erlangen, Germany, [4]Charité – Universitätsmedizin Berlin, Berlin, Germany, [5]Working Group On CMR, Experimental and Clinical Research Center, Berlin, Germany, [6]Department of Cardiology and Nephrology, HELIOS Hospital Berlin-Buch, Berlin, Germany, [7]DZHK (German Centre for Cardiovascular Research), Berlin, Germany

Keywords: Elastography, Elastography

Motivation: Abnormal changes in myocardial stiffness during the cardiac cycle are a potential biomarker for cardiac diseases. However, there is currently no established MR-method for time-resolved mapping of cardiac stiffness.

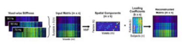
Goal(s): To demonstrate the reproducibility of time-resolved stiffness mapping of the in-vivo human heart over the cardiac cycle by MR elastography (MRE).

Approach: Eleven healthy volunteers were examined twice using multifrequency cardiac-triggered, segmented gradient echo spiral MRE for stiffness mapping of the left ventricular myocardium in a short-axis view.

Results: Excellent, good, and moderate reproducibility was achieved for isovolumetric contraction, systolic, and diastolic phases, respectively. Significant differences among all phases were apparent.

Impact: The achieved high reproducibility of cardiac multifrequency MRE, together with its ability to identify distinct time-resolved stiffness levels during the cardiac phases of isovolumetric contraction, systole and diastole, could potentially detect stiffness related cardiac pathology in early disease stages.

0558 14:18



Data-Driven Analysis of Brain Tissue Mechanics using Magnetic Resonance Elastography and Non-Negative Matrix Factorization

Alexa M Diano[1], Olivia M Bailey[1], Mary K Kramer[1], Kyra E Twohy[2], and Curtis L Johnson[1,2]

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Keywords: Elastography, Brain

Motivation: There exists a need for a comprehensive method to analyze regional brain tissue mechanics that accounts for variability across subject populations.

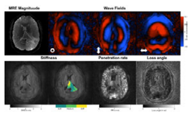
Goal(s): Here we aimed to implement a multivariate data-driven technique to capture brain mechanical properties across a wide population while preserving small-scale differences between subjects.

Approach: Non-negative matrix factorization was used to reduce mechanical properties derived from magnetic resonance elastography (MRE) into a low-dimensional form to generate unconfined regions of the brain that demonstrate high covariance across all subjects.

Results: This technique was able to capture recognizable anatomical regions in the brain without structural input to determine weightings on the population average.

Impact: This low-dimensional representation of brain tissue mechanics acquired from non-negative matrix factorization and MRE will help define baseline properties that accurately represent a wide range of subject populations while minimizing variability across imaging studies and contributing to improved statistical models.

0559 14:30 Biomechanical tumor hallmarks for the clinical diagnosis of glioma by high-resolution multifrequency MR elastography



Mehrgan Shahryari[1], Tom Meyer[1], Pablo Gottheil[2], Elisabeth Hain[3], Josef A. Käs[2], Eberhard Siebert[4], Vincent Prinz[5], and Ingolf Sack[1]

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Keywords: Elastography, Elastography

Motivation: Previous studies using MR Elastography (MRE) have suggested that gliomas exhibit reduced stiffness and viscosity. However, the interplay between micromechanical tumor changes that determine the macroscopic mechanical properties measured by MRE remains unclear.

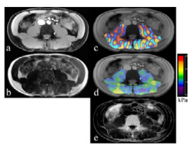
Goal(s): This study aims to investigate the relationship between viscoelastic parameters measured MRE *in-vivo* and histopathologically quantified parameters in glioma.

Approach: High-resolution multifrequency MRE with quantified histopathology was prospectively performed in 23 patients with glioma.

Results: Stiffness and viscosity in gliomas are associated with increased cell elongation, micro-vessel density, and apoptotic rate suggesting unjamming, neovascularization and cell proliferation as biomechanically sensitive tumor hallmarks for clinical diagnosis.

Impact: In this study, we demonstrated that viscoelastic parameters, quantified by MR Elastography, provide insights into cell mobility, cellularity, mitotic and apoptotic rates, as well as vascularization of gliomas *in-vivo*. This technique holds promise for future clinical diagnosis of neurotumors.

0560 14:42 Simultaneous acquisition of MR elastography, Dixon and X-ray CT like image



Tomokazu Numano[1], Daiki Ito[1,2], Koichi Takamoto[3], Hiroyo Kamio[4], Nobuaki Tanabe[1], Shota Konuma[1], Yoshito Ishihara[1], Jo Kikuchi[1], Hiromu Oka[1], and Hisao Nishijo[3]

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Keywords: Other Musculoskeletal, Elastography

Motivation: The purpose of study was integration of Dixon and X-ray CT like image technique in the GRE-MultiEcho-MRE sequence.

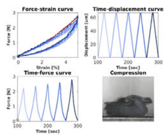
Goal(s): The additional visualization of bone damage and water / fat corpornents on MR elastography would yield benefits in evaluating radiologic skeletal muscle evaluation, since soft tissue injuries can be assessed directly related to the osseous injuries using one image modality.

Approach: The effectiveness of this method was evaluated by volunteer studies using the original MRE pulse sequence and vibration system.

Results: This method allows simultaneous acquisition of elastograms, wave images, water/fat component images and X-ray CT like images.

Impact: For the patient, a reduction in total imaging time is beneficial. For the clinicians, images such as elastograms, wave images, water/fat component images, and X-ray CT are available simultaneously for multimodal diagnosis.

0561 14:54



Viscoelastic properties of pancreatic ductal adenocarcinoma: ex vivo biomechanical validation of in vivo MR elastography

Anne-Sophie van Schelt[1,2], Nienke P.M. Wassenaar[1,2], Eric Schrauben[1], Jules L Nelissen[1], Jurgen H Runge[1,3], Marc C.V. van Turnhout[4], Rob C.H. Driessen[4], Jaap Stoker[1,5], and Aart J Nederveen[1]

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Keywords: Elastography, Pancreas, Elastography

Motivation: There are discrepancies in pancreatic MRE outcomes. Biomechanical validation of MRE in pancreatic ductal adenocarcinoma (PDAC) poses substantial challenges.

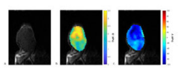
Goal(s): This study aims to conduct biomechanical analysis on the surgically removed specimen and correlate this to preoperative MRE outcomes.

Approach: Six PDAC patients underwent MRE prior to surgical intervention, resulting in shear wave speed (SWS) and phase angle (ϕ) for whole-tumor and tumor-center. Compression testing was performed on specimen at 5%-strain resulting in Young's moduli (E). Correlation analysis was done with MRE outcomes and E.

Results: Pearson's correlation revealed a significant correlation between $SWS_{tumor\text{-}whole}$ and E (r(6)=.857, p=.029) and $\phi_{tumor\text{-}center}$ (r(6)=.844, p=.035).

Impact: Validation using ex vivo compression mechanical testing of pancreatic MRE outcomes gives more insight in the accuracy of the measured elastic properties in complex and inhomogeneous tumorous tissue, which is imperative for clinical application of MRE as a predictive biomarker.

0562 15:06



Nonlinear storage modulus quantification with MR-elastography: from in vitro to in vivo assessment

Gwenaël Pagé[1], Jean-Luc Gennisson[1], Philippe Garteiser[2], and Bernard E. Van Beers[2]

[1]Biomaps, CEA, CNRS, Orsay, France, [2]Laboratory of Biomarker Imaging, INSERM, Paris, France

Keywords: Elastography, Elastography

Motivation: Estimating the nonlinear coefficient in MR elastography could provide a relevant mechanical parameter for tumor characterization.

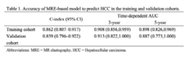
Goal(s): The goal of this study was to develop a method for assessing the nonlinear coefficient in MR elastography.

Approach: We developed a specific MR elastography setup and a post-processing pipeline to quantify nonlinear coefficients in phantoms and mice with a tumor implanted subcutaneously.

Results: In phantoms, we observed that nonlinear coefficient was able to provide a higher contrast than storage modulus to distinguish different structure. In addition, in mice, nonlinear coefficient was correlated to the entropy which is a marker of collagen distribution irregularity.

Impact: The estimation of the nonlinear coefficient provides a new biomarker to assess tissue mechanical parameters. The relation between this parameter and tissue structure could be relevant in tumor investigation, as tissue microarchitecture is an important marker of tumor severity.

0563 15:18 [3D MRE-based novel score predicts hepatocellular carcinoma development in patients with chronic hepatitis B]



Haimei Chen[1], Jie Zhu[1], Mengsi Li[1], Jun Chen[2], Meng Yin[2], Sudhakar K. Venkatesh[2], Richard L. Ehman[2], and Jin Wang[1]

[1]Radiology, Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, China, [2]Mayo Clinic College of Medicine, Rochester, MN, United States

Keywords: fMRI Analysis, Elastography

Motivation: Identifying patients with chronic hepatitis B (CHB) who are at high risk of HCC development for close monitoring to improve prognosis is crucial.

Goal(s): We aimed to develop a 3D MRE-based risk score to predict HCC development in CHB patients.

Approach: The novel HCC risk score was developed using liver shear stiffness and LSS, age, platelet count, and albumin.

Results: Our results showed that the risk score has excellent performance for the identification of patients of HCC development, the cutoff value 55 of our risk score provided the high negative predictive value for HCC development at 3 and 5 years.

Impact: MRE- based HCC risk score may be a non-invasively accurate tool for predicting HCC, which may provide a useful reference for decision-making in HCC surveillance strategy for CHB patients.

Power Pitch

Pitch: Quantitative Imaging

Power Pitch Theatre 1

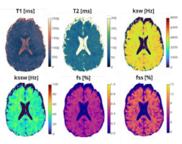
Tuesday
Pitches: 13:30 - 14:30
Posters: 14:30 - 15:30

Moderators: Emma Biondetti & Gastao Cruz

(no CME credit)

0564 Pitch: 13:30 Poster: 14:30 Screen 1

[In Vivo Glutamate CEST MR Fingerprinting (GluCEST-MRF)]



Jessica A. Martinez[1], Ricardo Otazo[1], and Ouri Cohen[1]

[1]Memorial Sloan Kettering Cancer Center, New York, NY, United States

Keywords: Quantitative Imaging, CEST & MT, MRF, Amine, Glutamate

Motivation: To obtain quantitative glutamate CEST and MT maps in the brain with higher resolution than spectroscopic imaging.

Goal(s): To develop a CEST-MRF pulse sequence and deep learning reconstruction approach for rapid quantitative glutamate imaging.

Approach: CEST-MRF pulse sequence with an acquisition schedule optimized by deep learning was developed to measure glutamate exchange rate and volume fractions. Quantitative maps were obtained using a neural network trained on physics-derived signals.

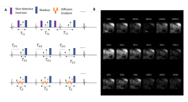
Results: The proposed approach yields water T1 and T2 relaxation maps, glutamate exchange and volume fraction maps and the semi-solid exchange and volume fraction maps in a scan time of less than 2 minutes.

Impact: The proposed quantitative glutamate-sensitive CEST-MRF technique can lead to improved diagnosis and treatment response evaluation in patients with brain tumors given that glutamate dysregulation is a key aspect of tumor growth.

0565 Pitch: 13:30

Poster: 14:30

Screen 2



Initial Feasibility of Free-breathing Multiparametric Mapping with Echo Planar Imaging to Derive T1, T2 and ADC Maps

Dingheng Mai[1,2], Danielle Kara[1,3], Yuchi Liu[4], Deborah Kwon[1,3,5], and Christopher Nguyen[1,2,3,5]

[1]Cardiovascular Innovation Research Center, Heart Vascular Thoracic Institute, Cleveland Clinic, Cleveland, OH, United States, [2]Department of Biomedical Engineering, Case Western Reserve University & Cleveland Clinic, Cleveland, OH, United States, [3]Cardiovascular Medicine, Heart Vascular Thoracic Institute, Cleveland Clinic, Cleveland, OH, United States, [4]Siemens Medical Solutions USA, Inc., Cleveland, OH, United States, [5]Imaging Institute, Cleveland Clinic, Cleveland, OH, United States

Keywords: Quantitative Imaging, Heart

Motivation: Co-registered quantification of relevant tissue characteristics including T1, T2 and ADC has the potential to aid the diagnosis of various cardiomyopathies.

Goal(s): Our goal was to produce co-registered cardiac T1, T2 and ADC maps using free-breathing **M**ulti**P**arametric single shot **E**cho **P**laner **I**maging (MP-EPI).

Approach: Pixel-wise value quantifications of T1, T2, and ADC were calculated and compared in a static phantom and 5 healthy subjects following respiratory motion correction.

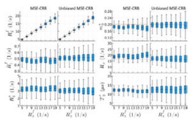
Results: The MP-EPI technique demonstrated consistency with reference measurements (R>0.97) for T1 and T2 values, with no significant differences observed in human subjects (p>0.2), and normal ADC values.

Impact: Free breathing, co-registered multiparametric maps from EPI-based images may provide complementary information for the diagnosis and characterization of comprehensive myocardiopathies. This method has the potential to expand to include other tissue characterization in the heart, such as T2*, and CEST.

0566 Pitch: 13:30

Poster: 14:30

Screen 3



Unbiased Neural Networks for Quantitative MRI Parameter Estimation

Andrew Mao[1,2,3], Sebastian Flassbeck[1,2], and Jakob Assländer[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, NYU Grossman School of Medicine, New York, NY, United States, [3]Vilcek Institute of Graduate Biomedical Sciences, NYU Grossman School of Medicine, New York, NY, United States

Keywords: Quantitative Imaging, Precision & Accuracy, Parameter Estimation, Magnetization transfer, MR fingerprinting

Motivation: Neural-network (NN)-based estimators trained with the mean-squared error criterion have a non-negligible bias which impedes inter-method comparability and the clinical adoption of quantitative MRI methods.

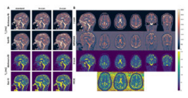
Goal(s): To develop fast, accurate, precise, and reproducible quantitative MRI estimators that are reliable in the face of pathology.

Approach: We explicitly penalize the bias of the NN's estimates during training and study the resulting NN's bias and variance properties for a magnetization transfer model.

Results: The proposed method reduces the NN's variable bias throughout parameter space, achieves a variance close to the theoretical minimum, and shows excellent concordance with parameter maps estimated using non-linear least-squares in vivo.

Impact: NNs trained with the proposed strategy are approximately minimum variance unbiased estimators and are therefore well-suited for the development, validation, and translation of new quantitative biomarkers, particularly for multi-compartment biophysical models such as magnetization transfer or diffusion in white matter.

0567 Pitch: 13:30 Poster: 14:30 Screen 4



Simultaneous T1 and T2 mapping of the brain with accelerated QuantoRAGE using optimized sequence parameters and fast neural network fitting

Tâm Johan Nguyên[1,2,3], Tom Hilbert[4,5,6], José P. Marques[7], Berk Can Açikgöz[3,8,9], Roland Kreis[2,3], Jessica AM Bastiaansen[3,8], Tobias Kober[4,5,6], and Gabriele Bonanno[1,2,3]

[1]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Bern, Switzerland, [2]Magnetic Resonance Methodology, Institute of Diagnostic and Interventional Neuroradiology, University of Bern, Bern, Switzerland, [3]Translational Imaging Center (TIC), Swiss Institute for Translational and Entrepreneurial Medicine, Bern, Switzerland, [4]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland, [5]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [6]LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [7]Donders Institute for Brain Cognition and Behaviour, Radboud University, Nijmegen, Netherlands, [8]Department of Diagnostic, Interventional and Pediatric Radiology (DIPR), Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland, [9]Graduate School for Cellular and Biomedical Sciences, University of Bern, Bern, Switzerland

Keywords: Quantitative Imaging, Brain, CRLB optimization, Machine Learning, Fast-Fitting, QuantoRAGE

Motivation: T_1 and T_2 relaxometry provide valuable information for early pathology detection but require long scan and fitting times for high-resolution whole-brain mapping.

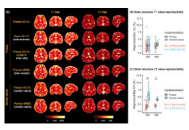
Goal(s): To reduce acquisition and map generation times for simultaneous T_1 and T_2 mapping.

Approach: The proposed accelerated sequence uses two scans instead of the original four, with parameters optimized using the Cramér-Rao lower bound (CRLB). A neural network fast fitting model is employed to drastically reduce parameter quantification times.

Results: The optimized technique reduced total acquisition time from 18:20 to 9:10 minutes and fitting time from several hours to 2 min for the entire brain.

Impact: Using QuantoRAGE, simultaneous T_1 and T_2 relaxometry of the whole brain with high isotropic resolution can be acquired in 9 minutes with quantitative maps generated within few seconds per slice. Both aspects bring quantitative MRI closer to clinical applications.

0568 Pitch: 13:30 Poster: 14:30 Screen 5



Rapid, open-source, cross-platform 3D multiparametric mapping for multisite neuroimaging

Shohei Fujita[1,2,3,4], Borjan Gagoski[2,5], Jon-Fredrik Nielsen[6], Maxim Zaitsev[7], Yohan Jun[1,2], Jaejin Cho[1,2], Xingwang Yong[1,2,8], Eugene Milshteyn[9], Shaik Imam[10], Qiang Liu[11], Qingping Chen[7], Yogesh Rathi[11,12], and Berkin Bilgic[1,2,13]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Department of Radiology, Juntendo University, Tokyo, Japan, [4]Department of Radiology, The University of Tokyo, Tokyo, Japan, [5]Fetal-Neonatal Neuroimaging & Developmental Science Center, Boston Children's Hospital, Boston, MA, United States, [6]Department of Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [7]Division of Medical Physics, Department of Radiology, Faculty of Medicine, Medical Center–University of Freiburg, Freiburg, Germany, [8]Key Laboratory for Biomedical Engineering of Ministry of Education, Department of Biomedical Engineering, College of Biomedical Engineering & Instrument Science, Zhejiang University, Zhejiang, China, [9]GE HealthCare, Boston, MA, United States, [10]Department of Radiology, Vanderbilt University, Nashville, TN, United States, [11]Department of Psychiatry, Brigham and Women's Hospital, Boston, MA, United States, [12]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [13]Harvard/MIT Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Quantitative Imaging, Precision & Accuracy, Validation; Cross-vendor

Motivation: To address the unmet need for a cross-platform, multiparametric technique to facilitate data harmonization across different sites.

Goal(s): To implement and evaluate a fully transparent 3D multiparametric mapping for multisite neuroimaging.

Approach: A multiparametric mapping technique, 3D-QALAS, was implemented in Pulseq. The acquired T1 and T2 maps were compared within-scanner, cross scanners, software versions, sites, and vendors.

Results: The Pulseq implementation exhibited significantly higher reproducibility than vendor-native implementations, particularly for T2 values, in both phantom and in vivo studies. This approach enabled ADNI-compliant field-of-view sizes with 1mm isotropic resolution within 5 minutes, while maintaining a cross-platform coefficient of variation below 4%.

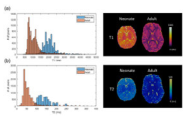
Impact: An open-source implementation across different vendors and scanners, along with a consistent reconstruction and fitting pipeline, improved measurement reproducibility. This approach facilitates data harmonization, version control and error-propagation assessment, making it also suitable for extracting quantitative information for downstream analysis.

0569 Pitch: 13:30 Poster: 14:30 Screen 6

[Optimizing MR Fingerprinting Pulse Sequences for Neonates and Across Age Ranges]

Siyuan Hu[1], Zhilang Qiu[1], Yuran Zhu[1], Debra McGivney[1], and Dan Ma[1]

[1]*Case Western Reserve University, Cleveland, OH, United States*



Keywords: Pulse Sequence Design, MR Fingerprinting

Motivation: Due to significantly different relaxation times and image contrasts between neonate and adult brain, MR sequences optimized for adults are sub-optimal and may produce measurement bias in pediatric scans.

Goal(s): Optimizing MR fingerprinting pulse sequence for neuroimaging across age ranges.

Approach: We predicted and minimized measurement errors using the systematic error index model with a digital neonate brain phantom to optimize MRF sequence parameters. Optimized sequences were compared against an adult-optimized sequence via simulation and in vivo scans.

Results: Optimized sequences showed improved image quality and accuracy for infant scans and maintained accuracy for adult scans in both simulation and in vivo experiments.

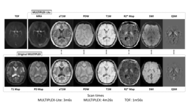
Impact: We present the first application of the systematic error index model for MRF sequence optimization for brain scans across age ranges to achieve high measurement accuracy with reduced scan time.

0570 Pitch: 13:30 Poster: 14:30 Screen 7

[A MULTIPLEX-Lite method for fast 3D multi-parametric imaging with MR Angiography]

Yongquan Ye[1], Miaowen Li[2], Hongyu Li[1], Ying Wu[3], and Jian Xu[1]

[1]*UIH America, Inc., Houston, TX, United States,* [2]*United Imaging Research Institute of Innovative Medical Equipment, Shenzhen, China,* [3]*United Imaging Healthcare, Shanghai, China*



Keywords: Pulse Sequence Design, Multi-Contrast

Motivation: Existing 3D multi-parametric imaging methods suffers from long scan times, and decent MRA contrasts are yet to be provided.

Goal(s): To develop a 3-minute 3D high resolution multi-parametric imaging method that offeres whole brain imaging with TOF quality MRA results.

Approach: A simplified version of the MULTIPLEX method, namely MULTIPLEX-Lite, is proposed. Compared to the original MULTIPLEX method, addtional MRA results are offered, while removing the T1 and PD mappings to further improve scan time.

Results: The proposed MULTIPLEX-Lite method offered whole brain high resolution (<1mm3 voxel volume) MRA, PDW, T1W, aT1W, SWI, R2* maps and QSM in one 3-minute scan.

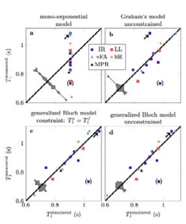
Impact: The proposed MULTIPLEX-Lite method is among the most feasible and practical solutions for routine clinically friendly 3D high-resolution multi-parametric imaging practices.

0571 Pitch: 13:30 Poster: 14:30 Screen 8

[Magnetization transfer explains most variablity of T1-estimates in the MRI literature]

Jakob Assländer[1,2]

[1]*Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York NY, NY, United States,* [2]*Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States*



Keywords: Quantitative Imaging, Relaxometry, T1, MT, magnetization transfer

Motivation: T_1-estimates vary substantially throughout the literature.

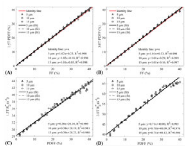
Goal(s): To provide evidence that magnetization transfer (MT) explains most of this variability.

Approach: We simulated 16 literature T_1-mapping approaches with an MT model and fitted a T_1-value to each simulated dataset. We then modified a global set of MT parameters to best explain the T_1-variability.

Results: We found that MT explains 71% of the literature's T_1-variability. The largest reduction and minimal Bayesian and Akaike information criteria were achieved when incorporating two recent advances in MT modeling: describing the semi-solid pool's spin dynamics with the generalized Bloch model and removing commonly-used constraints on the semi-solid pool's T_1.

Impact: Our results suggest that T_1 should be considered a semi-quantitative metric in biological tissue, meaning comparisons between different T_1-mapping methods and validations in doped-water phantoms are of limited value.

0572 Pitch: 13:30
Poster: 14:30
Screen 9



[Influence of fat droplet size on liver R2* relaxometry by Monte Carlo simulation and phantom studies]

Xiaoben Li[1], Tingmiao Wu[2,3], Scott B. Reeder[4,5,6,7,8], Diego Hernando[4,5], and Changqing Wang[1]

[1]School of Biomedical Engineering, Anhui Medical University, Hefei, China, [2]Department of Radiology, the First Affiliated Hospital of Anhui Medical University, Hefei, China, [3]Anhui Public Health Clinical Center, Hefei, China, [4]Department of Radiology, University of Wisconsin, Madison, WI, United States, [5]Department of Medical Physics, University of Wisconsin, Madison, WI, United States, [6]Department of Biomedical Engineering, University of Wisconsin, Madison, WI, United States, [7]Department of Medicine, University of Wisconsin, Madison, WI, United States, [8]Department of Emergency Medicine, University of Wisconsin, Madison, WI, United States

Keywords: Quantitative Imaging, Liver, R2*; fat droplet size; Monte Carlo simulations; phantom

Motivation: Liver fat (hepatic steatosis) can confound R_2^*-based iron quantification in chemical shift encoded MRI, while the size of fat droplets may also affect liver R_2^*. However, it is infeasible to experimentally investigate the influence of fat droplet size in vivo on liver R_2^* due to tissue complexity.

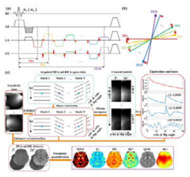
Goal(s): To investigate the influence of fat droplet size on liver R_2^* at both 1.5T and 3.0T.

Approach: Monte Carlo simulation and phantom studies.

Results: Liver R_2^* demonstrates a positive linear relationship with proton density fat fraction and remains relatively unaffected by fat droplet size.

Impact: These findings may benefit phantom design and understanding of the underlying mechanisms of R_2^* characteristics in the presence of hepatic steatosis.

0573 Pitch: 13:30
Poster: 14:30
Screen 10



[Whole Brain Multiparametric Mapping in Two Minutes Using a Dual-Flip-Angle Stack-of-Stars Blipped Multi-Gradient-Echo Acquisition]

Wenlong Feng[1], Zekang Ding[1], Quan Chen[1], Huajun She[1], and Yiping P. Du[1]

[1]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China

Keywords: Quantitative Imaging, Multi-Contrast, Multiparametric Mapping, Myelin Water Imaging, Relaxometry, Radial Stack-of-Stars Trajectory

Motivation: Multiparametric MRI of the brain can be used to improve the assessment of neurological diseases. However, the long scan time hinders its clinical applications.

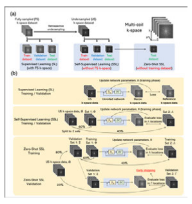
Goal(s): This study aims to develop a technique for fast whole brain multiparametric mapping.

Approach: A dual-flip-angle stack-of-stars (SOS) blipped multi-gradient-echo sequence was developed to accelerate the acquisition. A novel joint-sparsity-constrained multicomponent T_2^*-T_1 spectrum estimation algorithm was proposed to improve the quantification of myelin water fraction (MWF).

Results: The in vivo experiments have demonstrated good agreement between results of accelerated SOS and the reference, as well as good repeatability between two repeated accelerated SOS scans.

Impact: Our technique can provide robust whole brain multiparametric mapping of MWF, T_1, proton density (PD), R_2^*, magnetic susceptibility (QSM), and B_1 transmit field (B_1^+) with a two-minute scan, which has a great potential for neurological applications, such as multiple sclerosis.

0574 Pitch: 13:30 Poster: 14:30 Screen 11



Comparison of ground-truth-free deep learning approaches for accelerated quantitative parameter mapping

Naoto Fujita[1], Suguru Yokosawa[2], Toru Shirai[2], and Yasuhiko Terada[1]

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Keywords: Quantitative Imaging, Image Reconstruction, Accelerated parameter mapping, Self-supervised; Zero-shot self-supervised learning

Motivation: Ground-truth-free (GT-free) deep learning (DL) approaches are expected to lower the cost of training DL models in accelerated quantitative MRI, but their performance has not been well compared to supervised approaches, and their application to quantitative MRI is still limited.

Goal(s): Evaluation of the effectiveness of GT-free approaches in quantitative MRI.

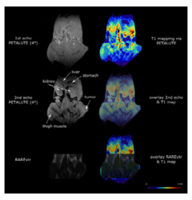
Approach: Three quantitative MRI methods (variable flip angle, multi-slice multi-echo, double echo steady state) were used to compare model-based DL architectures with three learning schemes: supervised learning, self-supervised learning, and zero-shot self-supervised learning in multiple acceleration factors.

Results: GT-free deep Learning approaches had high performance comparable to SL in many cases.

Impact: In this study, we compared GT-free approaches with SL and showed that they had high performance comparable to SL in many cases. These results indicate that GT-free approaches are applicable to a variety of sequences in accelerated quantitative MRI.

0575 Pitch: 13:30 Poster: 14:30 Screen 12

MERIT AWARD SUMMA CUM LAUDE



Accelerated Preclinical UHF Abdominal T1 Mapping using Novel Rosette Ultrashort Echo Time (PETALUTE)

Alexandra Lipka[1,2,3], Stephen Sawiak[4,5], Xin Shen[6], Uzay Emir[1,7], Ali Özen[8], Mark Chiew[9,10,11], Joseph Speth[1], Deng-Yuan Chan[1], Zhen Jiang[1], Gregory Tamer Jr.[7], and Matthew Scarpelli[1]

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Keywords: Preclinical Image Analysis, Preclinical, Abdomen, T1 Mapping

Motivation: Well established techniques for fast 3D T1 mapping with cartesian/radial trajectories are prone to respiratory artifacts.Previously established non-cartesian sequences have mitigated the influence of motion artifacts, though still suffer from long measurement times.

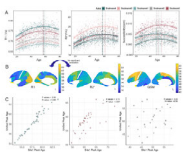
Goal(s): Implementation of a novel 3D dual-echo rosette k-space trajectory for preclinical UTE MRI(PETALUTE) for abdominal imaging of both anatomical and quantitative T1 measurements and retrospective 4-fold acceleration.

Approach: PETALUTE(resolution 0.24x0.24x0.24mm^3,accelerated scan-time 2:15min) acquisition for T1 mapping via variable flip angle method and evaluation of T1 values and acceleration effects.

Results: High-resolution non-gated abdominal imaging with the ability to clearly distinguish anatomy and T1 values,that did not deprecate when accelerated.

Impact: Well established methods for T1 mapping using cartesian/radial trajectories suffer from motion artifacts due to long acquisition duration.PETALUTE,a novel 3D dual-echo rosette k-space trajectory for preclinical UTE-MRI,is able to generate high-resolution non-gated abdominal anatomical images and T1 mapping in ~2min.

0576 Pitch: 13:30 Poster: 14:30 Screen 13



Normative trajectories of R1, R2*, and Susceptibility values of the healthy human brain cortex

Xinjie Chen[1,2,3], Po-Jui Lu[1,2,3], Mario Ocampo-Pineda [1,2,3], Matthias Weigel[1,2,3,4], Kwok-Shing Chan[5,6], Alessandro Cagol[1,2,3,7], Marcel Zwiers[8], Michelle G. Jansen[8], David G. Norris [8], Sabine Schädelin[1,2,3], Muhamed Barakovic[1,2,3], Jens Kuhle[2,3], Ludwig Kappos[2,3], Lester Melie-Garcia[1,2,3], Cristina Granziera[1,2,3], and José P Marques[8]

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Keywords: Quantitative Imaging, Quantitative Imaging

Motivation: Quantitative MRI (qMRI) offers sensitive and specific measures to study age-related microstructural changes in the brain. However, models assessing age trajectories in qMRI brain properties are often incomparable among centers.

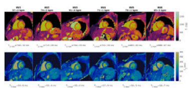
Goal(s): Develop normative models reflecting aging trajectories and assess the impact of bi-centric, non-fully matched protocols in brain aging studies.

Approach: Investigating age trajectories in cortical regions using polynomial regression models, focusing on quantitative R1, R2*, and susceptibility mapping (QSM).

Results: We validated data harmonization by observing the impact on normative trajectories using bicentric data, where we noted significantly different maturation and aging inflections for R1 and R2* trajectories across cortical regions.

Impact: This bi-centric, multi-parameter qMRI study investigates age-dependent variations across cortical regions, offering a valuable reference for subsequent qMRI aging research and emphasizing age effects on the cortical surface.

0577 Pitch: 13:30 Poster: 14:30 Screen 14



Cardiac Magnetic Resonance Fingerprinting for Simultaneous T1 and T2 Mapping at 0.55T

Carlos Castillo-Passi[1,2,3], Carlos Velasco[1], Donovan Tripp[1], Karl P. Kunze[1,4], Radhouene Neji[1], Pablo Irarrazaval[3,5,6], René M. Botnar[1,2,3,7,8], and Claudia Prieto[1,3,7]

[1]King's College London, London, United Kingdom, [2]Intitute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [3]Millennium Institute for Intelligent Healthcare Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [5]Insititute for Biological and Medical Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile, [6]Electrical Engineering Department, Pontificia Universidad Católica de Chile, Santiago, Chile, [7]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [8]Hans Fischer Senior Fellow Award, Institute for Advanced Study at Technical University of Munich, Munich, Germany

Keywords: MR Fingerprinting, Cancer

Motivation: Cardiac MRF (cMRF) allows for comprehensive myocardial tissue characterization in a single scan and has been investigated at 1.5T/3T. However, cMRF has not been demonstrated at low-field.

Goal(s): Investigate the feasibility of a bSSFP-cMRF sequence for simultaneous T1 and T2 mapping at 0.55T.

Approach: The proposed approach considers bSSFP radial readouts with varying IR and T2-preparation pulses over 16 heartbeats. bSSFP-cMRF was evaluated in phantoms and healthy subjects in comparison to reference maps.

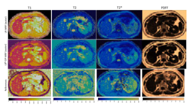
Results: bSSFP-cMRF at 0.55T shows excellent agreement with reference values in phantom and good image quality in healthy subjects with $T1$ and $T2$ values agreeing with the literature.

Impact: The simultaneous quantification of T1 and T2 at 0.55T in a single cardiac-MRF scan of 16s could provide an alternative to higher field scanners, allowing for a more accessible way to assess cardiovascular disease.

0578 Pitch: 13:30

Poster: 14:30

Screen 15



2D T1, T2, T2* and PDFF mapping in the kidney with rosette MRF using Hermitian low-rank and dictionary-patch based regularization

Gastao Cruz[1], Evan Cummings[1,2], Tom Griesler[1,2], Jesse Hamilton[1,2], Vikas Gulani[1], Matthew Davenport[1], and Nicole Seiberlich[1,2]

[1]Radiology, University of Michigan, Ann Arbor, MI, United States, [2]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

Keywords: MR Fingerprinting, Kidney, MRF; low-rank;

Motivation: Subjective qualitative T2-weighted, T1-weighted (with and without contrast) and fat suppressed images are currently used to characterize renal masses. Characterization could be improved and standardized by using objective, generalizable, quantiative criteria.

Goal(s): In this work, 2D single-breathhold, high-resolution T1/T2/T2*/PDFF mapping rosette MRF is deployed for kidney tissue characterization.

Approach: A novel MRF reconstruction is introduced to enable reduced MRF data collection time, incorporating separate low-rank models along the TE and TR domains, Hermitian symmetry via virtual coils, and a dictionary-patch based regularization.

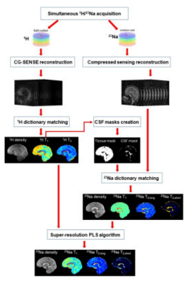
Results: In vivo results in healthy subjects demonstrate 2D 1x1x5 mm^3 T1/T2/T2*/PDFF MRF kidney mapping in a single breath-hold.

Impact: Simultaneous mapping of T1/T2/T2*/PDFF in the kidney in a single high-resolution breath-hold scan via the proposed MRF approach is feasible. This technique could bolster traditional pre-/post- contrast renal mass protocols with objective characterization methods.

0579 Pitch: 13:30

Poster: 14:30

Screen 16



Multinuclear fingerprinting (MNF): high-resolution simultaneous proton/sodium MR fingerprinting

Gonzalo Gabriel Rodriguez[1,2], Lauren O'Donnell[2], Zidan Yu[3,4], Martijn Cloos[5], and Guillaume Madelin[2]

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Keywords: MR Fingerprinting, Brain, 23Na, 1H

Motivation: Develop a method for high-resolution multinuclear fingerprinting (MNF).

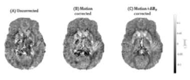
Goal(s): Generate high-resolution multi-parametric maps of proton and sodium nuclei.

Approach: The method consists of two steps:
1- Simultaneous acquisition of ^{1}H/^{23}Na MR fingerprinting (MRF) data resulting in high-resolution ^{1}H maps and low-resolution ^{23}Na maps
2- Application of a super-resolution algorithm to match the in-plane resolution of ^{23}Na maps to the in-plane high-resolution of the ^{1}H maps.

Results: Multinuclear fingerprinting (MNF) can generate high-resolution ^{1}H density, T_1, and T_2 maps and ^{23}Na density, T_1, T_{2long}, and T_{2short} maps in brain from simultaneous ^{1}H/^{23}Na MRF data acquired at 7 T in 21 min.

Impact: This method provides a novel approach towards the investigation of sodium maps as biomarkers for neurological diseases.

0580 Pitch: 13:30 Poster: 14:30 Screen 17



Robust motion- and $$$\delta B_0$$$ -correction for high-resolution QSM at 7T

Yannick Brackenier[1,2,3], Chiara Casella[1,4], Lucilio Cordero-Grande[1,2,5], Raphael Tomi-Tricot[1,2,6], Philippa Bridgen[1,3,7], Kawin Setsompop[8,9], Shaihan J Malik[1,2,3], and Joseph V Hajnal[1,2,3]

[1]Biomedical Engineering Department, School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]Centre for the Developing Brain, School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [3]London Collaborative Ultra high field System (LoCUS), London, United Kingdom, [4]Department for Forensic and Neurodevelopmental Sciences, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, [5]Biomedical Image Technologies, Universidad Politécnica de Madrid and CIBER-BNN, Madrid, Spain, [6]Siemens Healthcare Limited, Frimley, United Kingdom, [7]Guys and St Thomas' NHS Foundation Trust, King's College London, London, United Kingdom, [8]Department of Radiology, Stanford University, Palo Alto, CA, United States, [9]Department of Electrical Engineering, Stanford University, Palo Alto, CA, United States

Keywords: Signal Modeling, Susceptibility

Motivation: Quantitative susceptibility mapping (QSM) provides valuable clinical information and is widely used, especially at ultra-high field (7T). Due to long echo times, QSM acquisitions are extra sensitive to the changes in B_0 ($$$\delta\textbf{B}_0$$$), such as those secondary to motion.

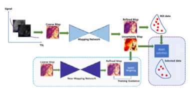
Goal(s): To provide purely data-driven motion **and** $$$\delta\textbf{B}_0$$$ correction for QSM.

Approach: We use the self-navigated DISORDER k-space re-ordering, originally proposed for motion correction, to additionally estimate $$$\delta\textbf{B}_0$$$. Within-scan motion and $$$\delta\textbf{B}_0$$$ are then retrospectively corrected during image reconstruction.

Results: We show improved reconstruction in all 5 scanned volunteers when additionally correcting $$$\delta\textbf{B}_0$$$. This directly improves QSM.

Impact: The proposed method can result in improved image quality when scanning in presence of motion and , e.g. due to heavy breathing. Combining this approach with an optimized QSM protocol will provide motion- and -robust QSM.

0581 Pitch: 13:30 Poster: 14:30 Screen 18



Using Aleatoric Uncertainty to Aid Deep Learning based T1rho Mapping and Analysis in the Liver

Chaoxing Huang[1,2], Vincent Wong[3], Queenie Chan[4], Winnie Chu[1,2], and Weitian Chen[1,2]

[1]Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Shatin, Hong Kong, [2]CUHK Lab of AI in Radiology, Shatin, Hong Kong, [3]Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Shatin, Hong Kong, [4]Philips Healthcare, Shatin, Hong Kong

Keywords: Quantitative Imaging, Liver

Motivation: The utility of uncertainty to ensure a reliable learning-based parametric mapping in quantitative MRI is underexplored.

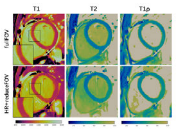
Goal(s): This study aimed to develop a reliable method for quantitative T1rho mapping of liver using uncertainty-based deep learning.

Approach: We proposed a parametric map refinement approach that trained the model probabilistically to estimate uncertainty in predicted T1rho values. The uncertainty map was used to enhance mapping performance and identify unreliable values in the region of interest.

Results: Testing on 51 patients with liver fibrosis showed a mapping error of less than 3% and simultaneous uncertainty estimation.

Impact: Our work demonstrates potential of saving scan time while preserving T1rho quantification accuracy. It is also shown that incorporating uncertainty estimation in the T1rho mapping network can improve the reliability of predicted values.

0582 Pitch: 13:30 Poster: 14:30 Screen 19



[High-resolution free-breathing simultaneous myocardial T1, T2 and T1ρ mapping with region-optimized virtual coils (ROVir)]

Zhenfeng Lyu[1,2], Sha Hua[3], Peng Hu[1,2], and Haikun Qi[1,2]

[1]School of Biomedical Engineering, ShanghaiTech University, Shanghai, China, [2]Shanghai Clinical Research and Trial Center, Shanghai, China, [3]Department of Cardiovascular Medicine, Ruijin Hospital Lu Wan Branch, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Keywords: Myocardium, Cardiomyopathy, Quantitative Imaging

Motivation: Cardiac parametric mapping with electrocardiogram-triggered single-shot acquisition has compromised spatial resolution due to limited quiescent period for data acquisition.

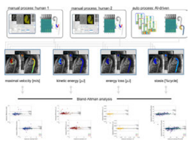
Goal(s): To develop a high-resolution simultaneous myocardial T1, T2 and T1ρ mapping technique.

Approach: Enhance the spatial resolution while reducing the FOV to make the acquisition window fit in the mid-diastolic quiescent period in the cardiac cycle. Subsequently, employ the ROVir technique to eliminate fold-over artifacts arising from FOV reduction.

Results: The proposed technique achieved high-resolution multi-parametric mapping without a loss of quantitative precision.

Impact: A novel framework was proposed to shorten the acquisition window and improve the spatial resolution of electrocardiogram-triggered cardiac parametric mapping beyond common k-space undersamping. High-resolution myocardial parametric mapping can provide more precise and reliable diagnostic information.

0583 Pitch: 13:30 Poster: 14:30 Screen 20



[Improving Reproducibility in Quantitative 4D Flow MRI Using AI-Driven Fully-Automated Processing and Analysis]

Ethan Johnson[1], Kai Yang[1], Elizabeth Weiss[1], Kelly Jarvis[1], Haben Berhane[1], Aparna Sodhi[2], Cynthia K Rigsby[2], and Michael Markl[1]

[1]Northwestern University, Chicago, IL, United States, [2]Ann & Robert H. Lurie Children's Hospital, Chicago, IL, United States

Keywords: Quantitative Imaging, Quantitative Imaging, 4D flow MRI, hemodynamics

Motivation: Reproducibility is fundamentally an issue for quantitative MRI, and any human intervention required for processing can be a significant source of variability.

Goal(s): This study aims to improve reproducibility in quantitative 4D flow MRI by removing all human input from processing, using AI-driven tools.

Approach: Hemodynamic parameters quantified by a fully automated neural-network-based processing tool for 4D flow MRI were compared to quantifications performed by two sets of human observers.

Results: Moderate but appreciable limits of agreement were observed between quantifications performed by different human observers. Quantified values from fully-automated processing were comparable to those from humans, but all inter-observer variability was eliminated.

Impact: This study offers a stable baseline for improving measurement reliability in quantitative 4D flow MRI by removing all manual human inputs required.

Power Pitch

Pitch: Validation & Simulation

Power Pitch Theatre 2

Tuesday
Pitches: 13:30 - 14:30
Posters: 14:30 - 15:30

Moderators: Anders Sandgaard & Lipeng Ning

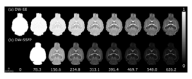
(no CME credit)

0584

Pitch: 13:30

Poster: 14:30

Screen 21



A modelling and experimental framework to investigate the sensitivity of steady-state diffusion MRI to microstructure

Zhiyu Zheng[1], Mohamed Tachrount[1], Karla L Miller[1], Michiel Cottaar[1], and Benjamin C Tendler[1]

[1]*Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom*

Keywords: Microstructure, Diffusion/other diffusion imaging techniques, Diffusion acquisition

Motivation: Diffusion-weighted steady-state free precession (DW-SSFP) has demonstrated higher SNR-efficiency vs the diffusion-weighted spin-echo (DW-SE) in post-mortem tissue. However, its sensitivity to microstructural features has not been comprehensively investigated.

Goal(s): To develop an investigation framework to quantify DW-SSFP's sensitivity to microstructure.

Approach: We combined Monte-Carlo simulations with phantom experiments incorporating diffusion hinderance/restriction and an ex-vivo mouse brain, comparing the estimated diffusion attenuation of DW-SSFP vs a DW-SE sequence with matched gradient waveforms and diffusion timings.

Results: DW-SSFP exhibited higher diffusion attenuation vs DW-SE in all tested substrates when gradient waveforms/timings are matched, suggesting its unique signal forming mechanisms may be highly sensitive to microstructure.

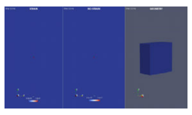
Impact: We present a framework combining Monte-Carlo simulations with experiments to characterise the sensitivity of diffusion-weighted steady-state free precession (DW-SSFP) to microstructure. DW-SSFP demonstrates greater signal attenuation versus a gradient waveform/timing-matched DW-SE across different substrates, demonstrating its potential for microstructural imaging.

0585

Pitch: 13:30

Poster: 14:30

Screen 22



A validated computational model of diffusion tensor imaging including cyclical strain and permeability

Ignasi Alemany[1,2], Sonia Nielles-Vallespin[2,3], Pedro F. Ferreira[2,3], Dudley J. Pennell[2,3], Andrew D. Scott[2,3], and Denis J. Doorly[1]

[1]*Imperial College London, London, United Kingdom,* [2]*Cardiovascular Magnetic Resonance Unit, Royal Brompton Hospital, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom,* [3]*National Heart and Lung Institute, Imperial College London, London, United Kingdom*

Keywords: Diffusion Modeling, Modelling, strain, diffusion, permeability, random walk, finite volume

Motivation: To investigate the effects of strain on diffusion where existing studies are limited to isotropic unrestricted media.

Goal(s): The aim of this study is to develop and validate a novel methodology that extends the classic Monte Carlo random walk algorithm to incorporate the effects of strain within complex media.

Approach: Strain is included in the MCRW simulations displacing the geometry and the particles in each time step and is validated against established finite volume (FV) methods and an analytical solution for free diffusion.

Results: We demonstrate the ability to assess changes in the diffusion tensor due to cyclical strain and long diffusion times.

Impact: The updated MCRW model offers new capabilities for quantifying strain-induced biases in diffusion tensor CMR metrics enabling clinicians to more accurately interpret microstructural changes, particularly in patients with pathological alterations.

0586

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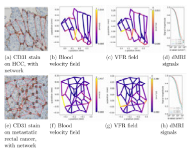
Pitch: 13:30

Poster: 14:30

Screen 23



FlowSim: a blood flow simulator for histology-informed diffusion MRI micro-vasculature mapping in cancer

Anna Voronova[1,2], Athanasios Grigoriou[1,2], Kinga Bernatowicz[1], Sara Simonetti[3,4], Garazi Serna[3], Núria Roson[5,6], Manuel Escobar[5,6], Maria Vieito[7,8], Paolo Nuciforo[3], Rodrigo Toledo[9], Elena Garralda[10], Roser Sala-Llonch[11,12], Marco Palombo[13,14], Raquel Perez-Lopez[1], and Francesco Grussu[1]

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Keywords: Simulation/Validation, Perfusion, cancer, IVIM, microvasculature

Motivation: Open-source software for simulating diffusion MRI (dMRI) signals arising from micro-vascular perfusion is needed to inform the development of new techniques for non-invasive vascular characterization.

Goal(s): To present *FlowSim*, a micro-vasculature perfusion dMRI signal simulator, demonstrating its utility for *in vivo* vascular property estimation.

Approach: *FlowSim* estimates blood velocities in all segments of custom vascular networks. These are used to calculate spin trajectories in the presence of arbitrary diffusion-encoding gradients.

Results: *FlowSim* synthesizes dMRI signals from realistic vascular networks reconstructed from histology. These can be used to inform the estimation of capillary blood velocity distributions *in vivo*, showcased herein in cancer.

Impact: We present *FlowSim*, a simulator of diffusion MRI (dMRI) signals arising from micro-vasculature perfusion. *FlowSim* synthesizes dMRI signals from realistic vascular networks reconstructed from histology, and informs the estimation of new microvasculature metrics *in vivo*, needed, for example, in cancer.

0587

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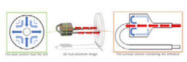
Screen 24



Evaluation of slow flow measurement with low b-value diffusion tensor imaging using fluid phantoms in comparison with 4D-flow

Tatsuya Oki[1], Yoshitaka Bito[2], Shinnosuke Hiratsuka[1], Masahiro Yoshimura[1], and Yoshiyuki Watanabe[1]

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Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging

Motivation: Is low b-value diffusion tensor imaging (low-b DTI) useful for analyzing cerebrospinal fluid flow, which is a slow and complex flow that is difficult to measure?

Goal(s): To validate low-b DTI for analyzing the slow flow.

Approach: To compare low-b DTI with 4D-flow in the fluid phantom where water flowed at a constant slow rate.

Results: A strong correlation between the mean diffusivity of Low-b DTI and the mean square of deviation of velocity of 4D-flow, which is supported by the theory that these correlate in laminar flow.

Impact: If low b-value diffusion tensor imaging is useful for analyzing slow and complex flows of cerebrospinal fluid, it should contribute to understanding the pathogenesis of various diseases in which impaired cerebrospinal fluid clearance system may be part of the etiology.

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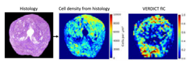

<u>Validation of in vivo VERDICT fIC against matched histology from whole-mount prostatectomy</u>

Marta Masramon Munoz[1], Manju Mathew[2], Saurabh Singh[2,3], Thomy Mertzanidou[1], Shipra Suman[1,2], Joey Clemente[2], Adam Retter[2], Marianthi-Vasilik Papoutsaki[2], Lorna Smith[2], Francesco Grussu[1,4,5], Veeru Kasivisvanathan[6], Alistair Grey[7,8], Eoin Dineen[6], Greg Shaw[6,7,8], Martyn Carter[9], Dominic Patel[10], Lucy Caselton[2], Caroline M. Moore[6], David Atkinson[2], Aiman Haider[11], Alex Freeman[11], Daniel Alexander[1], Shonit Punwani[2], and Eleftheria Panagiotaki[1]

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Keywords: Simulation/Validation, Validation, Prostate cancer diffusion VERDICT

Motivation: Intracellular volume fraction (fIC) maps from VERDICT-MRI have shown potential to improve prostate cancer (PCa) stratification, but the microstructural origin of the signal has not yet been investigated in in vivo settings.

Goal(s): Investigate the accuracy of fIC from in vivo VERDICT-MRI as a measurement of cell density using matched prostatectomy specimens.

Approach: Using personalised moulds from multiparametric (mp)MRI and deep learning image registration, we align whole prostatectomy histology images with corresponding VERDICT MR images. We compare fIC maps against cell density maps derived from histology.

Results: fIC maps show very strong agreement with histology-derived cell density maps of epithelial cells (r=0.8303).

Impact: Our study shows that VERDICT fIC maps are accurate descriptors of epithelial cell density in the prostate. The biological interpretability of these maps will facilitate translation into clinical practice, improving PCa stratification from MRI.

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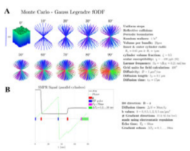

<u>Towards a Standard Model of Diffusion in White Matter with Phase and Relaxation – A Monte-Carlo Study</u>

Anders Dyhr Sandgaard[1], Valerij G. Kiselev[2], Noam Shemesh[3], and Sune Nørhøj Jespersen[1,4]

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Keywords: Microstructure, Microstructure

Motivation: Improving parameter estimation for the standard model of diffusion in white matter (SM) by modelling the subsequent decay of the spin-echo of the dMRI signal.

Goal(s): To numerically validate SMPR - an extension of SM incorporating orientation-dependent, susceptibility related relaxation rates and Larmor frequency shifts of the spin echo decay of the dMRI signal.

Approach: To perform Monte-Carlo (MC) simulations in orientationally dispersed, non-exchanging bundles of hollow magnetized cylinders, simulate a standard PGSE signal and its spin echo decay, and compare against the SMPR model.

Results: SMPR is in agreement with the MC simulations in both phase and signal magnitude.

Impact: Orientation-dependent susceptibility effects may improve parameter estimation of the Standard Model of diffusion in white matter and enable rotation-free mapping of susceptibility-related parameters.

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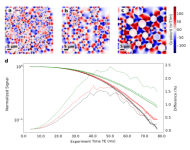
Screen 27



In-silico study of internal gradient distribution effects on diffusion-weighted signals of white matter tracts models at 9.4 T

Jesus Fajardo[1,2] and Gonzalo A. Alvarez[1,2,3]

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Keywords: Microstructure, Susceptibility, Internal Gradient, IGDT, white matter

Motivation: Non-invasively detecting tissue microstructure changes associated with pathologies holds immense diagnostic promise. Our approach complements conventional DWI methods by capturing distinct microstructural information.

Goal(s): We investigate the relationship between axon microstructure parameters and Internal Gradients distributions' influence on MRI signals.

Approach: We employed the Finite Perturber Method (FPM) to calculate intravoxel magnetic gradients and MonteCarlo simulations to simulate the spins diffusion using a MGSE sequence.

Results: Our findings demonstrate up to 2.5 % signal variations when incorporating Internal Gradient Distribution terms, offering insights into signal behavior with varying microstructure parameters.

Impact: The complementary findings of addressing non-invasive tissue-microstructure changes based on probing internal gradients paves the way for early pathological detection. This empowers clinicians to in-depth investigations, transforming our approach to diagnostics and enhancing healthcare outcomes.

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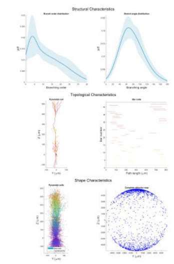
Screen 28



Tuneable Digital Phantoms for Grey Matter Modelling

Charlie Aird-Rossiter[1], Lida Kanari[2], Herman Cuntz[3], Derek Jones[1], and Marco Palombo[1]

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Keywords: Simulation/Validation, Simulations

Motivation: There are several generators of white matter phantoms that have been developed in recent years and have significant potential in developing and validating diffusion MRI techniques through computational simulation. However, no such generator has been proposed for grey matter phantoms.

Goal(s): We aim to provide a means of generating grey matter phantoms compatible with diffusion MRI simulations.

Approach: Combing the network growth presented in the Contextual Fibre Growth (ConFiG) algorithm with the generative method of topological neuro synthesis (TNS), to create non intersecting morphologically realistic cellular structures.

Results: We can show that our algorithm can generate non-intersecting realistic voxels of grey matter.

Impact: We have developed a highly versatile algorithm, ConCeG, which can generate realistic digital phantoms of GM. These phantoms are ready to be incorporated into dMRI simulators, such as Camino, DiSimPy and MCDS for testing and validating diffusion MRI techniques

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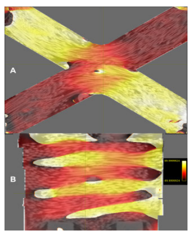

Elucidating Micro-scale Fiber Trajectories at 16μ in Anisotropic Phantoms via Structural Tensor Analysis

Sudhir Kumar Pathak[1], Rolf Pohmann[2], Nikolai Ivanovich Avdievitch[2], Klaus Scheffler[2,3], Anthony Zuccolotto[4], Yijen Wu[5], and Walter Schneider[6,7,8,9,10]

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Keywords: Phantoms, Phantoms, Validation, microstructural Imaging

Motivation: This study utilizes a custom-designed fiber crossing configuration based on **anisotropic textile hollow fiber phantom** and harnesses high-resolution **14T MRI** to unravel manufactured fiber crossings at a microscopic scale.

Goal(s): By applying structural tensor analysis in combination with eigenvalue decomposition, we have estimated underlying fiber orientations and visualized in multi-planar, directional-color-encoded maps.

Approach: This innovative approach yielded precise angular measurements across the volume to delineate the expected fiber orientation and crossing angles, thereby validating the structural tensor method's efficacy in capturing complex fiber architecture within a controlled environment.

Results: This Phantom can provide a ground truth for validating diffusion MRI based crossing assessments.

Impact: This research presents a pivotal advancement for validating MRI-based fiber crossing, offering a novel phantom design for assessing the accuracy and limitations of MRI methods in resolving complex fiber architectures in biological tissues.

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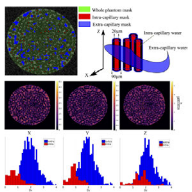

An anisotropic capillary based phantom for validation of diffusion-relaxation models

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Keywords: Simulation/Validation, Phantoms

Motivation: We aim to create a universal procedure for experimental verification of diffusion models using model systems based on glass capillaries.

Goal(s): Spatially ordered glass capillaries mimics the characteristic geometry of white matter and are ideal for performing a 'stress test' of various diffusion models. We aim to verify this through diffusion and relaxation measurements at varying spatial directions and time scales.

Approach: Combined diffusion- and relaxation-weighted MRI based measurements verify the geometry of the glass capillaries at different spatial scales.

Results: The glass capillary phantom was established as a ground truth model for modelling of white matter at different diffusion and relaxation regimes.

Impact: Glass capillaries present a unique object with simple physical and geometrical features mimicking white matter. We tested a glass capillary phantom in terms of a diffusion-relaxation model using conventional sequences and provide a simple theoretical interpretation of experimental results.

0594

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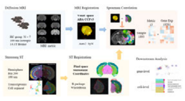
Screen 31



[Spatial Imaging Transcriptomic reveals the molecular basis among diffusion MRM models]

Yiqi Shen[1], Yao Shen[1], Zuozhen Cao[1], Sihui Li[1], Guojun Xu[1], Zhiyong Zhao[1], and Wu Dan[1]

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Keywords: Microstructure, Microstructure, Spatial Imaging Transcriptomic;Data Integration;Mouse Brain

Motivation: Integration of MRI and spatial transcriptomics may provide a new approach for imaging-genetics research for probing molecular basis underlying observed MRI phenotypes.

Goal(s): We proposed a pipeline for integration of diffusion MRI(dMRI) and spatial transcriptomics of mouse brain to understand potential biological pathway underlying dMRI microstructural models.

Approach: We spatially co-register population-averaged dMRI maps of mouse brain to 2D spatial transcriptomic for pixelwise correlation and explored genes function and celltype related with dMRI metrics.

Results: We found FA was associated with myelination and oligodendrocyte and water diffusivity was associated with neurons. We identified molecular basis driving two distinct gradients of dMRI in cortex.

Impact: Integration of spatial transcriptomics and MRI enables imaging-genomics analysis at an unprecedented resolution. Our study revealed molecular basis for typical microstructural markers in diffusion MRI. We further revealed genetic driven force of cortical gradients in axial and radial diffusivity maps.

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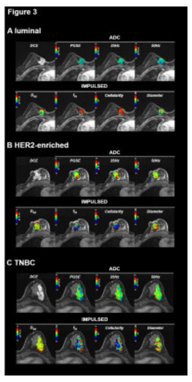
Screen 32



[Identify molecular subtypes in breast cancer using time-dependent diffusion MRI based microstructural mapping]

Xiaoxia Wang[1], Ruicheng Ba[2], Ting Yin[3], Dan Wu[2], and Jiuquan Zhang[1]

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Keywords: Microstructure, Breast

Motivation: It is imperative to noninvasively assess molecular subtypes in patients with breast cancer, as these play a vital role in guiding treatment approaches and monitoring outcomes. However, conventional apparent diffusion coefficient measurements may not reliably identify the histopathologic differences in molecular subtypes.

Goal(s): We explore the feasibility of time-dependent diffusion MRI (t_d-dMRI) based microstructural mapping for noninvasive identification of molecular subtypes.

Approach: The t_d-dMRI method was validated on breast cancer patients, and microstructural parameters were estimated and compared among molecular subtypes.

Results: The cellularity and diameter derived from t_d-dMRI proved effective for identifying molecular subtypes in breast cancer.

Impact: Microstructural mapping derived from td-dMRI proves to be an effective method for predicting molecular subtypes, demonstrating unique microstructural properties acroess various molecular subtypes, and thus is promising in personalizing treatment strategies.

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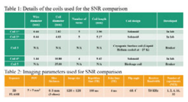

High-Resolution MR Microscopy of Mouse Spinal Cord at 15.2 T

Bibek Dhakal[1,2], Benjamin M. Hardy[1,2], Adam W. Anderson[2,3,4], Mark D. Does[2,3,4], Junzhong Xu[1,2,3,4], and John C. Gore[1,2,3,4]

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Keywords: Microstructure, Microstructure, MR microscopy, Diffusion MR microscopy, Micro-solenoid RF coils, Ultra-high field strength, Mouse spinal cord

Motivation: The research aims to overcome the challenges of performing microscopy to assess the microstructure of mouse spinal cords at high spatial resolution.

Goal(s): Our goal is to develop a micro-solenoid radiofrequency circuit, which combined with ultra-high field strength and fast imaging sequences, including diffusion MRI, can achieve microscopic-resolution images.

Approach: The study involves the development of a micro-solenoid transceiver coil, and imaging at 15.2 T using fast diffusion imaging sequences to achieve images of excised specimens at microscopic resolution.

Results: The micro-solenoid radiofrequency circuit significantly improved SNR, enabling high-resolution imaging and accurate data sets for implementing diffusion models at micron-scale resolution.

Impact: High-resolution diffusion imaging may provide estimates of diffusion parameters at a scale more commensurate with the microstructure of the spinal cord than in vivo acquisitions. This will be useful for validating models of water diffusion in complex environments neuronal tissue.

0597 Pitch: 13:30 Poster: 14:30 Screen 34

Diffusivity and kurtosis time-dependence changes in the rat brain during somatosensory evoked response

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Keywords: Microstructure, Gray Matter, Microstructure, Permeability, fMRI (task based), Multimodal, Small Animals, Preclinical

Motivation: The microstructure-function relationship is essential for our understanding of the healthy and pathological human brain.

Goal(s): In this context, the goal of our study was to investigate microstructural changes arising in the brain during neuronal activity.

Approach: Differences in mean diffusivity ***MD*** and mean kurtosis ***MK*** time-dependence between rest and active states were assessed in the somatosensory cortex following rat forepaw stimulation.

Results: While no changes were found in control cortical regions, the BOLD-fMRI positive cluster presented a significant decrease in ***MD*** and ***MK*** during activation. Interestingly, subcortical somatosensory relays displayed the opposite trend which could result from changes in inhibitory/excitatory balance.

Impact: Neuronal activity is accompanied by a myriad of microstructural changes. The diffusion-weighted signal sensitivity to underlying brain microstructure brings new perspectives into the structure-function relationship along with the promise of a functional contrast unbound from the current limitations of BOLD-fMRI.

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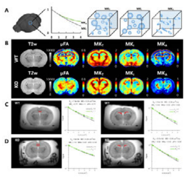
Screen 35



Tensor-Valued Diffusion MRI Identifies Brain Microstructural Alterations in Gene Knockdown Mouse

Jianyu Yuan[1,2], Yuxuan Liu[1,2], Shuai Li[1,2], Mingyao Liang[1,2], Yi He[1,2], Huanhuan He[1,2], and Hong Shan[1,2]

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Keywords: Microstructure, Brain Connectivity, Tensor-Valued Diffusion MRI, Microscopic anisotropy kurtosis (MKA) , Genetic diseases

Motivation: DEAD-box helicase 24 (DDX24) gene mutations linked to abnormalities of major vessels[1]. However, the effect of the gene DDX24 on brain microstructure remains unclear.

Goal(s): Our goal was to demonstrate how advanced tensor-valued diffusion MRI can reveal microstructural alterations in a Ddx24 knockdown mouse model.

Approach: We performed advanced tensor-valued diffusion MRI to examine Ddx24 knockdown mouse brain and evaluated the performance of Ddx24 knockdown mice in the Morris water maze test.

Results: Ddx24 knockdown mouse revealed declining microscopic anisotropy kurtosis (MK_A) in corpus callosum and hippocampus. Tensor-valued diffusion MRI is a sensitive neuroimaging tool to evaluate gene-edited mouse brain microstructural alterations.

Impact: Advanced tensor-valued diffusion MRI provided cylinders shapes sensitive MK_A and spherical shapes sensitive MKI for detecting microstructural alterations in genetic diseases.

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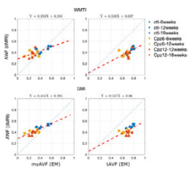
Screen 36



Sensitivity of quantitative MRI to demyelination and axonal loss: validation against myelinated and unmyelinated axons from histology

Ali Abdollahzadeh[1,2], Ricardo Coronado-Leija[1,2], Elizabeth Chasen[1,2], Dmitry S. Novikov[1,2], and Els Fieremans[1,2]

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Keywords: Microstructure, White Matter, Standard Modeling, Axon, Myelin, Unmyelinated axons, Diffusion, Validation, Axon loss, Segmentation, Electron microscopy

Motivation: Attaining microstructural specificity to myelinated/unmyelinated axons from macroscopic *in vivo* quantitative MRI.

Goal(s): Quantifying changes of myelinated and unmyelinated axons using dMRI.

Approach: We apply compartmental diffusion models of white matter, White Matter Tract Integrity (WMTI) and Standard Model Imaging (SMI) to the dMRI signal. We also measure Magnetic Transfer Resonance and R2. We develop automated techniques to segment 2d transmission electron microscopy (TEM) images of white matter into their constituent microstructure and apply volumetric analysis.

Results: We measured axonal water fraction (AWF) using WMTI and SMI. AWF correlated strongly with our EM volumetric analysis of myelinated and unmyelinated axons.

Impact: Demyelination and axonal loss occur in neurodegenerative pathologies. This validation study reveals specificity of R2 to myelin volume, while AWF from dMRI detects both unmyelinated and unmyelinated axons. Combining both modalities has the potential to differentiate demyelination from axonal loss.

0600 Pitch: 13:30 Poster: 14:30 Screen 37

How does dMRI signal evolve during diffusion encoding: theoretical analysis and numerical simulations for Gaussian diffusion

Fan Liu[1], Li Chen[2], Sisi Li[1], Quanshui Zheng[2], Hua Guo[1], Junzhong Xu[3,4,5,6], and Diwei Shi[2]

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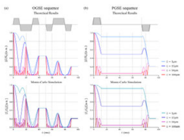

Keywords: Microstructure, Microstructure, dMRI signal analysis

Motivation: Until now, most attention has been focused on the final dMRI signals acquired, ignoring the signal evolution during diffusion encoding. However, the methods, which incorporated water exchange between compartments into modelling to extract more comprehensive tissue information, need to consider the signal evolution within the different compartments, as described in Karger model.

Goal(s): Figure out the dMRI signal evolution in the simplest case: Gaussian diffusion.

Approach: Theoretical analysis, Monte-Carlo and finite difference simulations.

Results: Signal-evolution curves provided by analytical expressions and numerical simulations are consistent. An “observation-size” effect emerges, the signal-evolution curve depends on the spatial size of the observation area.

Impact: Clarifying the actual dMRI signal evolution during diffusion encoding will inspire us to revisit the theoretical framework of Karger model. The results show that it is necessary to revise the current Karger-model-based methods for the “observation-size” effect.

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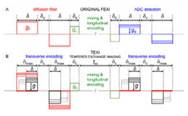
Tuned Exchange Imaging (TEXI) – A modified Filter-Exchange Imaging pulse sequence for applications with thin slices and restricted diffusion

Samo Lasic[1,2], Arthur Chakwizira[3], Henrik Lundell[2,4], Carl-Fredrik Westin[5], and Markus Nilsson[6]

[1]Department of Diagnostic Radiology, Lund University, Lund, Sweden, [2]Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital - Amager and Hvidovre, Copenhagen, Denmark, [3]Department of Medical Radiation Physics, Lund University, Lund, Sweden, [4]MR Section, DTU Health Tech, Technical University of Denmark, Lyngby, Denmark, [5]Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States, [6]Department of Clinical Sciences Lund, Radiology, Lund University, Lund, Sweden



Keywords: Diffusion Acquisition, Diffusion/other diffusion imaging techniques, exchange, restricted diffusion

Motivation: Thin slices in filter-exchange imaging lead to biased exchange rates, as thin slices require strong crushers. No current approach accounts for crushers in the presence of restricted diffusion.

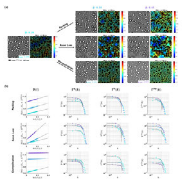
Goal(s): We set to address the bias in FEXI due to the influence of strong crushers and restricted diffusion.

Approach: Tuned exchange imaging (TEXI) relies on gauging exchange and restriction weighting. We modify FEXI to ensure constant restriction weighting also with strong crushers. The accuracy of exchange mapping was evaluated using Monte Carlo simulations.

Results: TEXI yields consistent exchange rates independent of slice thickness and restriction size even if strong crushers are used.

Impact: TEXI could be useful to maximize exchange sensitivity and specificity with thin slices and in the presence of restricted diffusion.

0602 Pitch: 13:30 Poster: 14:30 Screen 39



[Coarse-graining with time-dependent diffusion reveals signatures of demyelination and axonal loss]

Ricardo Coronado-Leija[1,2], Hong-Hsi Lee[3,4], Els Fieremans[1,2], and Dmitry S. Novikov[1,2]

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Keywords: Simulation/Validation, Diffusion/other diffusion imaging techniques

Motivation: Time-dependent diffusion $D(t)$ is sensitive to brain microstructure. Using Monte Carlo (MC) simulations, $D(t)$ has been shown to provide information about structural changes caused by pathological conditions.

Goal(s): To establish the relation between the parameters of $D(t)$ and the extra-axonal space geometry.

Approach: We solve the Fick-Jacobs equation in the effective medium framework, connect $D(t)$ to correlations of density and local diffusivity, and validate with Monte-Carlo simulations.

Results: Time-dependence of $D(t)$ is quantitatively related to geometric characteristics of axonal packing, demyelination and axonal loss.

Impact: By coarse-graining the extra-axonal space, time-dependent diffusion explores the geometry relevant for demyelination and axonal loss, enabling quantifying axonal microstructure.

0603 Pitch: 13:30 Poster: 14:30 Screen 40

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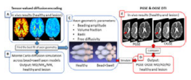

[Neurite Beading Model of Acute Stroke from Tensor-Valued Diffusion Encoding Predicts Diffusion Time Effects with Oscillating Gradients]

Mi Zhou[1], Robert Stobbe[1,2], Matthew Budde[3], and Christian Beaulieu[1,2]

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Keywords: Simulation/Validation, Simulations

Motivation: Can two different diffusion experiments (tensor-valued encoding and oscillating-gradient-spin-echo) support the role of axon beading for diffusion restriction in acute ischemic stroke?

Goal(s): To evaluate whether tensor-valued diffusion encoding yields an axon beading model that predicts experimental ischemic changes of diffusivity measured with OGSE.

Approach: Tensor-valued and OGSE/PGSE diffusion MRI were measured in the same acute stroke patients. Monte Carlo simulations were used to assess the links between these two independent measurements.

Results: The tensor-valued derived beading model predictions were in general agreement with independent experiments of less diffusivity reduction with OGSE than PGSE within stroke lesions.

Impact: Novel diffusion MRI sequences such as tensor-valued encoding and oscillating-gradient-spin-echo are complementary methods that point to the same microstructural basis (i.e. beading and elevated intra-cellular volume fraction) for the clinically useful diffusion reduction in acute ischemic stroke.

Power Pitch

Pitch: Cardiovascular Tissue Characterization & Functional Assessment

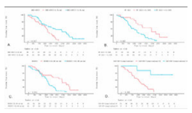
Power Pitch Theatre 3

Tuesday
Pitches: 13:30 - 14:30
Posters: 14:30 - 15:30

Moderators: Daniel Kim

(no CME credit)

0604 Pitch: 13:30 Poster: 14:30 Screen 41



Right ventricular electromechanical discoordination predict long-term clinical outcomes in patients with pulmonary arterial hypertension

Wen Li[1], Xu-yang Chang[2], Xian-chang Zhang[3], Yu-ling Qian[1], Jens Wetzl[4], Qing Gu[1], and Jian-guo He[1]

[1]Fuwai Hospital, Chinese Academy of Medical Sciences, Beijing, China, [2]Université Paris-Saclay, CentraleSupélec, ENS Paris-Saclay, CNRS:LMPS, Paris, France, [3]MR Research Collaboration, Siemens Healthineers Ltd., Beijing, China, [4]MR Application Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany

Keywords: Heart Failure, Myocardium, pulmonary hypertension; electromechanical discoordination;

Motivation: Non-invasive and accurate evaluation of right ventricular (RV) function in pulmonary arterial hypertension (PAH) is of urgent need in clinical practice.

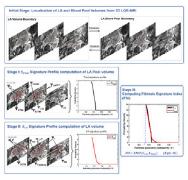
Goal(s): To investigate the clinical implications of RV electromechanical dyssynchrony which were non-invasively derived from cardiac MRI.

Approach: Calculate systolic stretch fraction (SSF) and diastolic relaxation fraction (DRF) based on strain MRI and test their prognostic values in an observation prospective PAH cohort.

Results: SSF-RV-Longitudinal could independently predict the clinical worsening.

Impact: The present study first reported SSF-RV-Longitudinal as a novel parameter to evaluate RV function, which could predict the clinical worsening in PAH patients.

0605 Pitch: 13:30 Poster: 14:30 Screen 42



Novel Robust Threshold-Free Probabilistic 3D LGE Fibrosis Signature Technique for Left Atrial Fibrosis Quantification

Mehri Mehrnia[1,2], Eugene Kholmovski[3], Daniel Kim[4], Aggelos Katsaggelos [4,5,6], Rod Passman[4], and Mohammed S.M. Elbaz[1]

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Keywords: Arrhythmia, Arrhythmia, atrial fibrillation, 3D LGE, fibrosis, signature

Motivation: Left atrial fibrosis assessment from 3D LGE-MRI is pivotal for predicting atrial myopathy and AF recurrence. However, current methods are clinically ineffective and sensitive to data uncertainties such as noise and inter-observer variability of thin LA wall segmentation

Goal(s): Hence, we propose a novel, robust, and standardized probabilistic 3D LGE fibrosis signature technique for quantifying fibrosis burden.

Approach: Our threshold-free signature technique probabilistically encodes multi-billion LGE intensity comparisons from the entire LA volume (not just LA wall).

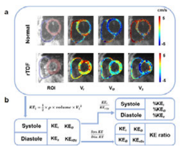
Results: We evaluated feasibility of our threshold-free method in quantifying LA fibrosis burden, and its stability against Rician noise and interobserver variability of LA volume segmentation.

Impact: Our signature technique as an index of fibrosis burden is highly robust to inherent scan uncertainties including high power Rician noise and inter-observer LA segmentation variability. As a result, our method increases potential clinical utility of 3D LGE MRI

0606 Pitch: 13:30

Poster: 14:30

Screen 43



Biventricular Myocardial Kinetic Energy Distribution in Patients With Repaired Tetralogy of Fallot

Shih-En Hsu[1], Ming-Ting Wu[2], Ken-Pen Weng[3], and Hsu-Hsia Peng[1]

[1]Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Taiwan, Hsinchu, Taiwan, [2]Department of Radiology, Kaohsiung Veterans General Hospital, Taiwan, Hsinchu, Taiwan, [3]Department of Pediatrics, Kaohsiung Veterans General Hospital, Taiwan/Department of Pediatrics, National Yang-Ming University, Taiwan, Hsinchu, Taiwan

Keywords: Myocardium, Heart

Motivation: Patients with repaired Tetralogy of Fallot (rTOF) have varied cardiac structures, yet there's a current lack of analysis on their cardiac kinetic energy.

Goal(s): We aim to assess myocardial kinetic energy (KE) differences between patients and normal groups.

Approach: We utilized tissue phase mapping images combined with MATLAB programs to calculate myocardial kinetic energy.

Results: The results revealed differences in myocardial kinetic energy values between patients and normal groups. Besides, significant variations were observed in the proportional values across three directions, along with notable differences in the KE systolic-to-diastolic ratio of the right ventricle.

Impact: Differential myocardial kinetic energy serves as a novel indicator for evaluating cardiac function in rTOF patients. It aids in early detection of cardiac abnormalities, potentially identifying the optimal timing for pulmonary valve replacement surgery.

0607 Pitch: 13:30

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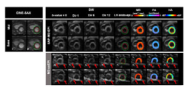
Poster: 14:30

Screen 44



Mitigating Geometric Distortion & Susceptibility Artifacts in cDTI via SAP-M2-EPI: A feasibility study

Mehdi Sadighi[1], Danielle Kara[1], Dingheng Mai[1], Khoi Nguyen[1], Shi Chen[1], Deborah Kwon[1], and Christopher Nguyen[1]

[1]Cardiovascular Innovation Research Center (CIRC), Heart, Vascular, and Thoracic Institute, Cleveland Clinic, Cleveland, OH, United States

Keywords: Myocardium, Heart, cardiac diffusion, Motion compensated gradients, Aliasing, geometric distortion, PROPELLER MRI

Motivation: We aimed to enhance in vivo cardiac diffusion tensor imaging (cDTI), a technique challenged by limitations, especially in high-BMI patients, causing notable aliasing and distortion issues.

Goal(s): Our primary goal was to introduce and validate Short-Axis-PROPELLER-M2-EPI (SAP-M2-EPI) for cDTI. The focus was on reducing aliasing and distortion artifacts while ensuring robust motion correction.

Approach: SAP-M2-EPI combines motion-compensated diffusion gradients with PROPELLER, effectively minimizing motion artifacts and suppressing aliasing and distortion.

Results: Our study shows that SAP-M2-EPI successfully mitigates motion artifacts and significantly reduces aliasing and distortion, particularly beneficial for high-BMI patients. This innovative approach holds great promise for enhancing cDTI diagnostic accuracy.

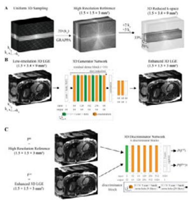
Impact: Impact: SAP-M2-EPI's success offers clinicians a potent tool for enhancing cDTI diagnoses, especially in high-BMI patients. It opens doors to in-depth cardiac research, encourages further methodological innovations, and ultimately promises better patient care through more accurate imaging.

0608 Pitch: 13:30

MERIT AWARD MAGNA CUM LAUDE

Poster: 14:30

Screen 45



3D Image Enhancement for High-Resolution ky-kz Accelerated 3D LGE CMR

Omer Burak Demirel[1], Manuel A Morales[1], Jordan A Street[1], Warren J Manning[1,2], and Reza Nezafat[1]

[1]*Department of Medicine (Cardiovascular Division), Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States,* [2]*Radiology, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States*

Keywords: Myocardium, Cardiovascular

Motivation: Prolonged scan times in high-resolution 3D late gadolinium enhancement (LGE) cardiovascular magnetic resonance (CMR) imaging hinders the full potential in clinical applications.

Goal(s): The primary goal of this study was to develop and evaluate a 3D enhanced-resolution for 2D (k_y-k_z) accelerated 3D LGE imaging.

Approach: A 3D generative adversarial network was implemented to enhance the spatial resolution of 2D-accelerated 3D LGE images.

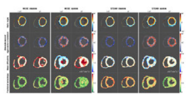
Results: The proposed method at 6-fold acceleration (3-fold in k_y and 2-fold in k_z) maintained intricate scar details and improved image quality.

Impact: The improvement in acquisition speed by 2D acceleration may benefit patients presenting with heavy respiratory motion and may be less sensitive to contrast washout.

0609 Pitch: 13:30

Poster: 14:30

Screen 46



In vivo STEAM and motion compensated spin echo diffusion tensor CMR in multiple cardiac phases: The effect of field strength

Andrew Scott[1,2], Ke Wen[1,2], Yaqing Luo[1,2], Jiahao Huang[1,3], Simon Gover[1], Rajkumar Soundarajan[1], Pedro F Ferreira[1,2], Dudley J Pennell[1,2], and Sonia Nielles-Vallespin[1,2]

[1]*CMR Unit, The Royal Brompton Hospital, London, United Kingdom,* [2]*National Heart and Lung Institute, Imperial College London, London, United Kingdom,* [3]*Bioengineering, Imperial College London, London, United Kingdom*

Keywords: Myocardium, Magnets (B0)

Motivation: Diffusion tensor cardiovascular magnetic resonance (DT-CMR) studies described in the literature have almost uniquely been performed at 3T while 1.5T scanners are more widely available.

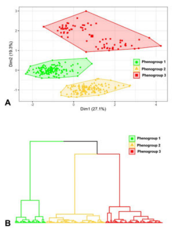
Goal(s): To compare the performance and microstructural parameters available from stimulated echo (STEAM) and motion compensated spin echo (MCSE) DT-CMR sequences at 1.5T and 3T.

Approach: DT-CMR was performed in 20 healthy volunteers using both sequences at both field strengths at peak systole and end diastole.

Results: MCSE and STEAM sequences are effective at both 1.5T and 3T. STEAM benefits from the increased SNR available at 3T.

Impact: DT-CMR studies should consider making use of 1.5T hardware where access to 3T scanners is more difficult particularly where MCSE sequences are to be used with systolic triggering.

0610 Pitch: 13:30 Poster: 14:30 Screen 47



Phenotypic clustering using cardiovascular magnetic resonance for risk stratification in beta-thalassemia major

Antonella Meloni[1], Laura Pistoia[1], Antonino Vallone[2], Riccardo Righi[3], Gennaro Restaino[4], Nicolò Schicchi[5], Emanuele Grassedonio[6], Stefania Renne[7], Ada Riva[8], Paola Maria Grazia Sanna[9], Monica Benni[10], Filippo Cademartiri[1], and Vincenzo Positano[1]

[1]Fondazione G. Monasterio CNR-Regione Toscana, Pisa, Italy, [2]Azienda Ospedaliera "Garibaldi" Presidio Ospedaliero Nesima, Catania, Italy, [3]Ospedale del Delta, Lagosanto (FE), Italy, [4]Gemelli Molise SpA, Fondazione di Ricerca e Cura "Giovanni Paolo II", Campobasso, Italy, [5]Azienda Ospedaliero-Universitaria Ospedali Riuniti "Umberto I-Lancisi-Salesi", Ancona, Italy, [6]Policlinico "Paolo Giaccone", Palermo, Italy, [7]Presidio Ospedaliero "Giovanni Paolo II", Lamezia Terme (CZ), Italy, [8]Ospedale "SS. Annunziata" ASL Taranto, Taranto, Italy, [9]Azienda Ospedaliero-Universitaria di Sassari, Sassari, Italy, [10]Policlinico S. Orsola "L. e A. Seragnoli", Bologna, Italy

Keywords: Myocardium, Heart

Motivation: Machine learning algorithms provide a means to uncover hidden patterns within complex and heterogeneous datasets.

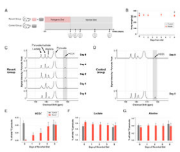
Goal(s): We aimed to identify phenogroups among patients with β-thalassemia major (TM) using an unsupervised clustering approach based on demographic, clinical, and CMR data.

Approach: We considered 356 β-TM patients who underwent MR for the assessment of iron overload, biventricular function and atrial, and replacement myocardial fibrosis.

Results: We identified three mutually exclusive phenogroups characterized by different biventricular function parameters and frequency of replacement myocardial fibrosis and by a different prospective risk of cardiovascular complications.

Impact: In TM, unsupervised clustering integrating routinely measured CMR parameters conveys the potential to significantly impact patient care and improve cardiovascular outcomes by enabling early detection of cardiac remodeling and damage, as well as improved risk stratification.

0611 Pitch: 13:30 Poster: 14:30 Screen 48



In vivo investigation of recuperation dynamics of altered myocardial PDH activity induced by a ketogenic diet

Jun Chen[1], Zohreh Erfani[1], Abdallah Elnwasany[2], Sarah Al Nemri[1], Mai T Huynh[1], Maheen Zaidi[1], Crystal E Harrison[1], Xiaodong Wen[1], Pamela A Szweda[2], Luke I Szweda[2], and Jae Mo Park[1,3,4]

[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [2]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States, [3]Biomedical Engineering, UT Southwestern Medical Center, Dallas, TX, United States, [4]Radiology, UT Southwestern Medical Center, Dallas, TX, United States

Keywords: Myocardium, Metabolism

Motivation: Metabolic alterations associated with a ketogenic diet (KD) include suppressed carbohydrate utilization in the myocardium, but how quickly they recover by reverting to a normal diet (ND) is under-investigated.

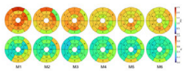
Goal(s): This study investigates recuperation dynamics of myocardial pyruvate oxidation by reverting a KD to a ND.

Approach: Cardiac metabolism of healthy rats was longitudinally assessed using hyperpolarized [1-^{13}C]pyruvate at baseline, during a KD, and a subsequent ND after the 5-week KD.

Results: Cardiac [^{13}C]bicarbonate disappeared with a KD. Reverting to ND gradually recovered the PDH flux over eight days. [1-^{13}C]Lactate production in the KD group showed the opposite but similar dynamic patterns.

Impact: Compensating the metabolic shifts by a ketogenic diet is challenged for proper assessment of cardiac metabolism and is often attempted by temporarily reverting the diet. Understanding the recuperation dynamics is crucial in proper assessment of cardiac metabolism.

0612 Pitch: 13:30 Poster: 14:30 Screen 49



Snap, Crackle And Pop: Benefits of Serial Motion Compensation in Cardiac Diffusion Tensor Imaging

Sam Coveney[1], Maryam Afzali[1,2], Richard J. Foster[1], Lars Müller[1], Noor Sharrack[1], Nadira Y. Yuldasheva[1], Sven Plein[1], Filip Szczepankiewicz[3], Erica Dall'Armellina[1], Jürgen E. Schneider[1], and Irvin Teh[1]

[1]Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, United Kingdom, [2]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom, [3]Medical Radiation Physics, Lund University, Lund, Sweden

Keywords: Myocardium, Myocardium, motion compensation, gradient moment nulling

Motivation: Cardiac diffusion tensor imaging (cDTI) based on spin-echo employs up to 2nd order (M2) motion compensated diffusion gradients. It is unclear whether higher order motion compensation would be beneficial.

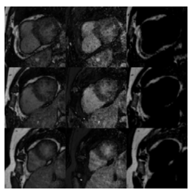
Goal(s): To evaluate the impact of higher order motion compensation (i.e. velocity, acceleration, jerk, snap, crackle and pop) in cDTI.

Approach: Diffusion gradient waveforms with M1 to M6 motion compensation were designed and implemented in a prospective study of healthy volunteers. Mean diffusivity and fractional anisotropy maps were quantitatively evaluated.

Results: Significant reductions in MD and MD heterogeneity were observed in the M6 relative to M2 compensated data.

Impact: We demonstrate the potential importance of compensating for higher orders of motion (>M2) in cardiac diffusion MRI. This work may inform gradient waveform design for more accurate and robust cardiac diffusion MRI.

0613 Pitch: 13:30 Poster: 14:30 Screen 50



Feasibility of water-fat separated free-running 3D cardiac cine imaging with a phase-sensitive approach

Dinghui Wang[1], Tzu Cheng Chao[1], Jerome Yerly[2,3], Matthias Stuber[2,3], Christopher Roy[2], Spencer Waddle[1,4], Jacinta Browne[1], and Tim Leiner[1]

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Keywords: Myocardium, Heart, Cardiac CINE, free-running, water-fat separation, phase sensitive, fat suppression

Motivation: Water-fat separated (WFS) imaging can improve detection and characterization of various cardiovascular pathologies. We hypothesize that the signal phase at half the repetition time of balanced steady-state free precession (bSSFP) may be used for efficient WFS cine imaging.

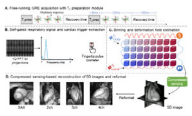
Goal(s): To study the feasibility of WFS free-running 3D cardiac cine imaging using the phase-sensitive approach.

Approach: After reconstruction of 5D whole heart images, the global slowly varying phase was estimated and removed. Water and fat voxels were then identified according to the phase.

Results: Water and fat were sufficiently separated around the heart. A field map of off-resonance can partially mitigate peripheral water/fat swaps.

Impact: A phase sensitive approach for WFS only requires negligible computational cost and minor adjustment of repetition time. It might be implemented with a wide range of bSSFP cine imaging techniques for fat suppression or to provide complementary water/fat information.

0614 Pitch: 13:30 Poster: 14:30 Screen 51



Free-running motion-resolved 5D whole-heart anatomical MRI at 3T without contrast agent

Augustin C. Ogier[1], Isabel Montón Quesada[1], Xavier Sieber[1], Pauline Calarnou[1], Jean-Baptiste Ledoux[1,2], Bastien Milani[1], Christopher W. Roy[1], Jérôme Yerly[1,2], Matthias Stuber[1,2], and Ruud B. van Heeswijk[1]

[1]Department of Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]CIBM Center for BioMedical Imaging, Lausanne, Switzerland

Keywords: Heart Failure, Heart, Cardiovascular; Acquisition Methods; Analysis/Processing

Motivation: Routine cardiac function assessment uses breath-held 2D cine imaging. Self-gated free-running sequences have recently been proposed to simplify the workflow. However, at 3T, GRE-based sequences require contrast agents to achieve blood-myocardium contrast.

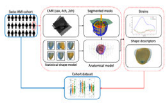
Goal(s): This study introduced a contrast-agent-free acquisition for assessing cardiac anatomy and function at 3T.

Approach: Based on an interrupted free-running sequence, the proposed approach integrates T_2 preparation and recovery modules to optimize blood-to-myocardium-contrast. A compressed-sensing-based reconstruction was used to generate 5D images of the whole heart.

Results: The framework was validated in 11 healthy volunteers, where it demonstrated slightly lower contrast but enabled effective left-ventricle segmentation and exhibited high reproducibility.

Impact: The proposed study introduces a contrast-agent-free method for a comprehensive 5D assessment of cardiac anatomy and function at 3T in a 5-minute acquisition. Demonstrating high agreement with the routine method, this approach holds promise for enhancing the overall patient management.

0615 Pitch: 13:30 Poster: 14:30 Screen 52



A deep learning framework for assessing remodelling and functional changes in infarcted left ventricles with reduced ejection fraction

Stefano Buoso[1], Jochen von Spiczak[1,2], Rabea Schlenker[1,3], Robert Manka[1,3], and Sebastian Kozerke[1]

[1]Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland, [2]Diagnostic and Interventional Raidology, University of Zurich, Zurich, Switzerland, [3]Department of Cardiology, University of Zurich, Zurich, Switzerland

Keywords: Myocardium, Cardiovascular, ischemia, deep-learning, strains, remodelling, function

Motivation: To perform a retrospective analysis of the anatomical and functional remodelling of left ventricles 4 and 12 months after the ischemic event.

Goal(s): To assess differences in remodelling between patients with recovered function and those without.

Approach: A deep-learning framework was developed to fit a statistical shape model to all cardiac phases of each patient and compute strains, valve motion and morphological descriptors.

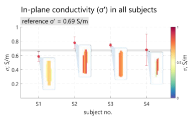
Results: Peak strain values and valve displacements at 4 and 12 months show different trends between patients with recovered function and those without. Peak-systolic shapes of patients with positive remodelling show a lower sphericity with respect to the others.

Impact: A deep learning framework reveals that relative changes in peak systolic anatomical shapes, radial and circumferential strains and valve motion after 4 months could provide a discriminator for predicting positive remodelling and restoration of functionality in patient with heart failure.

0616 Pitch: 13:30

Poster: 14:30

Screen 53



Complex B1+ field-based conductivity mapping in the human myocardium at 3T

Paulina Siuryte[1], Thierry Meerbothe[2], Yi Zhang[1], Markus Henningson[3], Joao Tourais[1], Christal van de Steeg-Henzen[4], Qian Tao[1], Stefano Mandija[2], and Sebastian Weingärtner[1]

[1]TU Delft, Delft, Netherlands, [2]UMC Utrecht, Utrecht, Netherlands, [3]Linköping University, Linköping, Sweden, [4]Holland PTC, Delft, Netherlands

Keywords: Myocardium, Electromagnetic Tissue Properties, electrical properties, conductivity, parametric mapping, cardiac, EPT

Motivation: While electrical property tomography is gaining popularity, cardiac applications are limited due to inadequate cardiac B_1^+ mapping. Thus, conductivity mapping in the heart using complex B_1^+ maps is yet unexplored.

Goal(s): To measure myocardial conductivity from the complex B_1^+ distribution in the heart at 3T.

Approach: A novel $|B_1^+|$ mapping method was adapted for free-breathing B_1^+ maps, followed by conductivity reconstruction via 1D polynomial fitting in saline phantoms and four healthy subjects.

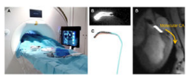
Results: Phantom results show excellent correlation with expected values (R^2=0.95). In-vivo, conductivity is largely homogenous with 0.69±0.13S/m average in-plane conductivity across all subjects, in line with the literature.

Impact: Electrical properties are a valuable biomarker, however, the translation to cardiac imaging remains limited. In this work, complex B_1^+ field-based conductivity is reported in the human myocardium at 3T, using a novel Bloch-Siegert shift-prepared cardiac B_1^+ mapping technique.

0617 Pitch: 13:30

Poster: 14:30

Screen 54



Interventional molecular MRI of early myocardial injury in a pig model of ischemia and reperfusion

Simon Reiss[1], Timo Heidt[2], Julien Thielmann[2], Alexander Maier[2], Constantin von zur Mühlen[2], and Michael Bock[1]

[1]Division of Medical Physics, Dept. of Diagnostic and Interventional Radiology, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany, [2]Dept. of Cardiology, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany

Keywords: Myocardium, Heart

Motivation: Cardiac MRI has become the gold standard for non-invasive characterization of myocardial tissue. However, current MRI techniques only indirectly represent cardiac inflammation.

Goal(s): To assess if interventional molecular MRI allows for visualization of the cellular processes during the inflammatory response after myocardial infarction.

Approach: Iron-labeled P-selectin contrast agent was injected in pigs after 40 minutes of myocardial ischemia. To increase sensitivity, the contrast agent was injected into the coronary artery via an MR-guided intervention.

Results: Infarcted myocardial segments could be visualized using the iron-labeled contrast agent by increased R2* values both in vivo and ex vivo.

Impact: The intracoronary injection of molecular contrast agents using interventional MRI can add valuable information for preclinical studies of the early cellular processes after myocardial ischemia.

0618 Pitch: 13:30

Poster: 14:30

Screen 55

Regional fat distribution is associated with subclinical left atrial and left ventricular diastolic dysfunction in early adult obesity

Jing Liu[1], Liqing Peng[1], Wenzhang He[1], and Xue Li[1]

[1]West China Hospital of Sichuan University, Chengdu, China

Keywords: Heart Failure, Cardiovascular

Motivation: Whether obese subjects with no clinical signs or comorbidities have diastolic dysfunction is unclear.

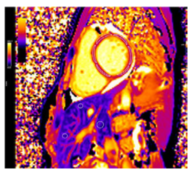
Goal(s): We non-invasively assess diastolic function in adults with uncomplicated obesity and evaluate its association with fat distribution.

Approach: Left atrial (LA) and left ventricular (LV) strain and volume-time curve using cardiac magnetic resonance were compared.

Results: The obese patients had impaired diastolic function, manifested as lower LV diastolic strain rates and peak filling rate index and declined LA reservoir and conduit function compared with controls. Central fat has a negative association while peripheral fat has a positive association on diastolic function.

Impact: CMR-derived feature tracking and volume-time curve non-invasively detected subclinical diastolic dysfunction in early adult obesity with preserved LVEF. This study also suggests that recognizing the role of different areas of fat on the heart may be beneficial for obese patients.

0619 Pitch: 13:30 Poster: 14:30 Screen 56



Cardiac–hepatic magnetic resonance findings in children with Kawasaki disease

Shengkun Peng[1], Lingyi Wen[2], Meining Chen[3], and Yingkun Guo[2]

[1]Department of Radiology, Sichuan Academy of Medical Sciences and Sichuan Provincial People's Hospital, University of Electronic Science and Technology of China, Chengdu, China, [2]Sichuan University West China Second University Hospital, Chengdu, China, [3]MR Research Collaboration, Siemens Healthineers, Chengdu, China

Keywords: Myocardium, Quantitative Imaging, Kawasaki disease

Motivation: Kawasaki Disease (KD) is recognized for cardiac and coronary arterial impact, however its influence on the liver remains underexplored, especially in pediatric patients.

Goal(s): Use T1 mapping to quantitatively evaluate cardiac-hepatic involvement and myocardial fibrosis in KD patients.

Approach: Using a 3T MR scanner, T1 mapping was conducted on the heart and liver of 115 KD patients and 40 controls, with myocardial fibrosis being diagnosed through LGE.

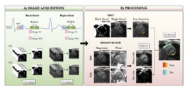
Results: KD patients displayed elevated cardiac and hepatic T1 values in both acute and chronic phases compared to controls. These values, in combined with sodium levels, were effective in identifying myocardial fibrosis in KD patients.

Impact: This study demonstrated T1 mapping was a noninvasive tool for the comprehensive assessment of cardiac-hepatic involvement and myocardial fibrosis in KD patients.

0620 Pitch: 13:30 Poster: 14:30 Screen 57

WITHDRAWN

0621 Pitch: 13:30 Poster: 14:30 Screen 58



Enhancing myocardial scar detection by combining fat-water separation with bright- and black-blood late gadolinium enhancement imaging

Manuel Villegas-Martinez[1,2], Victor de Villedon de Naide[1,2], Ilyes Ben Lala[1,2], Kalvin Narceau[1], Victor Nogues[1], Gaël Dournes[1,2], Claire Bazin[2], Jean-David Maes[2], Soumaya Sridi[2], Matthias Stuber[3,4], Hubert Cochet[1,2], and Aurélien Bustin[1,2]

[1]IHU LIRYC, Electrophysiology and Heart Modeling Institute, Université de Bordeaux – INSERM, Centre de Recherche Cardio-Thoracique de Bordeaux, Bordeaux, France, [2]Department of Cardiothoracic Imaging, Hôpital Cardiologique du Haut-Lévêque, Bordeaux, France, [3]Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland, [4]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland

Keywords: Myocardium, Fat

Motivation: Combined bright- and black-blood late gadolinium enhancement has shown potential for scar detection.However, accurate differentiation between scar and fat tissue in these images can pose a challenge.

Goal(s): To assess the SPOT-Dixon sequence, a joint bright- and black- blood methodology in combination with a two-point Dixon approach to improve myocardial scar detection and delineation.

Approach: The proposed sequence was tested in 13 patients with suspected cardiovascular diseases and the results were compared to those from reference sequences.

Results: The SPOT-Dixon sequence was able to reliably delineate scar tissue within the myocardium and differentiate it from fat in its proximity.

Impact: The proposed sequence combining the SPOT sequence and a two-point Dixon method gives reliable images of the myocardial scar and the fat tissue surrounding it, providing a valuable diagnostic advantage and potentially improving the accuracy of cardiovascular assessments.

Study Group Business Meeting

Motion Detection & Correction Business Meeting

Room 303-304 Tuesday 14:30 - 15:30

(no CME credit)

Other

ISMRM/ISMRT Chapter Poster Presentations

Exhibition Hall (Hall 403) Tuesday 14:30 - 15:30

(no CME credit)

Study Group Business Meeting
Brain Function Business Meeting

Room 303-304 — Tuesday 15:45 - 16:45

(no CME credit)

Study Group Business Meeting
MR Engineering Business Meeting

Room 324 — Tuesday 15:45 - 16:45

(no CME credit)

Other
Repeat It with Me: Reproducibility Team Challenge

Summit 2 — Tuesday 15:45 - 17:45

(no CME credit)

15:45 Introduction

16:00 Presentations

17:15 Announcement of Winners

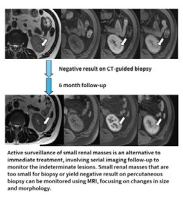
17:30 Discussion & Future Plans

Weekday Course
Kidney & Bladder: What's New?

Organizers: Nandita DeSouza, Durgesh Dwivedi

Summit 1 — Tuesday 15:45 - 17:45 — *Moderators:* Pim Pullens & Wen-Chau Wu

15:45 MRI for Active Surveillance of Renal Masses



Kye Jin Park[1]

[1]Asan Medical Centre, Korea, Republic of

Keywords: Body: Kidney, Cross-organ: Cancer

Synopsis:

1. Introduction: Active surveillance of renal mass is defined as serial imaging that monitors serial changes regarding growth and morphology.
2. Patient selection: According to several published guidelines and white papers, small renal masses especially < 2 cm with significant comorbidities and/or limited life expectancy are eligible for active surveillance.
3. Active surveillance of solid renal masses: The role of MRI will be discussed with the use of the clear cell likelihood ratio as a supportive tool.
4. Active surveillance of cystic renal masses: Serial changes in morphology is important in cystic renal masses.

16:15 Renovascular Disease

Alexandra Ljimani[1]

[1]Institute of Diagnostic and Interventional Radiology, Germany

16:45 MR Urography: Challenges in a Paediatric Population

Cemre Ariyurek[1]

[1]Boston Children's Hospital and Harvard Medical School, Boston, MA, United States

17:15 Bladder Cancer: Staging & Characterization

Nicolas Landini[1]

[1]University of Rome

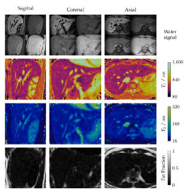
Oral

Quantitative Image Reconstruction

Hall 606 | Tuesday 15:45 - 17:45 | *Moderators:* Hongyan Liu & Tobias Kober

0622 15:45

MERIT AWARD MAGNA CUM LAUDE



Simultaneous 3D T1, T2, and fat-fraction mapping with respiratory-motion correction, for comprehensive liver tissue characterisation at 0.55T

Donovan Tripp[1], Radhouene Neji[1], Karl P Kunze[1,2], Michael G Crabb[1], Claudia Prieto[1,3,4], and René Botnar[1,3,4,5]

[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [3]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]Millennium Institute for Intelligent Healthcare Engineering, Santiago, Chile, [5]Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

Keywords: Quantitative Imaging, Quantitative Imaging, Liver, Low-Field

Motivation: Mulitparametric quantitative MRI is a powerful tool for diagnosis of liver disease, but current clinical sequences will acquire 2D slices in separate scans, prone to misregistration.

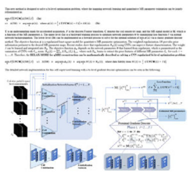
Goal(s): Demonstrate the simultaneous *in-vivo* acquisition of T_1, T_2, and fat fraction maps over the whole liver from a single free-breathing scan at 0.55T.

Approach: A dictionary-matching-based framework with non-rigid respiratory motion corrected reconstruction was validated in a cohort of ten healthy subjects.

Results: T_1, T_2, and fat fraction values acquired in phantoms and *in vivo* showed good agreement with values from corresponding reference scans.

Impact: Our technique promises an efficient means to acquire multiple parameter maps providing comprehensive staging and diagnosis of non-alcoholic fatty liver disease, believed to affect over two billion people worldwide.

0623 15:57



Accelerating Quantitative MRI using Self-supervised Deep Learning with Model Reinforcement

Wanyu Bian[1,2], Albert Jang[1,2], and Fang Liu[1,2]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States

Keywords: Quantitative Imaging, Quantitative Imaging, Model-based Reconstruction, Relaxometry, Brain, Self-supervised Learning

Motivation: Quantitative MRI (qMRI) is time-consuming and requires substantial efforts for acceleration to cut down the acquisition time.

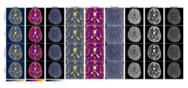
Goal(s): This paper proposes a novel self-supervised learning framework that uses model reinforcement, RELAX-MORE, for accelerated qMRI reconstruction.

Approach: The proposed method uses an optimization algorithm to unroll an iterative model-based qMRI reconstruction into a deep learning framework, enabling accelerated MR parameter maps that are highly accurate and robust.

Results: The proposed method generates high quality MR parameter maps that correct for image artifacts, removes noise, and recovers image features in regions of imperfect image conditions.

Impact: This work demonstrates the feasibility of a new self-supervised learning method for rapid MR parameter mapping, that is readily adaptable to the clinical translation of qMRI.

0624 16:09



[MRI2Qmap: compressed-sampled multiparametric quantitative MRI reconstruction using learned spatial priors from multimodal MRI datasets]

Mohammad Golbabaee[1], Matteo Cencini[2], Carolin M Pirkl[3], Marion I Menzel[3], Michela Tosetti[4], and Bjoern H Menze[5]

[1]University of Bristol, Bristol, United Kingdom, [2]INFN Pisa division, Pisa, Italy, [3]GE Healthcare, Munich, Germany, [4]IRCCS Stella Maris, Pisa, Italy, [5]University of Zurich, Zurich, Switzerland

Keywords: MR Fingerprinting, Quantitative Imaging, MR Fingerprinting, Compressed sensing, Image reconstruction, AI/ML Image Reconstruction

Motivation: Deep learning excels at compressed-sensing image reconstruction given large training datasets. Applying this paradigm to accelerated quantitative MRI, including magnetic resonance fingerprinting (MRF), is challenging because quantitative imaging datasets for training are scarce.

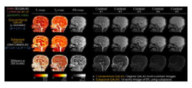
Goal(s): Can we overcome this limitation using new sources of training data from routine, largely available weighted-MRI images?

Approach: We introduce MRI2Qmap, a plug-and-play quantitative image reconstruction algorithm based on deep image denoising models pretrained on large multimodal weighted-MRI datasets.

Results: We showed, for the first time, that spatial/structural priors learned from independently-acquired datasets of routine weighted-MRI images can be effectively used for quantitative MRI image reconstruction.

Impact: Thanks to the widespread use of MRIs, our approach could enable much larger datasets to be used for training potentially enhanced AI models for fast quantitative MRI/MRF image reconstruction.

0625 16:21



[Rapid Pediatric Imaging with Zero-Shot Deep Subspace Reconstruction for Multiparametric Quantitative MRI]

Yohan Jun[1,2], Shohei Fujita[1,2], Jaejin Cho[1,2,3], Xingwang Yong[1,2,4], Eugene Milshteyn[5], Camilo Jaimes[2,3,6], Suely Fazio Ferraciolli[2,3,6], Borjan Gagoski[2,7], Michael S Gee[2,3,6], and Berkin Bilgic[1,2,8]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Pediatric Imaging Research Center, Massachusetts General Hospital, Boston, MA, United States, [4]Zhejiang University, Hangzhou, China, [5]GE Healthcare, Boston, MA, United States, [6]Department of Radiology, Massachusetts General Hospital, Boston, MA, United States, [7]Fetal-Neonatal Neuroimaging & Developmental Science Center, Boston Children's Hospital, Boston, MA, United States, [8]Harvard/MIT Health Sciences and Technology, Cambridge, MA, United States

Keywords: Quantitative Imaging, Pediatric, Quantitative Imaging

Motivation: To address unmet needs for accurate, rapid, and high-fidelity quantitative MRI using a 3D-QALAS sequence.

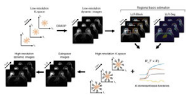
Goal(s): To enable accurate T_1 and T_2 mapping with reduced biases, g-factor noise amplification, and relaxation-related blurring compared to conventional QALAS.

Approach: We employed a zero-shot self-supervised subspace reconstruction technique, Zero-DeepSub, which combines scan-specific deep-learning-based reconstruction with low-rank subspace modeling, and demonstrated the performance using ISMRM/NIST phantom and pediatric patients.

Results: Zero-DeepSub enabled a highly accelerated, 2 min acquisition at 1 mm isotropic resolution at 3T, as well as a 5 min pediatric exam at 1.2 mm isotropic resolution at 1.5T.

Impact: Zero-DeepSub enabled accurate T_1 and T_2 mapping with reduced biases, g-factor noise amplification, and relaxation-related blurring, showing the potential to substantially speed up pediatric brain exams, thus obviating the need for or reducing the amount of sedation and anesthesia.

0626 16:33



[Sub-Second GRASP-LLR DCE: Locally Low-Rank Subspace Constraint aided by Deep Learning]

Eddy Solomon[1,2], Jonghyun Bae[1], Linda Moy[2], Laura Heacock[2], Li Feng[2], and Sungheon Gene Kim[1,2]

[1]Radiology, Weill Cornell Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University, New York, NY, United States

Keywords: Quantitative Imaging, Breast, DCE

Motivation: We hope to advance the assessment of breast dynamic contrast-enhanced MRI (DCE-MRI) by enhancing image quality, temporal resolution, and temporal fidelity.

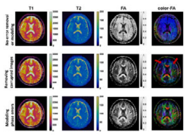
Goal(s): Propose a new radial GRASP reconstruction pipeline for DCE-MRI, which enables reliable spatially localized dynamics at a sub-second temporal resolution.

Approach: Presenting globally and locally low-rank reconstruction approaches for GRASP DCE-MRI aided by Residual Network (ResNet) architecture.

Results: Our results suggest that GRASP-LLR offers not only enhanced tumor lesion delineation with reduced background noise but also good separation between healthy, benign, and malignant cases.

Impact: We propose a new radial reconstruction pipeline for DCE-MRI which leverages a locally low-rank (LLR) subspace model in combination with deep learning approach, resulting in reliable spatially localized dynamics at a sub-second temporal resolution.

0627 16:45



[Modeling Phase Errors for Robust and Efficient Multidimensional MR Fingerprinting for Simultaneous Relaxation and Diffusion Mapping]

Zhilang Qiu[1], Siyuan Hu[1], Walter Zhao[1], Ken Sakaie[2], Filip Szczepankiewicz[3], Jessie E.P. Sun[4], Mark A. Griswold[4], Derek K. Jones[5], and Dan Ma[1]

[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Imaging Institute, Cleveland Clinic, Cleveland, OH, United States, [3]Medical Radiation Physics, Clinical Sciences Lund, Lund University, Lund, Sweden, [4]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States, [5]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom

Keywords: MR Fingerprinting, MR Fingerprinting

Motivation: Diffusion MRI can be corrupted by phase errors due to physiological motion, bulk motion, eddy currents, and other system imperfections, which makes its efficient embedding into MR Fingerprinting challenging.

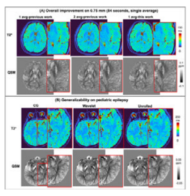
Goal(s): To develop a new approach to correct artifacts in multidimensional MR Fingerprinting (mdMRF) for simultaneous relaxation and diffusion quantification, that obviates cardiac gating, motion compensation, navigators, or data removal.

Approach: Modeling potential phase errors using phase offset and phase dispersion during dictionary generation, then quantifying and correcting measured phase errors in dictionary matching.

Results: The proposed approach significantly mitigates artifacts in mdMRF diffusion parameter mapping.

Impact: Phase error-induced artifacts due to physiological motion, bulk motion, and eddy currents is a key limitation in diffusion MRI. We develop an approach to improve robustness and efficiency of artifact correction in multidimensional MR Fingerprinting for relaxation and diffusion mapping.

0628 16:57 [Towards ultrafast submillimeter T2* and QSM quantification at 3T using spherical Echo Planar Time Resolved Imaging (sEPTI)]



Nan Wang[1], Mark Nishimura[2], Mahmut Yurt[2], Mengze Gao[1], Daniel Abraham[2], Cagan Alkan[2], Congyu Liao[1], Xiaozhi Cao[1], Zihan Zhou[1], and Kawin Setsompop[1]

[1]Radiology Department, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford, CA, United States

Keywords: Image Reconstruction, Image Reconstruction

Motivation: To further improve the image quality, SNR, and reduce scan time by reducing averages for submillimeter T2* and QSM at 3T

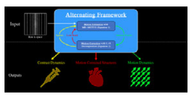
Goal(s): To achieve whole-brain 0.75-mm T2* and QSM quantification using sEPTI within a single average scan

Approach: We developed: (1) an iterative data-driven B0 update pipeline for accurate and high SNR B0 map; (2) data-driven eddy-current correction approach to reduce artifacts; (3) a physics-informed unrolled network to boost the SNR of the reconstructed image to achieve 2X acceleration by reducing the need of averages.

Results: sEPTI achieved whole-brain 0.75-mm T2* and QSM quantification within 84 seconds with the potential for wide applications

Impact: The work presented synergetic improvements in B0 update, eddy-current correction, and unrolled-network based SNR-boosted reconstruction for sEPTI, which achieves whole-brain 0.75-mm distortion-free and blurring-free T2* and QSM quantification at 3T in 84 seconds with the potentials for wide applications.

0629 17:09 [Time-Resolved Cardiac function: Myocardium Strain and First-Pass Perfusion Using MR-MOTUS]



Thomas E. Olausson[1,2], Maarten L. Terpstra[1,2], Niek R.F. Huttinga[1,2], Casper Beijst[2], Niels Blanken[3], Dominika Suchá[3], Teresa Correia[4,5], Cornelis A.T. van den Berg[1,2], and Alessandro Sbrizzi[1,2]

[1]Computational Imaging Group for MR Therapy and Diagnostics, University Medical Center Utrecht, Utrecht, Netherlands, [2]UMC Utrecht Cancer Center, Department of Radiotherapy, University Medical Center Utrecht, University Medical Center Utrecht, Utrecht, Netherlands, [3]Department of Radiology, University Medical Centre Utrecht, University Medical Center Utrecht, Utrecht, Netherlands, [4]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [5]Centre for Marine Sciences (CCMAR), Faro, Portugal

Keywords: Myocardium, Image Reconstruction, First-Pass Myocardial Perfusion; Motion estimation; Motion correction; Low-Rank & Sparse; Time-resolved imaging; Cine; Dynamic; Perfusion; Cardiac

Motivation: We aim at improving accuracy and reliability in cardiac imaging for coronary artery disease diagnosis and management. We address motion artifacts in first-pass myocardial perfusion MR imaging.

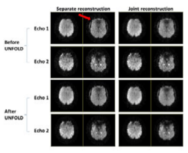
Goal(s): To develop and validate motion correction techniques for motion field accuracy and strain quantification in non-ECG triggered myocardial first pass perfusion examinations.

Approach: We use a modified MR-MOTUS framework for motion separation and reconstruction in patient data.

Results: Our approach demonstrates higher accuracy in respiratory/cardiac motion field estimation with additional strain analysis.

Impact: Our findings have the potential to improve patient care by enabling free-breathing and non-ECG triggered examinations of myocardial first-pass perfusion simultaneously with strain analysis. We also open avenues for further research in cardiac imaging and motion correction techniques.

0630 17:21



Joint optimization of multi-echo reconstruction and quantitative map estimation in Looping Star

Haowei Xiang[1], Ilhan Kemal Onder[2], Anahita H Mehta[2], Jeffrey A Fessler[1], and Douglas C Noll[3]

[1]Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI, United States, [2]Department of Otolaryngology-Head and Neck Surgery, University of Michigan, Ann Arbor, MI, United States, [3]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

Keywords: Image Reconstruction, Quantitative Imaging, Reconstruction

Motivation: Looping-star sequences, despite their advantages, exhibit low SNR and undersampling artifacts compared to standard GRE sequences.

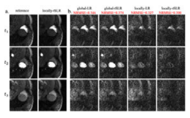
Goal(s): This work proposes to jointly reconstruct multi-echo data and estimate quantitative maps in looping-star to boost the SNR, reduce the undersampling artifacts, and improve image quality.

Approach: Our approach frames echo image reconstruction and quantitative map estimation as a unified optimization problem. This is then split into two sub-problems, addressed alternately using CG-SENSE.

Results: Compared to individual echo reconstruction, our joint optimization improves tSNR of both echo images and T2* maps and effectively mitigates image artifacts.

Impact: Our method jointly reconstructs multi-echo data in looping-star, enhancing SNR and reducing artifacts, with a notable tSNR improvement. It can be adapted to the Looping-Star fMRI protocol to potentially improve functional activity estimation.

0631 17:33



Temporal Structured Low-Rank Reconstruction for First-Pass Myocardial Perfusion Imaging

Xi Chen[1,2], Debiao Li[1,3], and Anthony G. Christodoulou[1,2]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Department of Bioengineering, UCLA, Los Angeles, CA, United States

Keywords: Sparse & Low-Rank Models, Perfusion, First-pass myocardial perfusion; structured low-rank

Motivation: First-pass myocardial perfusion imaging is a powerful tool for assessing coronary artery disease, but needs high levels of undersampling to achieve sufficient spatial coverage, spatiotemporal resolution, and motion robustness.

Goal(s): To develop efficient temporal image reconstruction models which can leverage linear time-invariant models of dynamic contrast enhancement without identifying an arterial input function or assuming tissue transfer function shapes.

Approach: We propose a novel temporal structured low-rank modeling technique to implicitly leverage linear time-invariant models of dynamic contrast enhancement.

Results: Temporal structured low-rank modeling outperforms conventional low-rank methods, especially as a local constraint.

Impact: Temporal structured low-rank modeling has the potential to improve spatial coverage, spatial resolution, and/or motion robustness for first-pass myocardial perfusion MRI.

Oral

Advanced MRI Methods in MSK Trauma

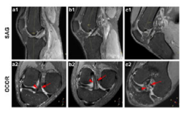
Nicoll 1 Tuesday 15:45 - 17:45

15:45 Introduction

Le Roy Chong

Changi General Hospital, Singapore, Singapore

0632 15:57



High-Resolution Oblique Coronal MRI with Optimal Flexed-Knee Angle for Anterior Cruciate Ligament Tear Diagnosis

Yunjie Liao[1], Can Chen[1], Xiao Liu[1], Qi Liang[1], Song Peng[1], Peng Wu[2], Lu Han[2], and Pengzhi Hu[1]

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Keywords: Whole Joint, MSK

Motivation: Anterior cruciate ligament (ACL) injuries are prevalent in the realm of knee injuries. Conventional MRI methodologies employed for diagnosing ACL tears exhibit low accuracy.

Goal(s): Evaluate the diagnostic efficacy of high-resolution coronal MRI performed at an optimal flexion angle specifically for ACL tears.

Approach: Healthy volunteers and patients are scanned to find the optimal flexion angle and compare the image quality with traditional extended-knee positioning approach.

Results: The implementation of high-resolution coronal imaging at the ideal flexion angle (30 degrees) has the potential to enhance ACL visualization and improve diagnostic accuracy when compared with conventional techniques.

Impact: The utilization of high-resolution coronal imaging at the optimal flexion angle (30 degrees) demonstrated a substantial enhancement in the visualization of the anterior cruciate ligament (ACL), resulting in a notable improvement in diagnostic accuracy as compared to conventional techniques.

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MERIT AWARD
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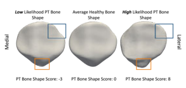

Association of Patella Bone Shape and MR-Diagnosed Patellar Tendinopathy with Patellar Cartilage T2/T1ρ in Elite Basketball Players

Andrew M. Schmidt[1], Elka B Rubin[1], Mackenzie Little[1,2], Madison George[3], Hayden Zheng[4], Katherine Young[1], Arjun D. Desai[1,5,6], Feliks Kogan[1], Sharmila Majumdar[7], Hollis G Potter[8], Garry E. Gold[1,3], and Anthony A. Gatti[1]

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Keywords: Tendon/Ligament, Tendon/Ligament, Bone shape, T2 mapping, T1ρ mapping

Motivation: Patellar tendinopathy (PT) is a common injury in basketball that can lead to early retirement. Basketball influences bone shape and cartilage composition, yet the association between these factors and PT is unknown.

Goal(s): We examined the association between PT, bone shape, and patellar cartilage composition in collegiate basketball players.

Approach: We developed a measure of bone shape indicative of PT and investigated whether PT-associated bone shape is associated with patellar cartilage $T_2/T_{1\rho}$.

Results: We effectively separated grades of PT using bone shape and identified bone shape features associated with PT. We found patellar cartilage composition is independent of PT and bone shape.

Impact: We developed a measure to identify varying grades of PT based on bone shape in collegiate basketball players. Future work will determine the association of our PT-bone shape score with MR-identifiable measures to identify athlete specific PT risk factors.

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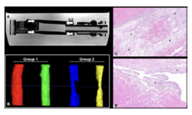

Quantitative analysis of induced tendon degeneration using magic angle insensitive ultra-short echo time magnetization transfer

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Keywords: Tendon/Ligament, Tendon/Ligament

Motivation: Ultra-short echo time (UTE) imaging combined with magnetization transfer (MT) allows for magic angle effects (MAE)-insensitive quantification of short T2 tissues, but clinically feasible applications are rare.

Goal(s): The objectives of this study were to qualitatively and quantitatively assess changes in bovine flexor tendons before and after collagen degradation.

Approach: 3D UTE MT imaging was compared to UTE T2* mapping at 0°, 27°, 55° and 90° relative to the B_0 field within a clinically feasible acquisition time.

Results: Compared to UTE T2* mapping, UTE MT imaging was significantly less affected by the MAE and demonstrated a better performance in differentiating partial tendon tears.

Impact: UTE MT imaging is a reliable and reproducible method for quantifying tendon degeneration that is robust to the magic angel effect, acquired within a clinically feasible scan time, and could therefore be a useful tool in the diagnosis of tendinopathies.

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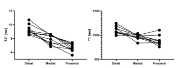

Importance of ACL substructure composition for quantitative analysis using UTE

Maik Rothe[1,2], Klaus Bohndorf[1], Richard Brill[1], Walter Alexander Wohlgemuth[1,2], and Alexander Gussew[1,2]

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Keywords: Tendon/Ligament, Quantitative Imaging

Motivation: Quantitative MR-imaging of ligaments needs special approaches like ultra-short echo-time (UTE) imaging. Most quantitative studies of the anterior cruciate ligament (ACL) regard it as a uniform structure and do not consider differences in ligament composition at different anatomical positions.

Goal(s): This study is aimed to use UTE to evaluate anatomical position specific T_1 and T_2^* parameters of the ACL.

Approach: The region specific ACL T_1 and T_2^* values of 10 healthy volunteers were investigated by quantitative UTE mapping.

Results: Quantitative mapping revealed that T_1 and T_2^* values decrease from the distal to the proximal ACL endings, due to different fractions of free water.

Impact: This study reveals that the anterior cruciate ligament (ACL) shows severe differences in quantitative values between its proximal and distal ends. The ACL region plays an important role in quantitative analysis and should be considered for assessments of pathologies.

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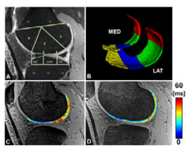

Articular Cartilage 3D T2* Mapping at 7 Tesla in Patients with Medial Meniscus Posterior Root Tears

Karsten Knutsen[1], Abdul Wahed Kajabi[1], Stefan Zbyn [2], Collin Steinberger [3], Luke Tollefson [4], Jesse Smith [1,5], Takashi Takahashi [1], Gregor Metzger [1], Robert LaPrade[4], and Jutta Ellermann[1]

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Keywords: Cartilage, Cartilage, Osteoarthritis

Motivation: Meniscal root tears are increasingly recognised as the 'root cause' of osteoarthritis with articular cartilage loss as the hallmark of the disease.

Goal(s): Utilising SNR gains at 7T UHF MRI to detect early changes in cartilage composition.

Approach: Compare high resolution quantitative cartilage 3D T2* relaxation times at 7T in patients with arthroscopically confirmed medial meniscal posterior root tears (MMPRT's) to matched controls.

Results: Prolonged T2* relaxation times were found in the weight bearing medial and lateral cartilage of the femur in patients with meniscal tears, when compared with controls. No changes were seen in the tibial cartilage.

Impact: Identifying early cartilage degeneration using high resolution T2* at 7 Tesla could inform timely treatments, such as prompt meniscal repair, potentially preventing the onset of osteoarthritis.

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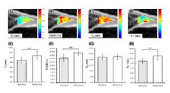

Quantitative UTE Imaging of Zonal Difference in Meniscus

Arya Suprana[1,2], Melissa Lou Silva[2], Marco Toto-Brocchi[2], Bhavsimran Malhi[2], Jiyo Athertya[2], James Lo[1,2], Soo Hyun Shin[2], Nicole Le[1,3], Eric Y Chang[2,3], Jiang Du[1,2,3], and Yajun Ma[2]

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Keywords: Quantitative Imaging, Cartilage, Meniscus

Motivation: Quantitative MR imaging techniques could reveal compositional differences between red and white zones in menisci. Unfortunately, this type of analysis may not be possible using conventional sequences due to the rapid signal decay of menisci.

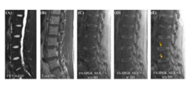
Goal(s): The study aimed to investigate whether quantitative UTE imaging techniques could detect the zonal difference between the red and white zones in menisci.

Approach: UTE imaging techniques, including UTE-T1, UTE-MT modeling, UTE-AdiabT1ρ, and UTE-T2*, were used to assess menisci *in vivo* quantitatively.

Results: T1, MMF, and T2* values in the red zone are significantly lower than those in the white zone.

Impact: Our qUTE MRI techniques enable a quantitative, zonal, and compositional analysis of menisci in vivo, which is valuable in helping understand the role of menisci in the pathogenesis of complex diseases such as osteoarthritis.

0638 17:09



Clinical evaluation of spine disorders using high contrast cartilaginous endplate imaging

Jiyo S Athertya[1], Sheronda Statum [1], Xiaojun Chen[1], Saeed Jerban[1], Christine B Chung[1,2], Jiang Du[1,2,3], Eric Y Chang[1,2], and Yajun Ma[1]

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Keywords: Other Musculoskeletal, MSK

Motivation: Lower back pain is a common cause of ailment driven by disc degeneration and endplate defects. Imaging the CEP region would increase the diagnostic accuracy of early detection.

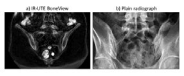
Goal(s): To develop an optimized sequence to image the CEP that is readily translatable to clinical settings.

Approach: The clinically available 3D FS-SPGR sequence was optimized and applied to image the CEP with high contrast for both asymptomatic and symptomatic subjects.

Results: The optimized 3D FS-SPGR sequence with T1-weighting can delineate the CEP regions with high contrast and reveal irregularities that are not visible on routinely used protocols.

Impact: The fast T1-weighted 3D FS-SPGR sequence can be readily implemented on clinical scanners, used to highlight the CEP, and shows promise for the detection of intervertebral disc abnormalities.

0639 17:21 Can MR only IR-UTE based BoneView imaging, along with routine MRI, be used to exclude sacroiliac joint (SIJ) pathologies without the need for X-Ray?



Sharmila David[1], Monica Gunasingh[2], Chirath Sulalith[1], Aruna Pallewatte[1], Narayana Krishna Rolla[2], Indrajit Saha[3], and Tejas Shah[2]

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Keywords: Bone, Bone, UTE, MSK

Motivation: For a comprehensive diagnostic imaging investigation of SIJ, neither plain radiographs alone nor MRI alone provide sufficient specificity and sensitivity for accurate diagnosis of traumatic and/or non-traumatic sources of SIJ dysfunction.

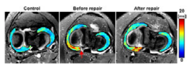
Goal(s): Our goal is to show that using UTE based BoneView imaging technique, we can sufficiently detect enough structural radiological features of SIJ in non-pathological cases.

Approach: 24 patients with non-pathological SIJ were recruited for this study and inter-reader as well as inter modality agreement was computed based on a likert scale by two radiologists.

Results: There was high inter reader agreement as well as inter modality agreement.

Impact: MR only (IR-UTE based BoneView + routine MR) can be used to exclude patients with pathological SIJs and further investigation is necessary to extend the findings further to pathological cases as well.

0640 17:33 Quantitative 3D T2* Mapping of Meniscus Before and After Meniscal Root Repair at 7 Tesla



Abdul Wahed Kajabi[1,2], Stefan Zbyn[3], Collin Steinberger[1], Jesse Smith[4], Karsten Knutsen[1], Luke Tollefson[5], Gregor Metzger[1], Rob LaPrade[5], and Jutta Ellermann[1,2]

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Keywords: Other Musculoskeletal, MSK, Meniscus

Motivation: Meniscal tears are a significant cause of osteoarthritis, and failure rate of meniscal repair remains high. MRI assessment of meniscus at 7T provides high signal-to-noise ratio and allows 3D evaluation of the tissue.

Goal(s): Investigate and follow-up meniscal tissue integrity in pre- and post-repair patients.

Approach: Quantitative 3D T2* mapping of the lateral and medial menisci in patients with posterior horn root tears in the medial meniscus and compare against matched controls.

Results: Significantly increased T2* values were identified beyond the tear in both lateral and medial menisci of pre-repair patients and the values remained significantly elevated six months post-repair.

Impact: Utilizing high-resolution 7 Tesla 3D T2* mapping, this study quantitatively and longitudinally assesses meniscal tissue integrity of patients who underwent medial meniscal posterior root tear repair, which has significant impact on management and standard of care for the patients.

Oral

Microstructure

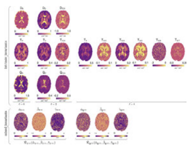
Nicoll 2 | Tuesday 15:45 - 17:45 | *Moderators:* Evren Ozarslan & Qiuyun Fan

15:45 Introduction

Evren Ozarslan

Linköpings Universitet, Sweden

0641 15:57



Cumulant tensors from the addition of angular momenta: All diffusion invariants in one abstract

Santiago Coelho[1,2], Filip Szczepankiewicz[3], Els Fieremans[1,2], and Dmitry S Novikov[1,2]

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Keywords: Diffusion Modeling, Diffusion/other diffusion imaging techniques

Motivation: The advent of quantitative imaging hinges on revealing the information content of MRI measurements. We provide a complete basis- and hardware-independent “fingerprint" for the diffusion signal up to moderate diffusion-weightings.

Goal(s): Find all rotationally invariant information present in the cumulant expansion up to b^2.

Approach: We classify all invariants of diffusion and covariance tensors in terms of irreducible representations of the group of rotations, discuss their geometric meaning, and relate them to tissue properties.

Results: We find a complete set of 21 independent rotational invariants up to b^2. Previously studied contrasts are expressed via only 7, while the rest provide novel complementary information.

Impact: We map the diffusion covariance tensor onto the addition of angular momenta, and provide all rotational invariants of the cumulant expansion (RICE). RICE apply to >50k publicly available human diffusion MRI datasets, providing new insights into tissue properties.

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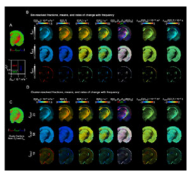

Data-driven classification of tissue water populations by massively multidimensional diffusion-relaxation correlation MRI

Omar Narvaez[1], Maxime Yon[1,2], Raimo Salo[1], Jenni Kyyriäinen[1], Daniel Topgaard[2], and Alejandra Sierra[1]

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Keywords: Diffusion Analysis & Visualization, Data Analysis, Multidimensional MRI

Motivation: Multidimensional diffusion-relaxation MRI opened new ways to non-invasively study sub-voxel populations of water with distinct MRI signal responses and, by inference, tissue microstructure. However, this technique creates large number nonparametric diffusion-relaxation distributions that are challenging to visualize or translate into microstructure specific maps.

Goal(s): The goal of this study is to automatically classify the distribution components for an ex vivo rat brain and compare them with histology to reveal their links to tissue fractions.

Approach: To achieve the automatic classification, we use an unsupervised data-driven clustering approach.

Results: We successfully separated white matter, gray matter, free water and additional tissue fractions.

Impact: Multidimensional diffusion-relaxation MRI combined with data-driven microstructure clustering offers new perspectives in high-specificity studies of healthy and damage tissue beyond the conventional white matter, gray matter, and free-water fractions. This is achieved by exploring the full sub-voxel multidimensional distribution space.

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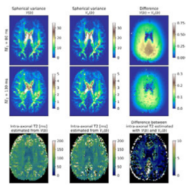

Unbiasing the spherical variance of a diffusion-weighted MR signal: An application to intra-axonal T2 estimation

Tomasz Pieciak[1], Guillem París[1,2], Antonio Tristán Vega[1], and Santiago Aja-Fernández[1]

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Keywords: Diffusion Modeling, Diffusion/other diffusion imaging techniques, intra-axonal T2, spherical variance, Rician bias

Motivation: The spherical variance (SV) from multiparametric diffusion MRI acquisitions enables the estimation of the axonal T2 relaxation time. The SV is prone to a noise-induced bias due to positively skewed Rician statistics, leading to overestimation in the axonal T2 parameter.

Goal(s): To derive a method to mitigate the Rician bias in the SV parameter map.

Approach: A closed-form formula to remove the Rician bias from the SV has been analytically derived and verified with in silico and in vivo data.

Results: The bias-corrected SV reduces the estimation error compared to the SV, translating to a less pronounced misestimation in the axonal T2 parameter.

Impact: The SV is a practical parameter to infer the properties of restricted compartments with diffusion MRI. This work shows a formula to remove the Rician bias from the SV. The correction can be used for other SV-based diffusion MRI measures.

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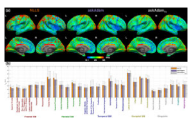

Ultra-high gradient diffusion MRI on Connectome 2.0 reveals time-dependent diffusion and water exchange in human gray matter

Kwok-Shing Chan[1,2], Yixin Ma[1,2], Hansol Lee[1,2], José P. Marques[3], Jonas Olesen[4], Santiago Coelho[5,6], Dmitry S. Novikov[5,6], Sune Jespersen[4], Susie Huang[1,2], and Hong-Hsi Lee[1,2]

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Keywords: Microstructure, Microstructure

Motivation: In vivo mapping of exchange between intra-neurite and extracellular water in gray matter is challenging, as the required strong diffusion weighting significantly reduces the signal-to-noise ratio.

Goal(s): We aim to demonstrate the feasibility of in vivo neurite exchange imaging using the state-of-the-art Connectome 2.0 scanner equipped with high-performance gradient system (G_{max}=500mT/m, $(dG/dt)_{max}$=600T/m/s).

Approach: We acquired in vivo diffusion MRI measurements with multiple diffusion times (13-30ms) up to b-values of 17.5ms/μm^2 on 5 human subjects. Anisotropic Kärger model (NEXI/SMEX) was used to estimate the exchange time from the diffusion data.

Results: The exchange time across the cortical ribbon is around 16ms.

Impact: The high performance gradient system on the Connectome 2.0 scanner enables in vivo mapping of water exchange time in gray matter, providing a tool to study neurite permeability in the healthy human brain and a variety of neuropsychiatric disorders.

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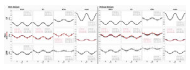

Robust double-diffusion-encoded spectroscopy (DDES) in the human brain on a clinical MR scanner using metabolite-cycling

André Döring[1,2], Jessie Mosso[1], Roland Kreis[3,4], Nicholas G Dowell[5], Derek K Jones[2], Chloé Najac[6], Matt G Hall[7], Henrik Lundell[8,9], Lijing Xin[1], and Itamar Ronen[5]

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Keywords: Microstructure, Brain, DDE, metabolites, microstructure

Motivation: Double-Diffusion-Encoded Spectroscopy (DDES) provides multiple metrics of cell-specific morphology in a single MR experiment but is prone to motion-induced signal distortions.

Goal(s): To obtain robust microstructural metrics of cell-type specific diffusion in different brain regions.

Approach: We combine DDES with metabolite-cycling (MC) and motion-compensation (MoCom) to correct for signal distortions in post processing.

Results: MoCom improves DDES data quality and reproducibility and allows metabolite specific diffusion metrics to be obtained on clinical 3T MR scanners.

Impact: The implementation of robust Double-Diffusion-Encoded Spectroscopy (DDES) on clinical MR scanners can shed new light on cellular microstructure in the healthy and pathological brain.

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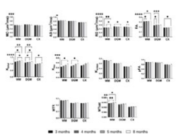

Isotropic diffusional kurtosis as a marker of glial cell content and diversification during brain maturation

Naila Rahman[1,2], Jake Hamilton[1,2], Kathy Xu[2], Arthur Brown[2,3], and Corey Baron[1,2]

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Keywords: Microstructure, Diffusion/other diffusion imaging techniques, Brain Maturation, Tensor-valued diffusion MRI

Motivation: Healthy rodent brain maturation research remains limited, although rodents are a predominant study model, which motivates further study to exclude confounds of developmental changes from pathophysiological interpretations.

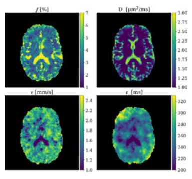
Goal(s): Our goals were to investigate how microstructural MRI metrics change over the course of brain maturation and disentangle what changes in these metrics may indicate on a neurobiological level.

Approach: 11 mice were scanned at 9.4T between 3-8 months of age, with histology (n=4) performed at 3 and 8 months.

Results: Total diffusional kurtosis and myelin-specific metrics showed significant increases over time, paired with increased isotropic kurtosis and increased histological oligodendrocyte and astrocyte content.

Impact: This work shows that there are ongoing microstructural changes even after mice are considered “adults”, detectable by isotropic kurtosis. We provide new interpretations of diffusion MRI changes during brain maturation, with evidence of the underlying mechanisms impacting isotropic kurtosis.

0647 17:09 Modelling the intermediate flow regime in flow-compensated intravoxel incoherent motion MRI



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Keywords: IVIM, Perfusion, IVIM, Diffusion

Motivation: Lack of consensus in perfusion modelling in IVIM MRI, with focus on blood flow in biological tissue.

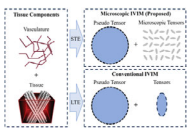
Goal(s): To model perfusion in flow-compensated IVIM MRI to allow for blood velocity and correlation time quantification.

Approach: Using a velocity autocorrelation function to describe the dynamics of capillary blood flow, an expression for perfusion signal attenuation was derived for flow-compensated IVIM MRI, and evaluated in healthy brain.

Results: The proposed model allows for direct quantification of velocity and correlation time of blood flow, in addition to perfusion fraction and diffusion coefficient.

Impact: The study presents initial proof-of-concept directly quantifying velocity and correlation time of blood flow in healthy brain using flow-compensated Intravoxel Incoherent Motion MRI. Access to these parameters can assist in characterizing tissue microvasculature in disease.

0648 17:21 Measuring intravoxel incoherent motion (IVIM) using Spherical Tensor Encoding (STE) diffusion MRI



Tianchi Wang[1,2,3], Tanxin Dong[1,2,3], Han Zang[1,2,3], Jiayu Zhu[4], Hai Lin[5], Jianmin Yuan[4], Fengting Zhu[6], Chuanmiao Xie[6], and Qiuyun Fan[1,2,3]

[1]*Academy of Medical Engineering and Translational Medicine, Tianjin University, Tianjin, China,* [2]*Tianjin Key Laboratory of Brain Science and Neuroengineering, Tianjin, China,* [3]*Haihe Laboratory of Brain-Computer Interaction and Human-Machine Intepration, Tianjin, China,* [4]*Central Research Institute, United Imaging Healthcare Group, Shanghai, China,* [5]*Central Research Institute, United Imaging Healthcare, Shanghai, China,* [6]*State Key Laboratory of Oncology in South China, Guangdong Provincial Clinical Research Center for Cancer, Guangdong, China*

Keywords: IVIM, Brain

Motivation: The assumption of Gaussian diffusion in the extravascular space in the IVIM model does not necessarily hold, especially for neuronal tissues.

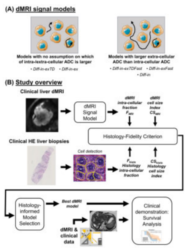
Goal(s): To mitigate the impacts on IVIM estimation from complicated extravascular space diffusion such as in the crossing-fiber tissues.

Approach: We employed Spherical Tensor Encoding (STE) in place of the Linear Tensor Encoding (LTE) as in the conventional Stejskal-Tanner experiment to eliminate the orientational dependence of diffusion signal.

Results: The feasibility of the microscopic IVIM based on STE experiments was demonstrated in both healthy and diseased participants, with expected contrasts according to known anatomy/pathology.

Impact: A new framework of IVIM measurement was proposed based on the Linear Tensor Encoding diffusion experiment. The proposed approach can achieve diffusivity estimates in one excitation, which will otherwise require acquisition of multiple diffusion weighting directions.

0649 17:33 Histology-informed biophysical diffusion MRI model selection for enhanced liver cancer immunotherapy assessment



Francesco Grussu[1], Kinga Bernatowicz[1], Marco Palombo[2,3], Caterina Tozzi[1], Sara Simonetti[4,5], Garazi Serna[4], Athanasios Grigoriou[1,6], Anna Voronova[1,6], Valezka Garay[7], Juan Francisco Corral[8,9], Marta Vidorreta[10], Pablo García-Polo García[11], Xavier Merino[8,9], Richard Mast[8,9], Núria Roson[8,9], Manuel Escobar[8,9], Maria Vieito[12,13], Rodrigo Toledo[14], Paolo Nuciforo[4], Elena Garralda[15], and Raquel Perez-Lopez[1]

[1]Radiomics Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [2]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom, [3]School of Computer Science and Informatics, Cardiff University, Cardiff, United Kingdom, [4]Molecular Oncology Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [5]Prostate Cancer Translational Research Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [6]Department of Biomedicine, Faculty of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain, [7]PET/MR Unit, CETIR-Ascires, Barcelona, Spain, [8]Department of Radiology, Hospital Universitari Vall d'Hebron, Barcelona, Spain, [9]Institut de Diagnòstic per la Imatge (IDI), Barcelona, Spain, [10]Siemens Healthineers, Madrid, Spain, [11]GE HealthCare, Madrid, Spain, [12]GU, Sarcoma and Neuroncology Unit, Hospital Universitari Vall d'Hebron, Barcelona, Spain, [13]Drug Development Unit, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [14]Biomarkers and Clonal Dynamics Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [15]Early Clinical Drug Development Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain

Keywords: Microstructure, Modelling, Immunotherapy, Liver, Tumours, Histology

Motivation: Multi-compartment liver diffusion MRI (dMRI) provides innovative markers of intra-cellular fraction (F) and cell size (CS). However, practical implementations for histologically-meaningful F and CS computation in the clinic are still sought.

Goal(s): To deliver a compact approach for F and CS estimation, informing model design with histology.

Approach: We compared 5 implementations of a standard two-compartment model for their ability to provide F and CS estimates that agree with reference biopsies in liver tumours.

Results: The best approach consisted of fitting a single-compartment model of intra-cellular diffusion to high b-value images. This provides promising metrics that stratify the risk of progression in immunotherapy.

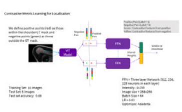
Impact: We deliver a clinically-feasible liver diffusion MRI approach for intra-cellular fraction, cell size and density estimation. It consists of fitting a single-compartment model of restricted diffusion to high b-value images, and provides metrics that may inform on cancer immunotherapy response.

Oral

The Future of AI in MRI: Emerging Technologies & Directions

Nicoll 3 | Tuesday 15:45 - 17:45 | *Moderators:* Akshay Chaudhari & Haifeng Wang

0650 15:45 Foundation Model based labelling of MR Shoulder images to drive Auto-Localizer workflow



Gurunath Reddy M[1], Muhan Shao[2], Deepa Anand[1], Kavitha Manickam[3], Dawei Gui[3], Chitresh Bhushan[2], and Dattesh Shanbhag[1]

[1]GE HealthCare, Bangalore, India, [2]GE HealthCare, Niskayuna, NY, United States, [3]GE HealthCare, Waukesha, WI, United States

Keywords: Other AI/ML, Machine Learning/Artificial Intelligence, One-shot, Shoulder, Foundation Models, Localization, Segmentation

Motivation: Develop automatic labelling capability on anatomical shoulder MRI images with minimal manual annotation.

Goal(s): Leverage large-FOV, low resolution coil sensitivity maps to guide correct positioning of three-plane localizer for shoulder MRI planning.

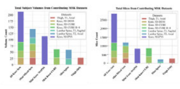
Approach: Use chained DINO-V2 and SAM foundation models, tuned to MRI localizers and a data driven similarity measure to label shoulder data at scale and transfer to low resolution coil sensitivity maps for CNN model training.

Results: Excellent shoulder region localization with FM on anatomical (91% accuracy) and with CNN model on calibration data (error < 15 mm)

Impact: A data adaptive, chained foundation model-based approach for annotating shoulder regions on MRI anatomical images at scale is shown. This allowed rapid development of model using low-resolution calibration data for correctly positioning three-plane localizer for shoulder anatomical planning and imaging.

0651 15:57

MERIT AWARD MAGNA CUM LAUDE



[Towards a Generalizable Foundation Model for Multi-Tissue Musculoskeletal MRI Segmentation]

Gabrielle Hoyer[1,2], Michelle Tong[1,2], Sharmila Majumdar[1], and Valentina Pedoia[1]

[1]Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Department of Bioengineering, University of California, Berkeley, Berkeley, CA, United States

Keywords: Analysis/Processing, Bone

Motivation: To evaluate the potential of foundation models for medical imaging analysis.

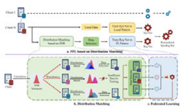
Goal(s): To understand the limitations of foundation models trained for the natural imaging domain, and assess the challenges for translation to complex musculoskeletal anatomy in a rich medical image domain.

Approach: A diverse collection of musculoskeletal MRI data was used to assess the generalizability of SAM when applied to a variety of segmentation tasks common to the medical research and clinical setting.

Results: SAM performed decently on zero-shot of medical data. The ability of SAM to perform well when finetuned on a spectrum of data, is somewhat lacking and requires additional evaluation.

Impact: A foundational model for generalizable musculoskeletal MRI segmentation, such as one fine-tuned on the Segment Anything Model (SAM) has the potential to overcome challenges with generalizability for widespread usage beyond a specific task, reducing burden in medical imaging pipelines.

0652 16:09



[Distribution Matching Based Personalized Federated Learning for Multi-Contrast Liver MRI Synthesis and Registration]

Rencheng Zheng[1], Hang Yu[2], Ruokun Li[3], Qidong Wang[4], Caizhong Chen[5], Fei Dai[1], Boyu Zhang[1], Ying-Hua Chu[6], Weibo Chen[7], Chengyan Wang[8], and He Wang[1]

[1]Institute of Science and Technology for Brain-Inspired Intelligence, Fudan University, Shanghai, China, [2]Institute of Science and Technology for Brain-inspired Intelligence, Fudan University, Shanghai, China, [3]Department of Radiology, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [4]Department of Radiology, The First affiliated Hospital, School of Medicine, Zhejiang University, Shanghai, China, [5]Department of Radiology, Zhongshan Hospital, Fudan University, Shanghai, China, [6]Siemens Healthineers, Shanghai, China, [7]Philips Healthcare, Shanghai, China, [8]Human Phenome Institute, Fudan University, Shanghai, China

Keywords: AI/ML Image Reconstruction, Liver

Motivation: The combined diagnosis of diffusion-weighted imaging (DWI) and dynamic contrast-enhanced (DCE)-MRI is of significant importance for liver diseases, but accurate registration between these two modalities remains a substantial challenge.

Goal(s): Our goal was to design a deep learning model for accurate registration between DCE and DCE-MRI, and conduct multicenter studies based on federated learning.

Approach: We proposed a multi-task synthesis-registration network (SynReg) and a personalized decentralized distribution matching federated framework (PDMa) based on SynReg.

Results: The proposed SynReg and PDMa method increased the registration accuracy in most centers both in liver region and liver tumor region.

Impact: Accurate and rapid registration of DWI and DCE can effectively assist clinicians in leveraging multimodal imaging for efficient diagnosis. Personalized federated learning can effectively aid single-center with limited data to leverage the abundant data from multiple centers for model development.

0653 16:21

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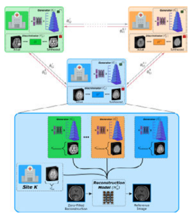


[Peer-to-Peer Generative Learning for Architecture-Agnostic Federated MRI Reconstruction]

Valiyeh Ansarian Nezhad[1,2], Gökberk Elmas[1,2], and Tolga Çukur[1,2,3]

[1]Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey, [2]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey, [3]Neuroscience Program, Bilkent University, Ankara, Turkey

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, Federated learning, multi-institutional, collaborative learning, image reconstruction

Motivation: Federated learning (FL) enables privacy-preserving training of deep reconstruction models across multiple sites to improve generalization at the expense of lower within-site performance. Yet, existing methods require a common model architecture across sites, limiting flexibility.

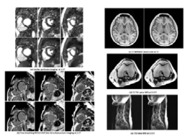
Goal(s): Our goal was to devise an architecture-agnostic method for collaborative training of heterogeneous models across sites.

Approach: We introduced a novel peer-to-peer generative learning method (PGL-FedMR), where individual sites share a generative prior for their MRI data with remaining sites, and prior-driven synthetic data are used to train reconstruction models at each site.

Results: PGL-FedMR improves across-site generalization over local models, and within-site performance over conventional FL.

Impact: Improvements in within-site and across-site performance for MRI reconstruction through PGL-FedMR, coupled with the ability to handle heterogeneous architectures, may facilitate privacy-preserving multi-institutional collaborations to build reliable reconstruction models for many applications where data are scarce including rare diseases.

0654 16:33



[Imaging transformer for MRI denoising with SNR unit training: enabling generalization across field-strengths, imaging contrasts, and anatomy]

Hui Xue[1], Sarah Hooper[1], Azaan Rehman[1], Iain Pierce[2], Thomas Treibel[2], Rhodri Davies[2], W Patricia Bandettini[1], Rajiv Ramasawmy[1], Ahsan Javed[1], Yang Yang[3], James Moon[2], Adrienne Campbell-Washburn[1], and Peter Kellman[1]

[1]National Heart, Lung, and Blood Institute, Bethesda, MD, United States, [2]Barts Heart Centre at St. Bartholomew's Hospital, London, United Kingdom, [3]University of California, San Francisco, San Francisco, CA, United States

Keywords: Other AI/ML, Machine Learning/Artificial Intelligence, imaging transformer, generalization

Motivation: MR denoising using the CNN models often requires abundant high quality data for training. In many applications, such as higher acceleration and low field, high quality data is not available. This study overcome this limitation by developing a SNR unit based training scheme and a novel imaging transformer (imformer) architecture.

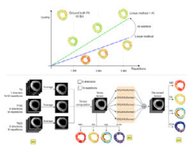
Goal(s): To develop and validate a novel imformer model for MR denoising, enabling generalization across field-strengths, imaging contrasts, and anatomy.

Approach: SNR unit training scheme and imaging transformer architecture

Results: Imformer models outperformed CNNs and conventional transformer. The SNR training enables storng generalization.

Impact: Recovery high-fidelity MR signal from very low SNR inputs; Enable 0.55T MRI model training.

0655 16:45



[Accelerating DT-CMR with Deep Learning-based Tensor De-noising and Breath Hold Reduction]

Michael Tanzer[1,2], Andrew Scott[1,2], Zohya Khalique[1,2], Maria Dwornik[1,2], Ramyah Rajakulasingam[1,2], Ranil De Silva[1,2], Dudley Pennell[1,2], Pedro Ferreira[1,2], Guang Yang[1,2], Daniel Rueckert[1,3], and Sonia Nielles-Vallespin[1,2]

[1]Imperial College London, London, United Kingdom, [2]Royal Brompton Hospital, London, United Kingdom, [3]Technische Universität München, Munich, Germany

Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence

Motivation: DT-CMR can revolutionise diagnosis and treatment of heart conditions by non-invasively imaging cardiomyocyte microstructure, but currently long acquisition times prevent clinical use.

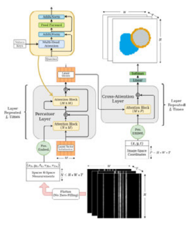
Goal(s): Reduce the number of breath-holds required for in-vivo DT-CMR acquisitions, resulting in significantly reduced scan times with minimal image quality loss.

Approach: We developed a deep learning model based on Generative Adversarial Networks, Vision Transformers, and Ensemble Learning to de-noise diffusion tensors computed from reduced-repetition DT-CMR data. We compared model performance to conventional linear fitting methods and a baseline deep learning approach.

Results: Our model reduced noise over 20% compared to previous state-of-the-art approaches while retaining known clinically-relevant myocardial properties.

Impact: This breakthrough in DT-CMR acquisition efficiency could enable rapid microstructural phenotyping of the myocardium in the clinic for the first time, revolutionising personalised diagnosis and treatment by unlocking DT-CMR's ability to non-invasively characterise heart muscle organisation at the cellular level.

0656 16:57



[Reconstruction-free segmentation from undersampled k-space using transformers]

Yundi Zhang[1,2], Nil Stolt-Ansó[1,3], Jiazhen Pan[1,2], Wenqi Huang[1,2], Kerstin Hammernik[1,4], and Daniel Rueckert[1,2,3,4]

[1]School of Computation, Information and Technology, Technical University of Munich, Munich, Germany, [2]School of Medicine, Klinikum rechts der Isar, Munich, Germany, [3]Munich Center for Machine Learning, Technical University of Munich, Munich, Germany, [4]Department of Computing, Imperial College London, London, United Kingdom

Keywords: AI/ML Image Reconstruction, Segmentation, k-space

Motivation: High acceleration factors place a limit on MRI image reconstruction. This limit is extended to segmentation models when treating these as subsequent independent processes.

Goal(s): Our goal is to produce segmentations directly from sparse k-space measurements without the need for intermediate image reconstruction.

Approach: We employ a transformer architecture to encode global k-space information into latent features. The produced latent vectors condition queried coordinates during decoding to generate segmentation class probabilities.

Results: The model is able to produce better segmentations across high acceleration factors than image-based segmentation baselines.

Impact: Cardiac segmentation directly from undersampled k-space samples circumvents the need for an intermediate image reconstruction step. This allows the potential to assess myocardial structure and function on higher acceleration factors than methods that rely on images as input.

0657 17:09

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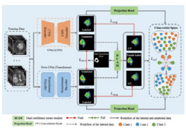

Dual-confidence-guided feature learning for semi-supervised medical image segmentation

Yudan Zhou[1], Shuhui Cai[1], Congbo Cai[1], Liangjie Lin[2], and Zhong Chen[1]

[1]Xiamen University, Xiamen, China, [2]MSC Clinical & Technical Solutions, Philips Healthcare, China

Keywords: Diagnosis/Prediction, Machine Learning/Artificial Intelligence, Data Processing, MRI medical segmentation, Brain

Motivation: Obtaining a large medical image dataset with accurate annotations is challenging, thus limiting the practical application of deep learning in clinical practice.

Goal(s): Developing a novel semi-supervised algorithm for a limited set of labeled images.

Approach: Building a dual-branch network with dual-confidence-guided constraints for tumor feature learning, enabling the model to learn accurate and comprehensive feature representations.

Results: In brain tumor segmentation, this algorithm achieved accurate tumor boundary segmentation using only 1% and 10% of labeled training data, and obtained segmentation results close to fully supervised learning when 20% of the training data was labeled.

Impact: Our dual-confidence-guided semi-supervised feature learning model can achieve accurate brain tumor region segmentation with limited labeled training data, speeding up the application of deep learning technology in clinical research and providing assistance for clinical diagnosis.

0658 17:21

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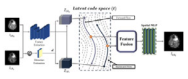


Continuous Spatio-Temporal Representation with Implicit Neural Representation and Neural Ordinary Differential Equation in DSC-MRI

Junhyeok Lee[1], Kyu Sung Choi[2], Jung Hyun Park[3], Inpyeong Hwang[2], Jin Wook Chung[2], and Seung Hong Choi[2]

[1]Seoul National University College of Medicine, Seoul, Korea, Republic of, [2]Department of Radiology, Seoul National University Hospital, Seuol, Korea, Republic of, [3]Seoul Metropolitan GovernmentSeoul National University Boramae Medical Center, Seoul, Korea, Republic of

Keywords: Analysis/Processing, DSC & DCE Perfusion

Motivation: Dynamic Susceptibility Contrast MRI (DSC-MRI) aids in diagnosing cerebrovascular conditions, but simultaneously achieving high spatial and temporal resolutions is challenging, limiting the capture of detailed perfusion dynamics.

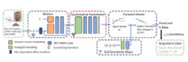
Goal(s): To develop a deep learning framework for spatio-temporal super-resolution in DSC-MRI to enhance the capture of perfusion dynamics.

Approach: Our proposed model utilizing bi-directional Neural ODE, feature extraction, and a local implicit image function to improve DSC-MRI images and address spatial and temporal resolution constraints.

Results: The reconstructed results outperform other methods, with enhanced NMSR, PSNR, and SSIM metrics, providing visual confirmation of accurate MR signal approximation and perfusion parameter calculation.

Impact: The spatiotemporal super-resolution of DSC-MRI with deep learning allows for more accurate assessment of perfused tissue dynamics and tumor habitat, as well as more freedom in choosing acquisition weights between spatial and temporal during MRI acquisition.

0659 17:33



Neural Implicit Quantitative Imaging

Felix Zimmermann[1], Simone Hufnagel[1], Patrick Schuenke[1], Andreas Kofler[1], and Christoph Kolbitsch[1]

[1]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany

Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence

Motivation: 3D quantitative MRI presents a challenging inverse problem. The application of learned reconstruction methods is hindered by the need for extensive training data and the large size of high-resolution voxel representations of multi-dimensional data. Implicit neural fields have shown promise in cine imaging and slice-to-volume registration.

Goal(s): Explore the use of neural fields for representing 3D high-resolution quantitative parameters in qMRI.

Approach: We integrate motion correction, sensitivity map estimation, and 3D parameter neural fields into an end-to-end, scan-specific optimization without training data.

Results: Demonstration of feasibility in the context of cardiac qMRI and initial results of whole-heart 3D T1 maps.

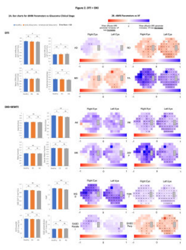
Impact: Introduction of implicit neural fields into qMRI, allowing for continuous representation of the quantitative parameters in 3D space. Our novel end-to-end reconstruction with motion correction, sensitivity map estimation provides fast high-resolution, whole-heart T1-maps without relying on training data.

Oral

Dementia & Neurodegenerative Diseases

Room 325-326 | Tuesday 15:45 - 17:45 | *Moderators:* Shannon Kolind & Yuhei Takado

0660 15:45



Relationships between Brain Microstructures and Visual Field Loss Patterns in Glaucoma using Diffusion MRI and Archetypal Analysis

Yueyin Pang[1], Carlos Parra[1], Ji Won Bang[1], Els Fieremans[2], Gadi Wollstein[1], Joel S Schuman[3,4,5], Mengyu Wang[6], and Kevin C Chan[1,2]

[1]Department of Ophthalmology, New York University Grossman School of Medicine, New York, NY, United States, [2]Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Wills Eye Hospital, Philadelphia, PA, United States, [4]Sidney Kimmel Medical College of Thomas Jefferson University, Philadelphia, PA, United States, [5]Department of Biomedical Engineering, Drexel University, Philadelphia, PA, United States, [6]Schepens Eye Research Institute, Harvard Medical School, Boston, MA, United States

Keywords: Other Neurodegeneration, Neurodegeneration

Motivation: In bilateral glaucoma, visual field loss often spares complementary regions between eyes to optimize residual vision, but the underlying mechanisms are unknown.

Goal(s): Investigate how brain microstructural environment relates to regional visual field loss patterns in glaucoma.

Approach: Advanced diffusion MRI parameters of optic radiation integrity were correlated with glaucomatous visual field loss patterns using partial correlation and archetypal analyses.

Results: Diffusion MRI metrics generally correlated with overall visual field loss. Complementary archetypal loss patterns were also found between eyes when associating pointwise visual field to certain MRI metrics sensitive to axonal/glial integrity and neuroinflammation, suggesting their involvement in influencing residual binocular vision.

Impact: Advanced neuroimaging combined with computational analysis can provide insights into the brain's role in influencing preferential damage to maximize retained binocular vision in glaucoma. Diffusion MRI holds promise for assessing glaucoma progression and brain plasticity for guiding vision preservation.

0661 15:57

In vivo mapping of sodium homeostasis disturbances in individual ALS patients: a brain 23Na MRI study

Aude-Marie Grapperon[1,2], Mohamed Mounir El Mendili[2], Adil Maarouf[2], Jean-Philippe Ranjeva[2], Maxime Guye[2], Annie Verschueren[1], Shahram Attarian[1], and Wafaa Zaaraoui[2]

[1]APHM, Hôpital de la Timone, Referral Centre for Neuromuscular Diseases and ALS, Marseille, France, [2]Aix Marseille Univ, CNRS, CRMBM-CEMEREM, Marseille, France

Keywords: Other Neurodegeneration, Neurodegeneration, non-proton; sodium; ALS

Motivation: ALS is a neurodegenerative disease leading to progressive motor deficit and death within few years. There is an unmet need to identify non-invasive biomarkers at the individual level to predict disease progression.

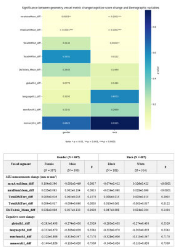
Goal(s): To study disease severity at the individual level in ALS by mapping abnormal sodium homeostasis using brain ^{23}Na-MRI.

Approach: 27 ALS patients were explored by brain ^{23}Na-MRI. Individual map of abnormal total sodium concentration (TSC) was computed for each patient compared to a local database of 62 controls.

Results: This study mapping sodium homeostasis disturbances at the individual level in ALS patients evidenced association between TSC increase and disease severity.

Impact: This pilot study mapping sodium homeostasis disturbances at the individual level in ALS patients through 23Na-MRI evidenced association between TSC increase and disease severity and may be a future biomarker to help stratifying patients and evaluating new therapeutics.

0662 16:09



[Longitudinal MRA Tortuosity Metric Measurements in a Population-based Study]

Ziyang Xu[1], Melissa Caughey[2], Sile Wang[1], Xinwei Zhou[3], and Ye Qiao[1]

[1]Department of Radiology, Johns Hopkins Hospital, Baltimore, MD, United States, [2]Joint Department of Biomedical Engineering, University of North Carolina & North Carolina State University, Chapel Hill, NC, United States, [3]Johns Hopkins Hospital, Baltimore, MD, United States

Keywords: Dementia, Blood vessels, MRA

Motivation: Current understanding of dolichoectasia has largely been drawn from patients with clinical need for brain imaging in the cross-sectional settings.

Goal(s): To characterize the longitudinal changes in brain MRA geometry vessel metrics and their associations with demographic variables, imaging biomarkers and cognitive performance.

Approach: Basic demographic and clinical information were compared between two groups w/wo MRI metric measurement change using two-sample t-tests. The associations between MRI metrics and cognitive decline or incidence dementia were tested using logistic regression.

Results: MRA geometry vessel metric change was not associated with the cognitive decline over time (3.6-8 years). Baseline cognitive score can predict future cognitive performance.

Impact: Clinical predictors of worsening dolichoectasia are unknown. Although MRA geometry vessel metric changes are not significant with cognitive decline, demographic variables show significance on some metric difference. Baseline cognitive score can also predict cognitive change.

0663 16:21

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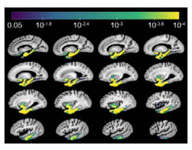


[Deformation-based morphometry reveals lower brain tissue volume in autopsy confirmed limbic age-related TDP-43 encephalopathy (LATE)]

Mahir Tazwar[1], Arnold M Evia[2], Abdur Raquib Ridwan[2], David A Bennett[2], Julie A Schneider[2], and Konstantinos Arfanakis[1,2]

[1]Department of Biomedical Engineering, Illinois Institute of Technology, Chicago, IL, United States, [2]Rush Alzheimer's Disease Center, Rush University Medical Center, Chicago, IL, United States

Keywords: Other Neurodegeneration, Aging, LATE-NC, TDP-43, Neuropathology, Aging, Postmortem MRI

Motivation: The association of limbic-predominant age-related TDP-43 encephalopathy neuropathological change (LATE-NC) with brain morphometry has not been thoroughly investigated.

Goal(s): To investigate gray and white matter morphometric abnormalities in LATE-NC in a large number of community-based older adults.

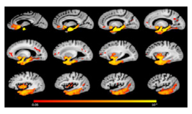
Approach: This study combined deformation-based morphometry (DBM) in ex-vivo brain MRI and detailed neuropathological data on the same community-based older adults (N=897), and investigated the association of LATE-NC with brain morphometric characteristics using voxel-wise linear regression models.

Results: LATE-NC was associated with lower volume in gray and white matter areas of temporal and frontal lobes and basal ganglia, consistent with the known pathological distribution of LATE-NC.

Impact: The pattern of morphometric abnormality in LATE-NC that was generated in the present work may potentially be used in combination with other imaging and clinical information towards the development of a marker of this devastating neuropathology.

0664 16:33

MERIT AWARD MAGNA CUM LAUDE



Difference in the spatial pattern of brain atrophy associated with Alzheimer's and LATE neuropathology

Khalid Saifullah[1], Abdur Raquib Ridwan[2], David A. Bennett[2], Julie A. Schneider[2], and Konstantinos Arfanakis[1,2]

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Keywords: Other Neurodegeneration, Aging, LATE, Alzheimer's, Neuropathology, Aging, Postmortem MRI

Motivation: Alzheimer's disease neuropathologic change (AD-NC) and limbic-predominant age-related TDP-43 encephalopathy neuropathologic change (LATE-NC) are common age-related pathologies and are associated with brain atrophy, especially in the medial temporal lobe. However, the difference in atrophy patterns associated with the two pathologies is not well known.

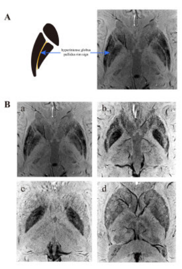
Goal(s): To investigate the difference in brain atrophy patterns associated with AD-NC and LATE-NC.

Approach: Ex-vivo MRI and detailed neuropathology were combined in a large number of community-based older adults that came to autopsy.

Results: LATE-NC stages 2 or 3 are associated with more atrophy in the anterior portion of the hippocampus compared to moderate or severe AD-NC.

Impact: Atrophy in the anterior portion of the hippocampus is more severe with LATE-NC stages 2 or 3 than with moderate or severe AD-NC.

0665 16:45



Hyperintense globus pallidus rim sign on 7T MRI is a novel biomarker of neurological Wilson's disease

Dongning Su[1], Zhijin Zhang[1], Zhe Zhang[2], Sujun Zheng[3], Tingyan Yao[4], Yi Dong[5], Wanlin Zhu[2], Ning Wei[2], Yue Suo[2], Xinyao Liu[2], Huiqing Zhao[1], Zhan Wang[1], Huizi Ma[1], Wei Li[1], Junhong Zhou[6], Joyce S. T. Lam[7], Tao Wu[1], Yuan Li[8], Petr Dusek[9], A. Jon Stoessl[7], Xiaoping Wang[10], Jing Jing[2], and Tao Feng[1]

[1]*Department of Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China,* [2]*Tiantan Neuroimaging Center of Excellence, Beijing Tiantan Hospital, Capital Medical University, Beijing, China,* [3]*Department of Hepatology, Beijing Youan Hospital, Capital Medical University, Beijing, China,* [4]*Department of Neurology, Xuanwu Hospital, Capital Medical University, National Clinical Research Center for Geriatric Disorders, Beijing, China,* [5]*Senior Department of Hepatology, the Fifth Medical Center of PLA General Hospital, Beijing, China,* [6]*Hinda and Arthur Marcus Institute for Aging Research, Hebrew SeniorLife, Roslindale, MA, United States,* [7]*Pacific Parkinson's Research Centre, Djavad Mowafaghian Centre for Brain Health, University of British Columbia, Vancouver, BC, Canada,* [8]*MR Research Collaboration Team, Siemens Healthineers, Beijing, China,* [9]*Department of Neurology and Centre of Clinical Neuroscience, First Faculty of Medicine, Charles University and General University Hospital, Prague, Czech Republic,* [10]*Department of Neurology, Jiading Branch of Shanghai General Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China*

Keywords: Other Neurodegeneration, Neurodegeneration, Wilson's disease; 7T MRI; biomarker; metal deposition pattern

Motivation: Excessive subcortical metal deposition seen on susceptibility imaging has suggested a characteristic pattern in neurological Wilson's disease (NWD).

Goal(s): To develop a novel imaging biomarker of NWD using 7T SWI.

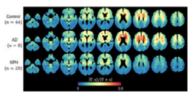
Approach: WD patients, monoallelic *ATP7B* variant carriers, health controls, and patients with comparable clinical or imaging manifestations were recruited for development of a novel biomarker of NWD and exploratory comparative analysis. All underwent 7T SWI with quantitative susceptibility mapping and principal component analysis performed.

Results: The novel biomarker of NWD termed "hyperintense globus pallidus rim sign" showed high diagnostic accuracy. It revealed a special metal deposition pattern in the lenticular nucleus in NWD.

Impact: A novel imaging biomarker of neurological Wilson's disease (NWD) termed "hyperintense globus pallidus rim sign" could aid the diagnosis and monitoring of NWD.

0666 16:57

MERIT AWARD MAGNA CUM LAUDE



Magnetic Resonance Elastography Based Measure of Compressibility in Normal Pressure Hydrocephalus and Alzheimer’s Disease

Pragalv Karki[1], Matthew C Murphy[1], Petrice M Cogswell[1], Armando Manduca[1,2], Richard L Ehman[1], and John Huston III[1]

[1]Department of Radiology, Mayo Clinic College of Medicine, Rochester, MN, United States, [2]Department of Physiology and Biomedical Engineering, Mayo Clinic College of Medicine, Rochester, MN, United States

Keywords: Dementia, Alzheimer's Disease, Biomarker's, Novel contrast mechanisms

Motivation: Magnetic resonance elastography (MRE) is typically used to assess shear mechanical properties of a tissue. A new measure related to the compressibility of a tissue could provide new insights into disease processes.

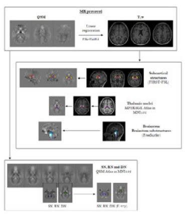
Goal(s): To test a new measure related to the tissue compressibility in application to neurological disorders.

Approach: A measure of compressibility was defined as the ratio of the magnitude of the divergence over the magnitude of the curl of displacements.

Results: Normal pressure hydrocephalus and Alzheimer’s disease displayed distinct patterns of compressibility measure compared to the control group.

Impact: An MRE-based compressibility measure demonstrates unique patterns in normal pressure hydrocephalus and Alzheimer’s disease. This may provide new insights into disease processes and guides future research.

0667 17:09



Myotonic Dystrophy type 1: susceptibility in Thalamus and Brainstem as biomarker of clinical impairment

Cristiana Fiscone[1], Magali Jane Rochat[2], Silvia De Pasqua[3], Micaela Mitolo[2,4], Claudio Bianchini[1], Gianfranco Vornetti[1,2], Fiorina Bartiromo[2], David Neil Manners[2,5], Patrizia Avoni[1,3], Rocco Liguori[1,3], Raffaele Lodi[1,2], and Caterina Tonon[1,2]

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Keywords: Other Neurodegeneration, Quantitative Susceptibility mapping, Myotonic Dystrophy type 1

Motivation: QSM is a valuable tool for investigating neurodegenerative conditions, including DM1, a genetic multisystem disorder affecting the central nervous system.

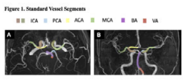
Goal(s): The objective of this research is to identify biomarkers of clinical impairment by exploring magnetic susceptibility in sub-cortical areas of DM1 brains.

Approach: We developed an automated pipeline for segmenting various structures and their sub-units. DM1 susceptibility values were compared to healthy controls and correlated with clinical and laboratory data.

Results: Thalamus and brainstem were identified as key structures, showing increased iron concentration and correlation with disability and polysomnography scores, contributing to a comprehensive understanding of DM1 and its symptomathology.

Impact: Examining iron accumulation in sub-cortical structures through QSM contributes to a complete understanding of DM1 as a neurodegenerative disorder. Thalamus and brainstem, crucial in autonomic functions, exhibit alterations and correlations with clinical measurements, suggesting central origins of DM1 symptomatology.

0668 17:21 [Brain arterial remodeling and incident dementia: the Atherosclerosis Risk in Communities (ARIC) Study]



Sile Wang[1], Melissa Caughey[2], Ziyang Xu[1], Xinwei Zhou[1], and Ye Qiao[1]

[1]*Deptartment of Radiology, Johns Hopkins University, Baltimore, MD, United States,* [2]*Deptartment of Biomedical Engineering, University of North Carolina & North Carolina State University, Chapel Hill, NC, United States*

Keywords: Dementia, Blood vessels, MRA

Motivation: We aimed to address the gap in understanding the neurovascular contributions to dementia risk in a US community-based study, recognizing the need to consider arterial geometry factors and cerebral small vessel disease (CSVD).

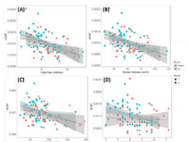
Goal(s): Our study sought to investigate the relationship between brain arterial remodeling and incident dementia risk, focusing on how arterial geometry and CSVD factor into this complex equation.

Approach: Our approaches involved analyzing data from a US community-based study to assess the impact of arterial remodeling, arterial geometry, and CSVD on dementia risk.

Results: Our study's core findings indicate an increased risk of incident dementia associated with brain arterial remodeling.

Impact: Our model is promising for the prediction of cognitive decline and dementia diagnosis based on the MRA measurements.

0669 17:33 [Brain CSF clearance measured by phase-contrast MRI and dynamic 18F-MK-6240 PET in Alzheimer's disease]



Liangdong Zhou[1], Gloria C Chiang[1], Xiuyuan H Wang[1], Pan Liu[2], Ilhami Kovanlikaya[1], Olivier Baledent[2], Mony J de Leon[1], and Yi Li[1]

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Keywords: Neurofluids, Alzheimer's Disease

Motivation: Beta-amyloid (Aβ) in Alzheimer’s disease (AD) is caused by decreased glymphatic clearance function. As the main source of CSF in glymphatic system, the mechanism of CSF dynamic in ventricle system is of great importance.

Goal(s): Use dynamic ^{18}F-MK-6240 PET and PC-MRI to study the relationship of CSF clearance in lateral ventricle (LV) and aqueduct.

Approach: CSF turnover rate in LV is derived from dynamic 18F-MK-6240 PET. Aqueduct parameters were calculated using PC-MRI data. Linear regression analysis was performed between PET and PC-MRI measurements.

Results: The CSF clearance measurements from both PET and MRI are consistent and show diagnostic group difference.

Impact: ^{18}F-MK-6240 PET derived CSF turnover rate and phase-contrast MRI produced aqueduct CSF measurements are highly correlated. The data reveals diagnostic group difference after controlling for age and sex, indicating that the decreased CSF clearance is associated with Alzheimer’s disease.

Oral

Designing Outside the Box: New Devices & New Systems

Room 331-332 | Tuesday 15:45 - 17:45 | *Moderators:* Thu-Thao Le & Wenwei Yu

0670 15:45

Development of a Compact Head-only Scanner with a Window and Shoulders Outside its Vertical Bore.

Taylor Froelich[1], Sebastian Theilenberg[2], Joseph Bailey[3], Lance DelaBarre[1], Steve Suddarth[1], Daniel Cosmo Pizetta[4], Mateus José Martins[4], Edson Luiz Géa Vidoto[4], Yun Shang[2], Russell Lagore[1], Terence W Nixon[5], John P Strupp[1], Jamal Olatunji[3], Mathieu Szmigiel[6], Mark Hunter[7], Edgar Rodríguez Ramírez[8], Mailin Lemke[9], Chathura Kumaragamage[5], Huub Weijers[3], R Gilberto Gonzalez[10], J. Thomas Vaughan[2,11], Robin A. de Graaf[5], Christoph Juchem[2,11], Alberto Tannús[4], Ben Parkinson[3], and Michael Garwood[1,12]

[1]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Department of Biomedical Engineering, Columbia University, New York, NY, United States, [3]Robinson Research Institute, Victoria University of Wellington, Wellington, New Zealand, [4]Centro de Imagens e Espectroscopia por Ressonância Magnética - CIERMag - São Carlos Physics Institute, University of São Paulo – IFSC-USP, São Carlos, Brazil, [5]Department of Radiology and Biomedical Imaging, Magnetic Resonance Research Center, Yale University School of Medicine, New Haven, CT, United States, [6]Air Liquide, Paris, France, [7]Tranzpower Limited, Wellington, New Zealand, [8]Victoria University of Wellington, Wellington, New Zealand, [9]Dreiform GmbH, Hürth, Germany, [10]Division of Neuroradiology, Massachusetts General Hospital, Boston, MA, United States, [11]Department of Radiology, Columbia University Medical Center, New York, NY, United States, [12]Department of Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States

Keywords: Hybrid & Novel Systems Technology, Hybrid & Novel Systems Technology, New Devices, Gradients, Magnets, Head-Only

Motivation: MRI has evolved into an indispensable tool, but remains inaccessible to much of the world's population.

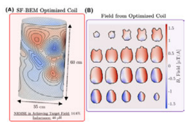
Goal(s): To build a compact, low-cost, mid- to high-field MRI system capable of producing diagnostic-quality images.

Approach: A complete redesign of MR scanner architecture and key technologies; including a compact high temperature superconducting magnet, multi-coil gradient array, and digital spectrometer. The system required extensive testing prior to integration and initial imaging.

Results: Initial experiments produced high-resolution images despite using an extremely inhomogeneous magnetic field from the compact 0.7 tesla magnet.

Impact: This work represents a significant milestone within the MRI community to address the problems in accessibility and under-utilization facing MRI today. By focusing on ways to develop portable, low-cost systems, the accessibility of this imaging modality can increase substantially.

0671 15:57



A Universal Bz Coil for Uniform Multiphoton Excitation in High-Field MRI

John M Drago[1,2,3], Mathias Davids[2,3], Jason P Stockmann[2,3], Bastien Guerin[2,3], and Lawrence L Wald[2,3,4]

[1]Dept. of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Dept. of Radiology, Massachusetts General Hospital, A. A. Martinos Center for Biomedical Imaging, Boston, MA, United States, [4]Dept. of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: RF Pulse Design & Fields, Brain

Motivation: Contrast in high-field MRI is obscured by the spatially non-uniform excitation flip angle profile of conventional birdcage transmit coils.

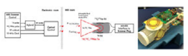
Goal(s): We demonstrate that a single B_z coil operated in the kHz range can supplement a birdcage to create a spatially-uniform flip angle profile using multiphoton excitation.

Approach: We use a stream function boundary element method to optimize the B_z coil windings to produce homogeneous nonselective multiphoton excitations across a universal pulse database and validate with Bloch simulations.

Results: The single B_z channel achieved a mean flip angle NRMSE of 13.9% for a 90° target MP-pTx pulse in test subjects.

Impact: The design method provides a simplified hardware configuration and reduced local SAR concerns compared to either conventional pTx or our previous work using a full shim array in conjunction with multiphoton parallel transmission.

0672 16:09



[Multinuclear MRI Using a Single Adaptable Transmit Hardware]

Natalia Gudino[1]

[1]*MRIEngT, LFMI,NINDS, NIH, Bethesda, MD, United States*

Keywords: Hybrid & Novel Systems Technology, New Devices

Motivation: Routine studies of nuclei other than ^{1}H are constrained by the need of separate fixed tuned hardware.

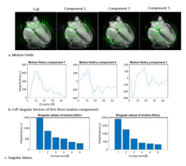
Goal(s): To increase flexibility of the multinuclear setup by developing an adaptable single transmit hardware to allow excitation of many low-frequency nuclei and ^{1}H.

Approach: The conventional remote broadband amplifier was replaced by an optically controlled dual-tuned on-coil amplifier for ^{1}H and X-nuclei excitation. The amplifier can be automatically tuned to the selected frequency by pulse-width-modulation of an optically transmitted pulse.

Results: Automatic tuning of a first prototype was possible for excitation of ^{13}C, ^{23}Na and ^{129}Xe, while performance of ^{1}H excitation at 7T was unaffected.

Impact: The presented technology combined with new adaptable receive hardware can advance the implementation of routine multinuclear studies to extend research of X-nuclei and their potential clinical use.

0673 16:21



[Dynamic tracking of cardiac motion fields using multi-frequency scattering parameters of an RF array – an MRI based feasibility study]

Bart Romke Steensma[1,2] and Cornelis Antonius Theodorus van den Berg[1,2]

[1]*Computational Imaging Group, UMC Utrecht, Utrecht, Netherlands,* [2]*PrecorDx, Utrecht, Netherlands*

Keywords: New Devices, Cardiovascular

Motivation: To enable high frame rate spatial mapping of cardiac mechanical motion with an array of RF antennas.

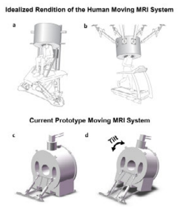
Goal(s): Investigate the feasibility of estimating 2D motion fields based on measurements of wideband multi-channel RF scattering parameters.

Approach: Paired CINE MRI and multi-channel wideband (55-1300 MHz) RF scattering measurements were acquired in vivo. Motion fields were determined from MRI, a Gaussian process regression model was trained and tested to predict motion fields from the RF scattering parameters.

Results: 2D motion fields in a 4Ch CINE image of the heart can be reconstructed with high precision (RMS error 0.66mm) based on RF scattering measurements.

Impact: We demonstrated feasibility of high precision and high framerate spatial motion mapping with RF antennas. Further validation with real-time MRI is warranted. This method could be applicable for motion tracking during medical imaging or in a low complexity care setting.

0674 16:33 [Moving MRI (mMRI): imaging a moving body with synchronized magnet movement]



Jingting Yao[1,2], Artan Kaso[1,2], Nikhil Patel[3], Yin-Ching Iris Chen[1,2], Yi-Fen Yen[1,2], André J.W. van der Kouwe[1,2], Daniel M. Merfeld[4], and Jerome L. Ackerman[1,2]

[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Radiology, Massachusetts General Hospital, Boston, MA, United States, [4]The Ohio State University College of Medicine, Columbus, OH, United States

Keywords: Hybrid & Novel Systems Technology, Hybrid & Novel Systems Technology, Artifacts, Brain, Motion Correction

Motivation: MRI is largely limited to scenarios involving small-scale bodily movements to minimize artifacts and field-induced physiological effects.

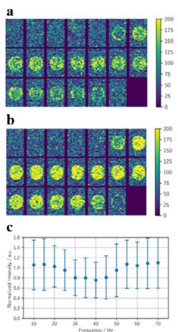
Goal(s): We are developing a moving MRI system where the magnet and subject's head remain stationary with respect to each other during large-scale motion.

Approach: Utilizing a compact, dry 1.5T magnet, we built an apparatus that tilted the entire magnet assembly, including the cold head, gradient/shim/RF coils, and the subject, up and down during scanning.

Results: We demonstrated the ability to scan phantoms and live animals while the magnet is in motion and to correct for imaging artifacts caused by tilting the magnet.

Impact: Our proof-of-concept prototype moving MRI system supports the future viability of developing a human-scale moving MRI system, which has the potential to advance studies in vestibular research, traumatic brain injury, and brain-behavior interactions, among other areas.

0675 16:45 [Low-frequency magnetic signal detection using stimulus-induced rotary saturation sequence in ultra-low field MRI]



Takenori Oida[1], Takahiro Moriya[1], Akinori Saito[1], Hiroyuki Ueda[2], Yosuke Ito[2], and Motohiro Suyama[1]

[1]Hamamatsu Photonics K.K., Hamamatsu, Japan, [2]Kyoto University, Kyoto, Japan

Keywords: Low-Field MRI, Low-Field MRI

Motivation: Realization of biomagnetic measurement using MRI with high spatial resolution.

Goal(s): Detection of low-frequency magnetic signals below 50 Hz in ultra-low field MRI (ULF-MRI).

Approach: Magnetic signal detections were performed by stimulus-induced rotary saturation (SIRS) sequence in ULF-MRI. As magnetic signals, reference magnetic fields with 225 nT_{pp} in amplitude and 10, 15, ..., 70 Hz in frequency were applied to the bottle phantom.

Results: The signal reduction of approximately 20% were observed when the reference magnetic field between 30 Hz and 45 Hz were applied. This indicates that low-frequency magnetic signals can be detected by the SIRS sequence in ULF-MRI.

Impact: We demonstrate the feasibility of biomagnetic measurement below 50 Hz such as brain activity first time by realizing low-frequency magnetic signal detection using stimulus-induced rotary saturation sequence in ULF-MRI with 7 mT in B_0.

0676 16:57 [A 16-Ch Elastic Thin RF Coil Array for Whole Brain Concurrent TMS-fMRI]

Yunsuo Duan[1,2], Feng Liu[1,2], Rachel Marsh[1,2], Matthew Riddle[1,2], Gauraw H. Patel[1,2], Lawrence S. Kegeles[1,2], John Thomas Vaughan[3], and Jack Grinband[1,2]

[1]MR Research, Department of Psychiatry, Columbia University, New York, NY, United States, [2]New York State Psychiatric Institute, New York, NY, United States, [3]Columbia MR Research Center, Columbia University, New York, NY, United States

Keywords: RF Arrays & Systems, RF Arrays & Systems, TMS

Motivation: The low TMS efficiency and complexity of the setup for whole brain concurrent TMS-fMRI remain challenging due to the lack of feasible RF coil arrays.

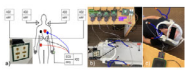
Goal(s): We proposed a 16-channel elastic whole brain RF coil array to increase the TMS efficiency and flexibility.

Approach: We developed a highly flexible close-fitting coil former with 3D printing and evenly placed the 16 coil loops made of flexible shielding sleeves on the former.

Results: The measured TMS efficiency was about 80% at the inner wall of the coil array. The SNRs of experimental images were comparable with those acquired using Nova 32-ch coil array.

Impact: The proposed 16-ch elastic coil array was capable of significantly improving the TMS efficiency and simplifying the setup of whole brain concurrent TMS-fMRI.

0677 17:09 [Four-Channel MM-Wave Radar Testbed for Neck vs Chest Cardiac Sensing]



Lauren Hughes[1], Fraser Robb[2], Shreyas Vasanawala[3], John Pauly[1], and Greig Cameron Scott[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]GE Healthcare, Aurora, OH, United States, [3]Radiology, Stanford University, Stanford, CA, United States

Keywords: Hybrid & Novel Systems Technology, Hybrid & Novel Systems Technology, Radar

Motivation: Respiratory and cardiac gating are common in modern MRI, but require additional sensors in contact with the patient and the associated cabling.

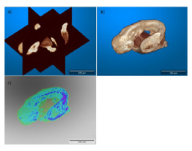
Goal(s): Our goal is to determine if CW mm-wave radar can act as a robust non-contact cardiac and respiratory sensor, with potential for gating in MRI.

Approach: A 4-channel 24 GHz radar test bed is developed with a pair of neck radars and a pair of chest radars. SSA and ICA methods help extract waveform structure relative to an ECG.

Results: The CW radars nicely separate breathing and heart rate with distinct features at the ECG QRS complex.

Impact: MM-wave radar could provide a non-contact sensor of cardiac/breathing in MRI. Potential applications include non-contact gating, and independent vascular pulse or motion sensing for use in neuroimaging.

0678 17:21 [Ultrahigh Resolution Imaging of Zebrafish Embryos with a µMRI Insert in a Horizontal Bore Small Animal Scanner]



Thomas Hüfken[1], Tobias Lobmeyer[1], Bernd Gahr[1], and Volker Rasche[1]

[1]Ulm University, Ulm, Germany

Keywords: New Devices, New Devices

Motivation: The absence of hardware specifically tailored for horizontal bore small animal MRI systems hinders the achievement of ultrahigh-resolution imaging.

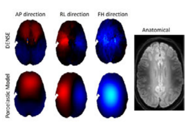
Goal(s): To facilitate volumetric imaging at sub 10^3 μm^3 spatial resolutions in a conventional horizontal small animal scanner.

Approach: A custom-made high-performance gradient system and RF-hardware was interfaced to the system RF- and gradient-amplifiers, avoiding the requirement for specialized imaging software. A constant time imaging sequence was employed to capture ultrahigh-resolution images.

Results: The setup was successfully tested for imaging of zebrafish embryos at different time points post fertilization with an isotropic spatial resolution of 9^3 μm^3.

Impact: The suggested approach enables isotropic single-digit µm ultrahigh resolution imaging in conventional horizontal bore MRI systems. This supports novel imaging applications for a wide range of tiny animals, plants, or biological tissue without dedicated microscopy MR systems.

0679 17:33 [Imaging pressure gradients and stress fields driving ISF flow in the brain by assimilating DENSE pulsatile motion data into a poroelastic model.]



Matthew Mcgarry[1], Jaco Zwanenburg[2], John Weaver[3], and Keith Paulsen[1]

[1]Dartmouth College, Hanover, NH, United States, [2]University Medical Center Utrecht, Utrecht, Netherlands, [3]Dartmouth-Hitchcock Medical Center, Lebanon, NH, United States

Keywords: Neurofluids, Neurofluids

Motivation: Interstitial fluid (ISF) flow in the brain is important for brain function and therapies. Very slow ISF flow is difficult to directly measure, however, the driving forces can be estimated from pulsatile motion fields.

Goal(s): We assimilate pulsatile motions from DENSE sequences into a poroelastic computational model which allows fluid pressure gradient and solid stress fields to be extracted.

Approach: Generalized least squares and Galerkin weighted residual methods were used to fit a pulsatile blood pressure field to the data and compute stresses/pressure gradients.

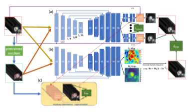
Results: Stress and pressure images show good symmetry and distributions are as expected from anatomical considerations.

Impact: Imaging the pulsatile fluid pressure gradients and solid stress fields provides new insights into the forces which drive flow of interstitial fluid in the brain, which is of critical importance in Alzheimer's disease and currently very difficult to directly measure.

Room 334-336 | Tuesday 15:45 - 17:45 | *Moderators:* Gastao Cruz

0680 15:45

MERIT AWARD SUMMA CUM LAUDE



Physically and Anatomically Constrained Self-Supervised Motion Correction for Free-Breathing Cardiac T1 Mapping

Eyal Hanania[1], Ilya Volovik[2], Israel Cohen[1], and Moti Freiman[1]

[1]The Technion – Israel Institute of Technology, Haifa, Israel, [2]Bnai Zion medical center, Haifa, Israel, Haifa, Israel

Keywords: Myocardium, Machine Learning/Artificial Intelligence, Motion Correction

Motivation: Cardiac T1 mapping is often limited by the need for breath-holding to prevent motion artifacts, which restricts its use in patients who cannot hold their breath.

Goal(s): To create a self-supervised deep learning method for motion-corrected, free-breathing cardiac T1 mapping without requiring large datasets or worrying about data variability.

Approach: We present a new self-supervised model that combines a signal relaxation model with anatomical constraints and employs the voxel-morph framework for motion correction. Our model's performance was assessed using a publicly available myocardial T1 mapping dataset.

Results: Our approach outperformed other state-of-the-art registration methods in terms of R2, DICE, and Hausdorff distance.

Impact: Our model offers the possibility of extending cardiac T1 mapping to patients who cannot perform breath-hold MRI procedures by ensuring robust motion correction for accurate T1 mapping, all without the necessity for large training datasets or worries about data anomalies.

0681 15:57

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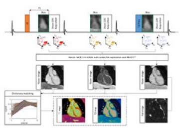


Highly-efficient free-breathing 3D whole-heart joint T1/T2 mapping and water/fat imaging at 0.55T

Dongyue Si[1], Michael G Crabb[1], Karl P Kunze[1,2], Simon Littlewood[1], Claudia Prieto[1,3], and René M Botnar[1,3,4]

[1]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [3]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

Keywords: Myocardium, Low-Field MRI, Parametric mapping

Motivation: Myocardial T1 and T2 mapping has emerged as a useful clinical tool for the diagnosis of different heart disease. However, current mapping sequences were mostly developed with 2D breathhold acquisitions and validated at 1.5T or 3T. The investigation of myocardial mapping techniques on more affordable low-field MRI systems is scarce.

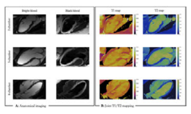
Goal(s): To develop a highly-efficient free-breathing 3D whole-heart joint T1/T2 mapping sequence with isotropic-resolution at 0.55T.

Approach: The proposed sequence acquires 3 interleaved volumes for joint T1/T2 estimation and water/fat separation.

Results: The proposed sequence shows good agreement with spin-echo reference in phantom and provides comparable results in-vivo with conventional 2D mapping sequences.

Impact: The proposed sequence enables comprehensive 3D joint T1/T2 mapping and water/fat anatomical evaluation of the whole-heart with 2mm isotropic-resolution at 0.55T during a fast free-breathing scan and thus shows promise for the detection of different cardiac diseases.

0682 16:09 [Improved 3D multi-contrast CMR for high-quality anatomical imaging and joint T1/T2 mapping in a single free-breathing scan]



Ivan Kokhanovskyi[1,2,3], Michael G. Crabb[3], Carl Ganter[1], Carlos Castillo-Passi[3,4,5], Karl P. Kunze[3,6], Radhouene Neji[3], Dimitrios Karampinos[1], Marcus R. Makowski[1,2], Claudia Prieto[3,5,7], and Rene M. Botnar[2,3,4,5,7]

[1]Department of Diagnostic and Interventional Radiology, Klinikum rechts der Isar, Technical University of Munich, Munich, Germany, [2]Institute for Advanced Study, Technical University of Munich, Munich, Germany, [3]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [4]Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [5]Millenium Institute for intelligent Healthcare Engineering, Santiago, Chile, [6]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [7]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

Keywords: Myocardium, Heart, Bright- and black blood imaging, T1/T2 mapping

Motivation: Cardiovascular MR (CMR) provides comprehensive assessment of heart disease. However, conventional CMR examinations involve multiple sequential 2D acquisitions under breath-hold conditions.

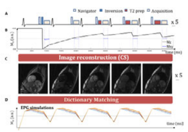
Goal(s): To devise and develop a novel 3D free-breathing sequence for simultaneous assessment of cardiovascular anatomy via bright- and black-blood imaging and myocardial tissue quantification in a single scan.

Approach: Implementation of an improved iNAV-based 5-heartbeat interleaved sequence (proACTION) with distinct IR and T2 preparation modules and non-rigid motion correction for robust and accurate myocardial tissue quantification.

Results: proACTION provides accurate delineation of cardiac and vascular structures, while demonstrating good agreement with conventional mapping sequences in healthy subjects.

Impact: Comprehensive 3D whole-heart tissue characterization and clinically relevant anatomical information can be obtained in an efficient, free-breathing, and easier to use one-click-scan with the proposed proACTION approach.

0683 16:21 [Free-breathing respiratory-navigator-gated 2D radial MR fingerprinting of the transplanted heart at 3T.]



Pauline Calarnou[1], Augustin C. Ogier[1], Tamila Abdurashidova[2], Jean-Baptiste Ledoux[3,4], Jérôme Yerly[3,4], Roger Hullin[2], and Ruud B. Van Heeswijk[3]

[1]Radiology, Department of Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, Lausanne, Switzerland, [2]Cardiology Service, Cardiovascular Department, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, Lausanne, Switzerland, [3]Department of Radiology, Lausanne University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, Lausanne, Switzerland, [4]CIBM Center for BioMedical Imaging, Lausanne and Geneva, Switzerland, Lausanne, Switzerland

Keywords: Myocardium, Transplantation

Motivation: To acquire T_1, T_2 and ECV maps in heart transplant recipients using a free-breathing technique that minimizes through-plane motion.

Goal(s): To characterize a free-breathing 2D joint T_1/T_2 cardiac MR fingerprinting technique named PARMA that includes a lung-liver navigator in the patient setting.

Approach: We compared the resulting maps to gold standard maps in a phantom and to clinical routine maps in 10 healthy volunteers and 9 heart transplant recipients.

Results: We found high accuracy in the phantom and high precision in the volunteers and heart transplant recipients.

Impact: This work demonstrates the feasibility of a free-breathing 2D joint T1/T2 MR fingerprinting in a heart transplant recipient population that cannot always perform long breath holds. The navigator allows a free breathing acquisition with limited through-plane motion.

0684 16:33

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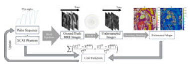


Pattern Search Pulse Sequence Optimization for Cardiac MR Fingerprinting

Zhongnan Liu[1], Jacob Richardson[2], Nicole Seiberlich[2,3], and Jesse Hamilton[2,3]

[1]Department of Electrical Engineering and Computer Science, Univerisity of Michigan, Ann Arbor, MI, United States, [2]Department of Radiology, Univeristy of Michigan, Ann Arbor, MI, United States, [3]Department of Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

Keywords: Myocardium, MR Fingerprinting, T1 mapping, T2 mapping, cardiovascular

Motivation: Current cardiac MRF sequences have been designed empirically, and thus do not exploit the full flexibility in sequence design of the MRF framework.

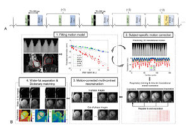
Goal(s): The goal of this project is to develop a sequence optimization method for cardiac MRF, which can be applied to shorten the breathhold and diastolic window.

Approach: An optimization method was implemented that simulates MRI signal generation, spiral undersampling, and pattern recognition during each iteration, using a pattern search algorithm to update multiple parameters.

Results: In simulations, phantoms, and healthy subjects, the shortened optimized scan yielded similar myocardial T_1 and T_2 values as a previously described cardiac MRF technique.

Impact: This study proposes a sequence optimization method for cardiac MRF with many potential applications, including designing shortened scans to reduce breathhold requirements and limit motion artifacts.

0685 16:45



3D free-breathing simultaneous myocardial T1 and T1ρ mapping with B1+ correction and subject-specific non-rigid motion correction

Haikun Qi[1,2], Zhenfeng Lyu[1], Jiameng Diao[1], Jiayu Zhu[3], Jian Xu[4], René Botnar[5,6], Claudia Prieto[5,6], and Peng Hu[1,2]

[1]School of Biomedical Engineering, ShanghaiTech University, Shanghai, China, [2]Shanghai Clinical Research and Trial Center, Shanghai, China, [3]United Imaging Healthcare, Shanghai, China, [4]UIH America, Inc., Houston, TX, United States, [5]King's College London, London, United Kingdom, [6]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile

Keywords: Myocardium, Cardiovascular

Motivation: Multi-parametric mapping is useful for comprehensive myocardial tissue characterization. However, 3D free-breathing cardiac multi-parametric mapping faces challenges.

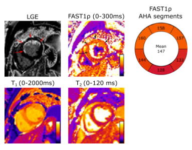
Goal(s): Develop a 3D free-breathing cardiac multi-parametric mapping framework that is robust to confounders of motion, fat and field inhomogeneities and validate it for joint T1 and T1ρ mapping at 3T.

Approach: A subject-specific respiratory motion model was constructed to enable intra-bin 3D translational and inter-bin non-rigid motion correction. B1+ inhomogeneities were corrected with optimized dual-flip-angle strategy. A dual-echo Dixon readout was adopted for water-only mapping.

Results: The proposed technique achieved good agreement with conventional techniques in measuring T1 and T1ρ in phantoms and healthy subjects.

Impact: A novel framework was proposed for efficient 3D free-breathing multi-parametric mapping. The 3D simultaneous cardiac T1 and T1ρ mapping technique with scan time of ~ 5 minutes may serve as an efficient tool for diagnosing ischemic and non-ischemic cardiomyopathies.

0686 16:57



[Accelerated T1ρ,adiab Mapping using Slice Selective Spin-Lock Preparation Pulses (FAST1ρ)]

Andrew Tyler[1], Karl Kunze[2], Radhouene Neji[1], Pier Giorgio Masci[1], Amadeo Chiribiri[1], and Sébastien Roujol[1]

[1]Biomedical Engineering and Imaging Science, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Camberly, United Kingdom

Keywords: Myocardium, Relaxometry

Motivation: $T_{1\rho}$ mapping is a promising non-contrast technique for the assessment of myocardial scar. Myocardial $T_{1\rho}$ mapping techniques commonly acquire multiple images in one breath hold to calculate a single-slice $T_{1\rho}$ map. Recently, non-selective adiabatic pulses have been employed for spin-lock preparation ($T_{1\rho,adiab}$). FAST1ρ provides a two-fold acceleration for multi-slice myocardial $T_{1\rho,adiab}$ mapping.

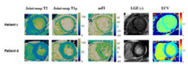
Goal(s): To assess the $T_{1\rho,adiab}$ map quality of FAST1ρ compared to a single-slice 2D $T_{1\rho,adiab}$ mapping sequence.

Approach: 10 healthy-volunteers were scanned with FAST1ρ and a single-slice sequence.

Results: FAST1ρ had no significant difference in intra-subject variability or subject-wise precision, to the single-slice sequence, and successfully visualized a myocardial scar.

Impact: FAST1ρ provides a two-fold acceleration for multi-slice myocardial $T_{1\rho,adiab}$ mapping. It has no significant difference in intra-subject variability or subject-wise precision, compared to a single-slice sequence, and shows promise for characterization a myocardial scar.

0687 17:09



[Free-breathing T1ρ dispersion imaging for myocardial fibrosis without exogenous contrast agents]

Qinfang Miao[1,2], Zhenfeng Lv[1,2], Sha Hua[3], Peng Hu[1,2], and Haikun Qi[1,2]

[1]School of Biomedical Engineering, ShanghaiTech University, Shanghai, China, [2]Shanghai Clinical Research and Trial Center, Shanghai, China, [3]Department of Cardiovascular Medicine, Ruijin Hospital Lu Wan Branch, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Keywords: Myocardium, Cardiomyopathy

Motivation: LGE and ECV are standard cardiac MR (CMR) techniques for detecting focal and diffuse myocardial fibrosis, requiring gadolinium contrast agents. For patients with gadolinium contraindications, non-contrast CMR techniques are needed to detect myocardial fibrosis.

Goal(s): To evaluate the performance of endogenous T1ρ dispersion imaging for myocardial fibrosis.

Approach: A recently proposed free-breathing T1ρ dispersion imaging technique was employed to image patients with non-ischemic cardiomyopathies. The endogenous parameters, T1ρ, myocardial fibrosis index (mFI), and native T1 were evaluated against LGE and ECV.

Results: T1ρ and mFI were elevated in the LGE region and mFI showed the best correlation with ECV among the tested parameters.

Impact: T1ρ dispersion imaging is a promising CMR technique for detecting myocardial fibrosis without exogenous contrast agents.

0688 17:21 [Non-invasive quantification of myocardial volume oxygen consumption using free-breathing, ungated, self-calibrated MR blood oximetry]

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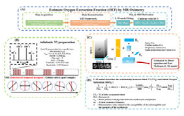


Chia-Chi Yang[1], Archana Malagi[1], Yuheng Huang[2,3], Ghazal Yoosefian[2], Xinheng Zhang[2,3], Xinming Guan[2], Anthony Christodoulou[1,4], Debiao Li[1], Hui Han[5], Rohan Dharmakumar[2], and Hsin-Jung Yang[1]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]krannert cardiovascular research center, Indiana University School of Medicine, Indianapolis, IN, United States, [3]Bioengineering, UCLA, Los Angeles, CA, United States, [4]Department of Radiological Sciences, David Geffen School of Medicine, UCLA, Los Angeles, CA, United States, [5]Radiology, Weill Cornell Medicine, New York, NY, United States

Keywords: Heart Failure, Heart, myocardial volume oxygenation consumption

Motivation: Whole-heart myocardial oxygen consumption (MVO_2) is the central factor that determines cardiac function and is a sign of heart diseases.

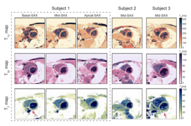
Goal(s): We proposed a high-resolution, free breathing, cardiac-phase resolved sequence to quantify MVO_2 in the beating hearts.

Approach: Healthy pigs were scanned at 3T. Coronary sinus images were acquired with a continuous, free-breathing, Radial T2Prep-IR sequence with flow compensation and water excitation and a 2D phase contrast sequence to quantify the MVO_2. Invasive ground truth was also measured to verify the accuracy of our estimation.

Results: The proposed method measured comparable SbO_2,OEF,MBF and MVO_2 values to the invasive ground truth.

Impact: The proposed free-breathing, motion-resolved cardiac MR Oximetry technique has the potential to non-invasively measure accurate myocardial oxygen consumption without using ionizing radiation and exogenous contrast agents.

0689 17:33 [Adiabatic spin-lock preparations for myocardial T2p mapping at 3T.]



Chiara Coletti[1], Joao Tourais[1], Christal van de Steeg-Henzen[2], and Sebastian Weingärtner[1]

[1]TU Delft, Delft, Netherlands, [2]HollandPTC, Delft, Netherlands

Keywords: Myocardium, RF Pulse Design & Fields, T2p, adiabatic RF, rotating-frame relaxometry

Motivation: $T_{2\rho}$ may provide complementary information between $T_{1\rho}$ and T_2, but high sensitivity to field inhomogeneities has prevented its application in cardiac MRI.

Goal(s): We evaluated adiabatic $T_{2\rho}$ preparations for human myocardium mapping at 3T.

Approach: To obtain $T_{2\rho}$ preparations, adiabatic half-passage pulses were added before and after pairs of hyperbolic secant pulses. $T_{2\rho}$ mapping was tested and compared with adiabatic $T_{1\rho}$ and T_2 maps in phantoms and 5 healthy subjects.

Results: $T_{2\rho}$ maps yielded similar values to T_2, with improved repeatability and resilience to B_0 and B_1^+ field inhomogeneities in phantom, and better precision and reproducibility in vivo, complementing $T_{1\rho}$.

Impact: Adiabatic $T_{2\rho}$ preparations enable robust in vivo myocardial $T_{2\rho}$ mapping at 3T, potentially enabling the use of an alternative rotating-frame relaxation contrast mechanism for cardiac tissue characterization at high field strengths.

Power Pitch

Pitch: Advanced MRI & MRS Biomarkers

Power Pitch Theatre 1

Tuesday
Pitches: 15:45 - 16:45
Posters: 16:45 - 17:45

Moderators: Renuka Sriram & Lijing Xin

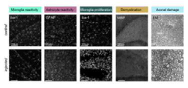
(no CME credit)

0690

Pitch: 15:45

Poster: 16:45

Screen 1



Are we validating enough our MRI markers? Cell-specific challenges to dissect the neurobiology of microstructural MRI

Antonio Cerdán Cerdá[1], Raquel Garcia-Hernandez[1], Mara Cercignani[2], Santiago Canals[1], and Silvia De Santis[1]

[1]Instituto de Neurociencias, CSIC-UMH, Alicante, Spain, [2]CUBRIC, Cardiff, United Kingdom

Keywords: Biology, Models, Methods, Diffusion/other diffusion imaging techniques, inflammation, brain, degeneration, demyelination

Motivation: Validation of MRI-extracted biomarkers is seldom performed, and when available,
Is normally underpowered and based on correlation.

Goal(s): Here we present an innovative framework for validating microstructural MRI biomarkers by eliciting cell-specific responses.

Approach: The framework is based on injection of neurotoxins in rats, followed by MRI exploration and histology.

Results: We successfully isolated conditions associated to neurodegenerative, demyelinating and inflammatory pathologies and demonstrated sensitivity and specificity of MRI- derived biomarkers.

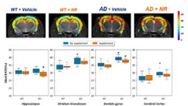
Impact: This framework impulse a much-needed change in paradigm for MRI validation by challenging the biological content of MRI derived biomarkers, refine and test new models for microstructural imaging and bridge the gap between advances in MRI physics and clinical applications.

0691

Pitch: 15:45

Poster: 16:45

Screen 2



Effect of nicotinamide riboside on glutamate in a 5XFAD mouse model of Alzheimer's disease as measured by glutamate CEST MRI

Anshuman Swain[1], Narayan Datt Soni[2], Ravi Prakash Reddy Nanga[2], James G Davis[3], Halvor Juul[2], Joeseph A Baur[3], and Ravinder Reddy[2]

[1]Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Physiology, University of Pennsylvania, Philadelphia, PA, United States

Keywords: Biomarkers, Alzheimer's Disease

Motivation: Nicotinamide riboside (NR) supplementation has increased in popularity for treating neurodegenerative diseases and is attributed to elevated NAD^{+} levels. Effective monitoring of NR-mediated changes may highlight metabolic underpinnings of NR in dementia.

Goal(s): This study uses glutamate-CEST MRI to monitor changes in glutamate levels following NR supplementation in wild-type and 5XFAD mouse models of AD.

Approach: Mice (WT and AD) were treated with NR or a vehicle (placebo) for 12 weeks followed by GluCEST MRI.

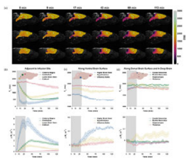
Results: There was a significant GluCEST increase in AD mice compared to WT. Following NR, GluCEST decreased in AD mice, primarily in the hippocampus.

Impact: NR supplementation may help alleviate excitotoxicity in AD, thereby preventing neuronal cell death/degeneration. GluCEST provides an effective method for assessing changes in glutamate levels, allowing for monitoring excitotoxicity in patients presenting symptoms of AD and the effects of NR treatment.

0692 Pitch: 15:45

Poster: 16:45

Screen 3



[3D Dynamic Contrast-Enhanced MR Fingerprinting for Quantitative CSF Transport Mapping in Mouse Brain at 9.4T]

Yuran Zhu[1], Guanhua Wang[2], Yuning Gu[1], Walter Zhao[1], Jiahao Lu[1], Christina J. MacAskill[1], Andrew Dupuis[1], Mark A. Griswold[1,3], Dan Ma[1], Chris A. Flask[1,3,4], and Xin Yu[1,3,5]

[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [3]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States, [4]Department of Pediatrics, Case Western Reserve University, Cleveland, OH, United States, [5]Department of Physiology and Biophysics, Case Western Reserve University, Cleveland, OH, United States

Keywords: Neurofluids, Neurofluids, Contrast Agent, Quantitative MR, Glymphatic System

Motivation: Quantitative MR provides the opportunity of quantifying concentration of contrast agent and its transport in cerebrospinal fluid (CSF) in the whole brain.

Goal(s): To develop a fast multi-parametric mapping method tailored to dynamically and quantitatively assessing Gd-DTPA transport in mouse brain.

Approach: We designed and validated a new 3D MR fingerprinting (MRF) sequence with subspace-based reconstruction to simultaneously track T_1 and T_2 changes in mouse brain following intrathecal contrast infusion with a temporal resolution of <4.5 min at 9.4T.

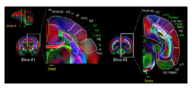
Results: Dynamic T_1 and T_2 changes allowed direct quantification of transport kinetics in different brain regions between multiple subjects without normalization.

Impact: We present the first 3D MR fingerprinting method for dynamic quantification of contrast agent transport in rodent brains. With unprecedented speed, accuracy, and robustness, our method offers unlimited opportunities for multi-parametric quantification in various preclinical imaging applications.

0693 Pitch: 15:45

Poster: 16:45

Screen 4



[Common coordinate framework of infant marmoset brain based on ultra-high-resolution diffusion MRI]

Tianjia Zhu[1,2], Juri Kim[1,2], Fengxia Wu[1,3], Minhui Ouyang[1,4], Andre Sousa[5], Jon Levine[5], Arnold Kriegstein[6], and Hao Huang[1,4]

[1]Department of Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States, [2]Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Anatomy and Neurobiology, Shandong University, Jinan, China, [4]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [5]Department of Anatomy and Neurobiology, University of Wisconsin - Madison, Madison, WI, United States, [6]Department of Neurology, University of California San Francisco, San Francisco, CA, United States

Keywords: Large Animals, Nonhuman Primates, Normal development, normal development, large animals-nonhuman primates, ultra-high resolution diffusion MRI, common coordinate framework

Motivation: Integrating a spatially resolved and molecularly defined cell atlas with studies of developing brain function, neurophysiology, and behavior will require an anatomical common coordinate framework (CCF). Ultra-high-resolution diffusion-MRI (dMRI) improves anatomical determinations and provides rich contrasts and microstructural information.

Goal(s): To build the first dMRI-based anatomical CCF for infant marmoset brains.

Approach: Ultra-high resolution dMRI at 9.4T was performed on a 10-month-old marmoset brain. Anatomical regions were delineated.

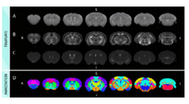
Results: An ultra-high-resolution CCF for the infant marmoset brain at isotropic 0.1mm diffusion MR imaging resolution, characterized by comprehensive labels of fine neuroanatomical structures and coordinate framework.

Impact: The first infant marmoset brain CCF will allow integrating spatially resolved, molecularly defined cell atlas with studies of developing brain function, neurophysiology, and behavior. It will provide insights into evolution and human-specific features of brain development relevant to brain disorders.

0694 Pitch: 15:45

Poster: 16:45

Screen 5



Using a standard MRI atlas with non-equitable sex representation introduces spurious sex effects

Patricia Martinez-Tazo[1], Alexandra Santos[1], Mohamed Kotb Selim[1], Elena Espinós-Soler[1], and Silvia De Santis[1]

[1]*Instituto de Neurociencias, CSIC-UMH, Alicante, Spain*

Keywords: Preclinical Image Analysis, Data Analysis, template, Allen brain

Motivation: Overcoming sex bias in preclinical research requires unbiased tools. Equitable sex representation in the creation of the atlas is seldom achieved, but failing to do so might introduce bias in the analysis.

Goal(s): Our goal was to create a mouse MRI template that includes animals of both sexes, incorporating both structural and diffusion contrasts, and then compare it with a single-sex template.

Approach: We scanned a large cohort of mice, including both sexes, to generate a template and registered the Allen annotation to it.

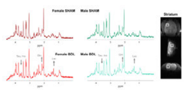
Results: Using single-sex templates generates spurious sex differences that are not present when using resources with equitable sex representation.

Impact: The MouseX DW-Allen Atlas is the first mouse MRI template that adopts the Allen annotation and is built with both sexes. It fills an important gap in preclinical imaging research, promotes gender equality, and fosters collaborative and multi-approach science.

0695 Pitch: 15:45

Poster: 16:45

Screen 6



Sex- and brain region-specific 1H MRS neurometabolic profiles in young rats with hepatic encephalopathy

Jessie Mosso[1,2], Katarzyna Pierzchala[1,2], Dario Sessa[1,2], Stefanita Mitrea[1,2], Estelle Gerossier[1,2], Brayan Alves[1,2], Olivier Braissant[3], Valérie A. McLin[4], and Cristina Cudalbu[1,2]

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Keywords: Spectroscopy, Metabolism, MRS, hepatic encephalopathy, sex-difference, SPECIAL

Motivation: The lack of preclinical studies on potential sex-differences in the pathophysiology of hepatic encephalopathy (HE) prevents a comprehensive understanding of the disease.

Goal(s): To study the effect of sex on the neurometabolic profiles measured with ^{1}H MRS.

Approach: We compared ^{1}H MRS metabolite concentrations in the hippocampus and striatum of young male versus female rats with HE.

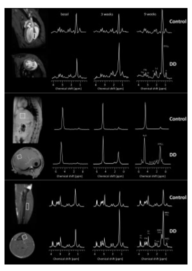
Results: We observed overall stronger neurometabolic effects of the disease on male versus female HE rats, including weight loss and decrease in brain antioxydants levels (Asc, GSH), likely hampering the capacity of male animals to counteract oxidative stress, important player in the pathophysiology of HE.

Impact: Sex-differences, often overlooked in preclinical studies, investigated here showed distinct ^{1}H MRS neurometabolic profiles in female versus male rats with hepatic encephalopathy (HE), opening a new window of investigation for patients with HE.

0696 Pitch: 15:45

Poster: 16:45

Screen 7



In vivo 1H MRS identifies intramyocellular lipids as early prediabetic marker in diet-induced obesity

Vera Flocke[1], Katja Wegener[1], Tamara Staub[1], Maria Grandoch[1], and Ulrich Flögel[1]

[1]*Heinrich Heine University, Düsseldorf, Germany*

Keywords: Small Animals, Metabolism, Diabetes, Lipids, MRS

Motivation: Obesity is one of the main risk factors for type 2 diabetes and is also associated with an increased cardiovascular risk. However, the transition from the early states of impaired glucose intolerance to a more progressive disease stage still remains elusive.

Goal(s): To identify biomarkers and time points for early therapeutic interventions to stop further transition.

Approach: We used an established mouse model exposed for 9 weeks to a diabetogenic diet and longitudinally monitored important organs/tissues by MRI+MRS.

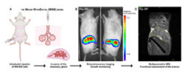
Results: Using MRS we could detect massive accumulation of lipids in all organs which preceded even a sigificant weight gain in DD-fed mice.

Impact: MRS of intramyocellular lipids was most sensitive to reveal *in vivo* very early alterations in the prediabetic state and, thus, may also be used in humans to identify patients at the transition point from prediabetes to diabetes.

0697 Pitch: 15:45

Poster: 16:45

Screen 8



Multiparametric MRI of a Mouse-INtraDuctal (MIND) in vivo model of human invasive lobular breast carcinoma

Clémentine Lesbats[1], Renée L Flaherty[2], Ralph Sinkus[3,4], Cathrin L Brisken[2], and Simon P Robinson[1]

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Keywords: Biology, Models, Methods, Cancer, preclinical, biomarkers, elastography

Motivation: Invasive lobular carcinoma (ILC) is a major subtype of breast cancer but remains very difficult to detect until late stage. There is a lack of sensitive imaging techniques for the diagnosis of ILC.

Goal(s): To define clinically-translatable MRI biomarkers of the heterogeneous tumour microenvironment in ILC.

Approach: A Mouse-INtraDuctal (MIND) model was used to emulate late stage ILC. Multiparametric MRI was performed on ~10 month-old tumours.

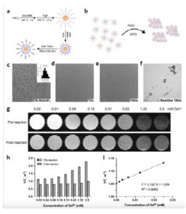
Results: ILC exhibited bimodal ADC and stiffness profiles. Invasive tumour regions displayed low ADC and elevated stiffness compared to lobular *in situ* regions.

Impact: Multiparametric MRI can inform on the evolving microenvironment within MIND model of invasive lobular carcinoma.
Invasive regions displayed restricted water diffusion and elevated stiffness, highlighting the utility of DWI and MRE as informative techniques for detecting and assessing invasiveness.

0698 Pitch: 15:45

Poster: 16:45

Screen 9



NaGdF4-Based Magnetic Resonance Nanoprobes for Qualitative Inflammation Imaging in Glioma: Hot or Cold?

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[1]Department of Radiology, Shanghai Fourth People's Hospital, School of Medicine, Tongji University, Shanghai, China, [2]Department of Orthopaedics, Shanghai Key Laboratory for Prevention and Treatment of Bone and Joint Diseases, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Keywords: Probes & Targets, Molecular Imaging

Motivation: It is in urgent need to develop an imaging method to reveal the intrinsic 'cold' or 'hot' status of tumor microenvironment for glioma patients, which would offer guidance for planning therapeutic regimen, and thus maximize the therapeutic efficacy and reduce unnecessary treatment.

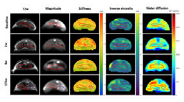
Goal(s): To visualize the inflammatory status of glioma tumor microenvironment non-invasively using myeloperoxidase responsive $NaGdF_4$-based nanoprobes under MRI.

Approach: Different glioma models with different inflammatory status were created and imaged with our nanoprobes under 11.7 T at T1WI (n = 6 each group).

Results: MPO-enriched 'hot' gliomas showed patchy hypointense T1 signal while MPO-rare 'cold' gliomas presented moderate hyperintensity in T1WI.

Impact: Depending on the level of MPO in tumor microenvironment, nanoprobes will get self-assembled in various degree, thus altering T1 relaxation time. By using this, it is promising to monitor the tumor inflammatory status for glioma patients thus guide clinical treatment.

0699 Pitch: 15:45
Poster: 16:45
Screen 10



[Biophysical analysis of hepatocellular carcinoma and tumor niche in an orthotopic mouse model with diffusion MRI and MR elastography]

Pedro Augusto Dantas de Moraes[1], Yasmine Safraou[1], Karolina Krehl[2], Tom Meyer[1], Akvile Häckel[1], Eyk Schellenberger[1], Anja Kühl[3], Jürgen Braun[4], Lynn Jeanette Savic[1], Ingolf Sack[1], and Jing Guo[1]

[1]Radiology, Charité – Universitätsmedizin Berlin, Berlin, Germany, [2]Department of Veterinary Medicine, Institute of Animal Welfare, Animal Behavior and Laboratory Animal Science, Freie Universität Berlin, Berlin, Germany, [3]iPATH.Berlin, Charité – Universitätsmedizin Berlin, Berlin, Germany, [4]Institute of Medical Informatics, Charité – Universitätsmedizin Berlin, Berlin, Germany

Keywords: Preclinical Image Analysis, Elastography, Cancer, HCC

Motivation: The biomechanical interplay between hepatocellular carcinoma (HCC) and the hosting liver is poorly understood.

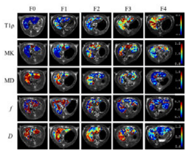
Goal(s): To characterize the development of HCC and its interactions with the surrounding liver using imaging-based biophysical properties.

Approach: We investigated longitudinally HCC and the host liver in an orthotopic mouse model using MR elastography (MRE) and diffusion-weighted imaging (DWI).

Results: During tumor development, the host liver became softer with reduced viscosity and restricted water diffusivity while HCC became stiffer, less viscous and restricted water diffusivity.

Impact: Preclinical MRE is a useful tool to study biomechanical properties of tumors and the tumor environment. In a mouse model of hepatocellular carcinoma, we showed for the first time how liver tumors shape their biomechanical niche in the hosting liver.

0700 Pitch: 15:45
Poster: 16:45
Screen 11



[Noninvasive assessment of liver fibrosis using multiple MRI parameters: an experimental study in rats]

Yiwan Guo[1], Peng Sun[2], Zhigang Wu[2], Chen Huang[1], Ziwei Jin[1], Tingting Guo[1], and Xin Li[1]

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Keywords: Preclinical Image Analysis, Diffusion/other diffusion imaging techniques, liver fibrosis, multiparametric MRI, T1rho

Motivation: Early detection and noninvasive assessment of liver fibrosis are significant in clinical practice.

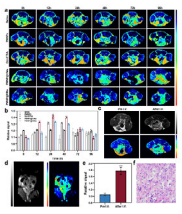
Goal(s): Liver biopsy have some drawbacks for staging liver fibrosis. We aimed to investigated the value of T1ρ, DKI, and IVIM in assessment of liver fibrosis and established an optimal diagnostic model.

Approach: Twenty four thioacetamide (TAA)-treated rats and six control rats were included in this experimental study. All rats were scanned with 3.0T MRI machine. Corresponding imaging parameters were measured and compared among different fibrosis stages.

Results: T1ρ and MD derived from DKI had better diagnostic performance than other parameters. Their combination model further improved the diagnostic efficiency.

Impact: T1ρ and DKI could easily incorporated into routine liver MR imaging. The model combining T1ρ and MD derived from DKI was promising to be a noninvasive biomarker to detect and accurately stage liver fibrosis in the clinical practice.

0701 Pitch: 15:45 Poster: 16:45 Screen 12



MRI with cancer cell membrane coated Mn (II) nanoprobes in precise diagnosis of early pancreatic cancer

Yanqi Zhong[1], Shudong Hu[1], and Weiqiang Dou[2]

[1]Affiliated hospital of Jiangnan University, Wuxi, China, [2]GE Healthcare, MR Research, Beijing, China

Keywords: Probes & Targets, Tumor

Motivation: gadolinium widely used in MRI clincally show low detecting efficiency for early pancreatic cancer(<2 cm). It is thus urgent to develop safe and effective contrast agents to address this issue.

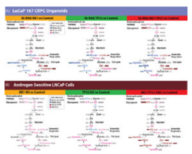
Goal(s): This study aims to investigate the potential of cancer cell membrane coated Mn(II) nanoprobes (PMNP@CMs) in MRI for precise diagnosis of early pancreatic cancer.

Approach: PMNP@CMs were prepared for MRI of pancreatic cancer to explore the imaging effects *in vivo* and *in vitro* compared with gadolinium.

Results: PMNP@CMs showed more predominant MRI effect than gadolinium and may be considered as safe and efficient contrast agents to realize diagnosis for early pancreatic cancer.

Impact: This work has developed a nano magnetic resonance imaging contrast agent (PMNP@CMs) that is more advantageous than gadolinium and can achieve precise diagnosis of early pancreatic cancer.

0702 Pitch: 15:45 Poster: 16:45 Screen 13



Metabolic and imaging phenotypes associated with RB1 loss in castrate resistant prostate cancer

Fahim Ahmad[1], Margaret White[2], Kazutoshi Yamamoto[3], Daniel R. Crooks[4], Supreet Agarwal[2], Ye Yang[4], Brian Capaldo[2], Sonam Raj[2], Aian Neil Alilin[2], Anita Ton[3], Stephen Adler[5], Jurgen Seidel[3], Colleen Olkowski[3], Murali Krishna Cherukuri[6], Peter L Choyke[3], Kathleen Kelly[2], and Jeffrey R Brender[6]

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Keywords: Biology, Models, Methods, Cancer, prostate, metabolomics

Motivation: The progression of prostate cancer is marked by both *RB1* and *T53* inactivation and higher ^{18}FDG-PET uptake, but it's unclear whether *RB1* or *TP53* inactivation drives increased glucose import.

Goal(s): Can metabolic changes be used as a biomarker for *RB1* and *TP53* loss?

Approach: Metabolomic analysis by NMR and IC-MS for a comprehensive measure of metabolic changes *ex vivo* and and hyperpolarized MRI to measure the Warburg effect *in vivo*.

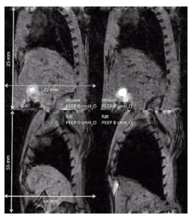
Results: ^{18}FDG uptake was unaffected by loss of either *RB1* or *TP53*. *RB1* and *TP53* did induce a series of other metabolic changes which could be detected *in vivo* by hyperpolarized MRI

Impact: Neuroendrocrine prostate cancer is a life-threatening progression of prostate cancer that is characterized by mutations in two key genes. Hyperpolarized MRI may enhance early diagnosis of NEPC without biopsy.

0703 Pitch: 15:45 Poster: 16:45 Screen 14

[Imaging of thorax and diaphragm movement in mechanically ventilated mice and rats]

Myrte Wennen[1,2], Wout J. Claassen[3], Nick D. van Huis[4], Leo M.A. Heunks[5], Coen A.C. Ottenheijm[3], Ruslan Garipov[6], Lindy K. Alles[1,4], Bram F. Coolen[4], and Gustav J. Strijkers[4,7]



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Keywords: Biology, Models, Methods, Preclinical, Diaphragm, Small Animals, Thorax, 3D CINE imaging

Motivation: The pathophysiology of diaphragm dysfunction in mechanically ventilated patients is not fully understood and adequate animal models are required to accommodate further research.

Goal(s): Our goal was to develop a method to image 3D thoracic movement during mechanical ventilation of mice and rats at different pressure levels of mechanical ventilation.

Approach: With our setup we visualized the movement of the thorax in mice and rats using self-gated 3D pseudo-radial k-space sampling.

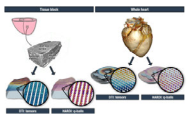
Results: Imaging was feasible in both animal types and increase of pressure resulted in a decrease of mean diaphragm excursion of 0.9 and 1.3 mm in mouse and rat respectively.

Impact: Our proposed setup allows controlled mechanical ventilation and MR imaging of 3D thorax movement in mice and rats. This can be used to study the pathophysiology behind mechanical ventilation-induced respiratory muscle dysfunction, and ultimately guiding clinical practice in respiratory care.

0704 Pitch: 15:45 Poster: 16:45 Screen 15

[Comparison of cardiomyocyte orientation assessed with diffusion tensor imaging and a high-angular resolution diffusion imaging model]

Pedro Ferreira[1,2], Camila Munoz[1], Nicoleta Baxan[3], Andrew Scott[1], Dudley Pennell[1], and Sonia Nielles-Vallespin[1]



[1]CMR unit, Royal Brompton Hospital, London, United Kingdom, [2]NHLI, Imperial College, London, United Kingdom, [3]Imperial College, London, United Kingdom

Keywords: Preclinical Image Analysis, Diffusion/other diffusion imaging techniques

Motivation: The orientation of the cardiomyocytes can be probed non-invasively with diffusion imaging. In-vivo, this is typically assessed by the orientation of the primary eigenvector in a diffusion tensor model, although questions remain about the ability of this model to probe complex cardiomyocyte arrangements.

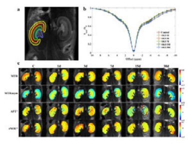
Goal(s): To assess the agreement of cardiomyocyte orientation measures given by a diffusion tensor and a more robust q-ball model.

Approach: A diffusion tensor model was compared to a q-ball diffusion model in a healthy porcine heart.

Results: Median angular deviations of 7.8 and 10.8 degrees were found for the main diffusion direction between the two models.

Impact: We provide an estimate of cardiomyocyte angular orientation differences between a diffusion tensor model and a more robust diffusion q-ball model with a higher angular resolution in a healthy porcine heart.

0705 Pitch: 15:45 Poster: 16:45 Screen 16



[Assessment of rhabdomyolysis-induced acute kidney injury with chemical exchange saturation transfer MRI]

Qianqian Zhang[1,2], Quan Tao[2,3], Zelong Chen[4], Erdmann Seeliger[5], Kan Deng[6], Zhigang Wu[7], Thoralf Niendorf[8], and Yanqiu Feng[1,2]

[1]School of Biomedical Engineering, Southern Medical University, Guangzhou, China, [2]Guangdong Provincial Key Laboratory of Medical Image Processing & Guangdong Province Engineering Laboratory for Medical Imaging and Diagnostic Technology, Southern Medical University, Guangzhou, China, [3]Department of Rehabilitation Medicine, Zhujiang Hospital, Southern Medical University, Guangzhou, China, [4]Medical Imaging Center, Nanfang Hospital, Southern Medical University, Guangzhou, China, [5]Institute of Translational Physiology, Charite-Universitatsmedizin Berlin, Berlin, Germany, [6]Philips Healthcare, Guangzhou, China, [7]Philips Healthcare, Shenzhen, China, [8]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbruck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany

Keywords: Small Animals, CEST & MT

Motivation: There is a gap in exploring the progression of acute kidney injury (AKI) caused by rhabdomyolysis (RM).

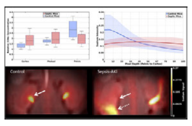
Goal(s): Investigate the feasibility of CEST MRI for assessing the progression of RM-induced AKI in a mouse model.

Approach: The RM-AKI model was established by intramuscular injection of glycerol solution and examined longitudinally by CEST (days 1, 3, 7, 15, 30). CEST quantification parameters and their diagnostic performance were compared.

Results: MTR presented a significant difference, and showed the best diagnostic performance for AKI and moderate negative correlations with pathological changes.

Impact: MTR has potential clinical utility for assessing renal diseases.

0706 Pitch: 15:45 Poster: 16:45 Screen 17



[23Na Magnetic Resonance Imaging in Sepsis-Induced Acute Kidney Injury: A Preclinical Study]

Ali Nahardani[1], Sara Moradi[1], Van Nhat Minh Vo[1], and Verena Hoerr[1]

[1]Heart Center Bonn, Department of Internal Medicine II, University Hospital Bonn, Bonn, Germany

Keywords: Small Animals, Preclinical, Sodium MRI

Motivation: Currently, there is a lack of research in ^{23}Na-MRI, investigating the renal sodium concentration gradient in Sepsis-Induced acute kidney injury (AKI).

Goal(s): This study aimed to investigate sodium concentration changes across the renal parenchyma and to compare them with T_1, T_2, and T_2* alterations as well as kidney perfusion.

Approach: 38 mice (N=19 as control and N=19 with septic AKI) were investigated by multi-parametric MRI.

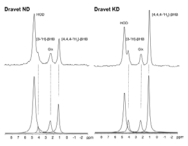
Results: In septic AKI, thrombi developed in kidneys and caused renal hypoperfusion. Lack of blood supply to kidneys resulted in sodium retention at cortex and little sodium output at pelvis even in the absence of detectable edema.

Impact: This study helps to better understand the radiological pathology of sepsis-induced acute kidney injury in ^{23}Na-MRI. It connects the concept of altered sodium concentration with changes in renal perfusion, T_1, T_2, and T_2* relaxation constants.

0707 Pitch: 15:45

Poster: 16:45

Screen 18



A deuterium MRS study of the effect of the ketogenic diet on β-hydroxybutyrate metabolism in a mouse model of Dravet syndrome

Joel R Garbow[1], Xia Ge[1], Kyu-Ho Song[1], John A Engelbach[1], Liu Lin Thio[1], Jeffrey J Neil[1], and Joseph JH Ackerman[1]

[1]*Washington University in St. Louis, Saint Louis, MO, United States*

Keywords: Epilepsy, Deuterium

Motivation: Children with Dravet syndrome, a drug-resistant epilepsy, often show a positive response to the ketogenic diet (KD) where the TCA cycle is driven mainly by ketones.

Goal(s): To monitor TCA cycle metabolism of ketone body β-hydroxybutyrate in wild-type and Dravet mouse models comparing normal diet (ND) vs. KD.

Approach: Deuterium (^2H) single-voxel brain MRS is applied to wild-type and Dravet mouse models following subcutaneous administration of [3,4,4,4-$^2H_4$]β-hydroxybutyrate.

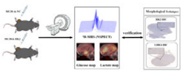
Results: Mice on KD vs. ND show enhanced brain uptake of β-hydroxybutyrate ($p < 0.001$) with subsequent increase in glutamine+glutamate ("Glx") production ($p < 0.002$), evidence that the KD upregulates brain monocarboxylate transporters.

Impact: Deuterium metabolic imaging quantification of TCA cycle flux in individual Dravet patients may (i) assess metabolic dysfunction, (ii) assist in selecting the best treatment option, and (iii) allow optimization of the diet. Hence development of a personalized treatment plan.

0708 Pitch: 15:45

Poster: 16:45

Screen 19



Non-invasive monitor expression of the glycolytic enzyme in vivo with deuterium MRI

Xinjie Liu[1], Yusheng Guo[2], Zhi Zhang[1], Feng Pan[2], Lian Yang[2], Peng Sun[3], Xin Zhou[1], Chaoyang Liu[1], and Qingjia Bao[1]

[1]*Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, Wuhan, China,* [2]*Department of Radiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China,* [3]*Clinical & Technical Support, Philips Healthcare (Beijing), Beijing, China*

Keywords: Small Animals, Metabolism, Deuterium metabolic imaging; Tumor; Glycolytic enzyme

Motivation: Enzyme expression plays a crucial role in tumor metabolism, influencing tumor development and response to therapy. However, there is a lack of non-invasive techniques to measure the expression of glycolytic enzymes in research and clinics.

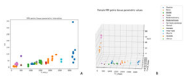
Goal(s): Verify whether Deuterium metabolic imaging (DMI), a promising non-invasive technique, can effectively monitor the expression changes of glycolysis enzyme in vivo.

Approach: Utilize deuterium MRS/MRI to monitor metabolic flux in two groups of mice with control tumor and HK2 knockdown tumor.

Results: DMI can indirectly monitor the expression changes of glycolytic enzymes represented by HK2 in vivo by measuring metabolic flux.

Impact: This study provides a non-invasive technique for measuring glycolytic enzyme expression of tumors in vivo. The proposed method might have clinical potential in cancer treatment management and response monitoring in a timely manner.

0709 Pitch: 15:45 Poster: 16:45 Screen 20



Quantitative MRI method for characterising endometriomas

Usman Shah[1], Alex Bagur[1], Hannah Curwen[1], Mike Brady[1,2], Sally Collins[1,2], Amy Herlihy[1], and Michele Pansini[1,3]

[1]Perspectum, Oxford, United Kingdom, [2]University of Oxford, Oxford, United Kingdom, [3]Clinica Di Radiologia EOC, Istituto Di Imaging Della Svizzera Italiana (IIMSI), Lugano, Switzerland

Keywords: Biomarkers, Quantitative Imaging

Motivation: Diagnostic delay and uncertainty are common problems faced by patients suffering from endometriosis. Although laparoscopy remains the gold-standard for diagnosis, quantitative MRI (qMRI) could offer an alternative non-invasive approach.

Goal(s): To use qMRI to characterise endometriotic lesions.

Approach: Quantitative analysis of multiparametric MRI data (including T1 MOLLI, T2* and PDFF parametric maps) to characterise tissue metrics obtained from patients suffering with chronic pelvic pain who subsequently underwent a diagnostic laparoscopy.

Results: Endometriomas have characteristic qMRI values different to other tissues in the female pelvis.

Impact: The distinctive parametric characteristics of endometriomas provides a foundation for the development of a non-invasive diagnostic tool that can detect endometriotic lesions within the pelvis.

Power Pitch

Pitch: Progress in Body Applications

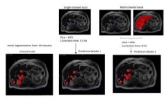
Power Pitch Theatre 2

Tuesday
Pitches: 15:45 - 16:45
Posters: 16:45 - 17:45

Moderators: GIRISH BATHLA & Judith Zimmermann

(no CME credit)

0710 Pitch: 15:45 Poster: 16:45 Screen 21



Enhancing Liver Cyst Segmentation for ADPKD Patients Through Deep Learning Assistance

Mina Chookhachizadeh Moghadam[1], Dominick Romano[1], Mohit Aspal[1], Xinzi He[1], Kurt Teichman[1], Zhongxiu Hu[1,2], Mert Rory Sabuncu[1,3], and Martin Prince[1,2]

[1]Radiology, Weill Cornell Medicine, New York City, NY, United States, [2]Radiology, Columbia university, New York City, NY, United States, [3]School of Electrical and Computer Engineering, Cornell University, New York City, NY, United States

Keywords: Liver, Segmentation, ADPKD, PLD, Liver Cyst, Deep Learning, Segmentation Model

Motivation: Autosomal dominant polycystic kidney disease (ADPKD) often also has polycystic liver disease (PLD), impacting patients' well-being. Manually segmenting liver cysts for measuring disease burden is time-consuming and error-prone, necessitating an automated solution.

Goal(s): We introduce a deep-learning (DL) framework for liver cyst segmentation in ADPKD/PLD patients.

Approach: An nnUNet-based framework ensembled 2D and 3D models trained on our institute's ADPKD dataset to detect liver cysts in an external test set. Additionally, we implemented patient, cyst, and voxel-level evaluation metrics for clinical impact assessment.

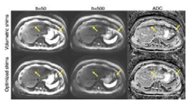
Results: Our model achieved an 84% cyst-level Dice score significantly reducing annotation time by 91%.

Impact: This research aims to revolutionize PLD monitoring by transitioning from qualitative to quantitative, replicable, and scalable approaches. Advanced DL models can produce high-quality liver cysts annotations and introduce cyst-level evaluation metrics, aiding radiologists with precise disease assessment and clinical decisions.

0711 Pitch: 15:45

Poster: 16:45

Screen 22



Diffusion MRI of the Abdomen with Motion-robust Diffusion Encoding, Multi-shot Readout, and Optimized Slice-specific Shimming

Aidan Tollefson[1,2], Srijyotsna Volety[1,2], Patricia Lan[3], Arnaud Guidon[4], Gaohong Wu[5], Daiki Tamada[2], Ali Pirasteh[1,2], and Diego Hernando[1,2]

[1]*Medical Physics, University of Wisconsin-Madison, Madison, WI, United States,* [2]*Radiology, University of Wisconsin-Madison, Madison, WI, United States,* [3]*GE Healthcare, Menlo Park, CA, United States,* [4]*GE Healthcare, Boston, MA, United States,* [5]*GE Healthcare, Waukesha, WI, United States*

Keywords: Liver, Diffusion/other diffusion imaging techniques

Motivation: Single-shot and multi-shot M1-optimized diffusion imaging (MODI) are recent DWI methods used to mitigate motion and distortion artifacts, yet they often experience chemical shift-based fat suppression failures in the abdomen.

Goal(s): To optimize fat suppression in multi-shot MODI-DWI of the abdomen.

Approach: Slice-specific chemical shift-encoded (CSE) data-informed optimization of shims is combined with single-shot and multi-shot MODI-DWI in 7 subjects imaged at 3T.

Results: Improved fat suppression and water signal excitation were observed alongside the motion and distortion artifact reduction provided by multi-shot MODI-DWI. Unwanted fat signal was reduced through this technique in areas of interest such as the liver, spleen, and ribcage.

Impact: Motion-robust, low-distortion DWI of the abdomen, with reliable fat suppression is demonstrated by combining multi-shot EPI, M1-optimized DW waveforms, and an optimized slice-by-slice shimming approach. This combined method may enable improved detection and staging of cancer in the abdomen.

0712 Pitch: 15:45

Poster: 16:45

Screen 23

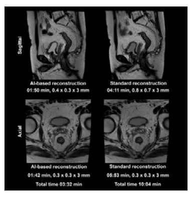


Image quality assessment and longitudinal quality monitoring of clinically-applied AI-based reconstructions in MRI of rectal cancer

Owen Alun White[1,2], Joshua Shur[1], Francesca Castagnoli[1,2], Geoff Charles-Edwards[1,2], Brandon Whitcher[1,2], Erica Scurr[1], Georgina Hopkinson[1], Dow-Mu Koh[1,2], and Jessica M Winfield[1,2]

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Keywords: Cancer, Machine Learning/Artificial Intelligence, Image Quality; Quality Control / Quality Assurance; QA/QC; AI/ML image reconstruction

Motivation: With increasing AI adoption in MR-reconstructions, robust quality assessment becomes paramount. This study aims to ensure that AI-techniques meet clinical requirements at implementation and longitudinally.

Goal(s): 1) Compare image quality of AI-imaging with standard techniques in anorectal cancer. 2) Develop longitudinal quality control (QC) assessments capable of detecting changes in AI-reconstructions without resource-intensive evaluations.

Approach: A prospective study involving 40 patients utilised radiologist scoring and quantitative image-quality-metrics (IQMs). Retrospective reconstructions gauged sensitivity of IQMs to reconstruction pipeline changes.

Results: AI-reconstructions demonstrated >50% time savings with improved image quality. Feasibility of quantitative-IQMs for assessing AI-reconstructions is established, providing a practical solution for ongoing QC.

Impact: There is a need to develop QC assessments offering performance monitoring for AI-based reconstructions in diverse clinical settings. The study presents feasible ways to support integration of AI-imaging into clinical practice, including resource-efficient quantitative image quality assessments.

0713 Pitch: 15:45 Poster: 16:45 Screen 24

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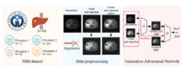

<u>Synthesized Gd-EOB-DTPA-enhanced hepatobiliary phase MR images via generative adversarial learning</u>

Kaixuan Zhao[1,2,3], Yan Liu[4], Zhigang Wu[5], Yongzhou Xu[5], Zaiyi Liu[2,3], and Guangyi Wang[2]

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Keywords: Liver, Liver

Motivation: Gd-EOB-DTPA-enhanced hepatobiliary phase (HBP) imaging is clinical routine for liver lesion identification, and is usually empirically conducted at 20 minutes after bolus injection.

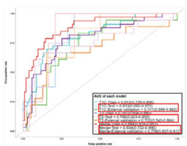
Goal(s): Our goal was to demonstrate the feasibility of optimizing clinical workflow by synthesizing Gd-EOB-DTPA-enhanced HBP images via machine learning.

Approach: Precontrast and early-enhanced T1WIs (5-min after bolus injection) acquired at 3 T were used to synthesize HBP images via a generative adversarial network in 490 subjects.

Results: Our preliminary results showed that synthesized HBP images are visually comparable to acquired HBP images with high SSIM(0.87±0.08) and PSNR(29.6±2.25).

Impact: Machine learning synthesized HBP images could provide comparable diagnostic information to acquired HBP images, suggesting that machine learning might be used to optimize clinical workflow and greatly shorten acquisition time for Gd-EOB-DTPA-enhanced MRI.

0714 Pitch: 15:45 Poster: 16:45 Screen 25



<u>Multiparametric radiomics-based machine learning predicts consensus molecular subtype 4 of colorectal cancer: a multi-center study</u>

Zonglin Liu[1], Meng Runqi[2], Yiqun Sun[1], Li Rong[1], Fu Caixia[3], Tong Tong[1], and Shen Dinggang[2]

[1]Fudan University Shanghai Cancer Center, Shanghai, China, [2]ShanghaiTech University, Shanghai, China, [3]MR Application Development, Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China

Keywords: Pelvis, Multimodal

Motivation: The consensus molecular subtype (CMS) is a novel classification system that reflects the genetic characteristics of the tumor. CMS4 is associated with the worst prognosis.

Goal(s): To investigate whether a radiomics-based machine learning approach could predict CMS4 status in CRC patients.

Approach: The sequencing data was input into the CMS classification system to generate CMS subtype outcomes. Radiomics features were extracted from baseline T2WI and contrast-enhanced MRI. Machine learning algorithms were applied to explore the best-performing and most robust model.

Results: The best performing model achieved AUCs of 0.855 and 0.759 in the test set and external validation set.

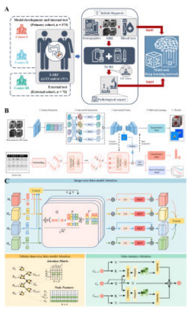
Impact: The genetic phenotype of CMS4 colorectal cancer may be potentially associated with morphological features. Multiparametric radiomics-based machine learning shows promising potential in distinguishing CMS4 from other subtypes of CRC.

0715 Pitch: 15:45
Poster: 16:45
Screen 26

[Predicting tumor recurrence of locally advanced rectal cancer after neoadjuvant chemoradiotherapy based on multi-task deep-learning model]

Zonglin Liu[1], Meng Runqi[2], Yiqun Sun[1], Li Rong[1], Fu Caixia[3], Tong Tong[1], and Shen Dinggang[2]

[1]Fudan University Shanghai Cancer Center, Shanghai, China, [2]ShanghaiTech University, Shanghai, China, [3]MR Application Development, Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China



Keywords: Pelvis, Machine Learning/Artificial Intelligence

Motivation: The promising application of deep learning (DL) techniques for prognostic prediction in various tumors has been reported, but mostly with single-task models

Goal(s): Exploring the use of multi-task DL models to automate the whole process of prediction for rectal cancer patients.

Approach: We designed a modality-fusion-based multi-task DL model to concurrently predict tumor volumes, patient relapse state, and patient risk scores based on a combination of multimodal MR images and clinical tabular data.

Results: The multi-task DL model achieved favorable predictive performance at the stage of initial diagnosis with automatic lesion identification, and further improved with the inclusion of postoperative pathology indicators.

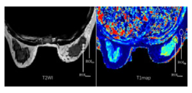
Impact: Multi-tasking DL may be a new approach and orientation to fully automate the process of clinical prediction, and its feasibility is expected to be further explored in other oncology studies in the future.

0716 Pitch: 15:45
Poster: 16:45
Screen 27

[Accelerated Synthetic MRI with Deep Learning–Based Reconstruction for Breast Imaging]

Fan Yang[1], Yitian Xiao[1], Jiayu Sun[1], Bo Zhang[2], and Huilou Liang[2]

[1]Department of Radiology, West China Hospital of Sichuan University, Chengdu, China, [2]GE HealthCare MR Research, Beijing, China



Keywords: Breast, Breast, Synthetic MR,Deep Learning based reconstruction

Motivation: Synthetic MRI, with its unique advantages including unique signal acquisition, rapid synchronization, visualization and multiparameter maps, is gradually applied in breast cancer diagnosis. However, its extended scanning time restricts its broader use.

Goal(s): To accelerate synthetic MRI while maintaining its quantitative parameters and image quality using deep learning-based reconstruction (DLR).

Approach: 12 female patients were enrolled and scanned with two sets of synthetic MRI: a standard protocol and an accelerated protocol (before and after DLR). Quantitative parameters, SNR of lesion and subjective image quality were compared.

Results: Comparable image quality was achieved using accelerated synthetic MRI with DLR.

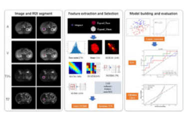
Impact: The combination of DLR with accelerated synthetic MRI protocol has significant benefits in promoting the practical application of synthetic MRI in breast imaging and enhancing examination efficiency.

0717 Pitch: 15:45
Poster: 16:45
Screen 28

[Multi-region Radiomics-based Prediction of Microvascular Invasion in Hepatocellular Carcinoma Using Multi-sequence MRI]

Feng Chen[1], Shishi Luo[1], Mengying Dong[1], Weiyuan Huang[1], Yuting Liao[2], Xiao Yu[2], and Yongzhou Xu[2]

[1]Hainan General Hospital (Hainan Affiliated Hospital of Hainan Medical University), Haikou, China, [2]Philips Healthcare, Guangzhou, China



Keywords: Liver, Cancer

Motivation: Identifying MVI before surgery is crucial to optimizing treatment strategies and predicting prognosis.

Goal(s): To develop a multi-region radiomics-based predictive model using multi-sequence MRI to assess MVI in HCC.

Approach: Three Models (Tumor, Tumor-Expand5, Tumor-Expand10) were constructed and evaluated.

Results: The Tumor-Expand5 model, with the best predictive accuracy, demonstrates its effectiveness. The research explores the advantages of 5mm VOI expansion for MVI diagnosis over the 10mm VOI expansion, providing valuable insights. Despite limitations, this study offers a preoperative tool to predict MVI in HCC, enhancing clinical decision-making.

Impact: Predicting Microvascular Invasion (MVI) in HCC through multi-region radiomics-based MRI advances precision medicine and treatment optimization. The Tumor-Expand5 model's superior diagnostic performance demonstrates the potential to enhance clinical decision-making.

0718

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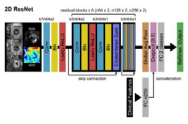
Screen 29



[Deep learning model based on multiparametric MRI for prediction of synchronous liver metastasis from rectal cancer: a two-center study.]

Jing Sun[1], Pu-Yeh Wu[2], and Dechun Zheng[1]

[1]Clinical Oncology School of Fujian Medical University, Fuzhou, China, [2]GE Healthcare, MR Research China, Beijing, China

Keywords: Cancer, Cancer, Rectal cancer, Deep learning radiomics, Magnetic resonance imaging, Synchronous liver metastasis

Motivation: Accurate synchronous liver metastasis (SLM) risk stratification is important for treatment planning and prognosis improvement.

Goal(s): Our goal is to establish a non-invasive and quantitative prediction model of synchronous liver metastases (SLM) in rectal cancer (RC) to help with accurate staging.

Approach: The deep learning (DL) model was fitted based on multi-parameter MRI of primary cancer combined with Clinical features (CF) features, and 5-fold cross-validation and external validation were performed.

Results: We demonstrated that the combination of CF and DL features achieved a satisfactory predictive performance for SLM, and also confirmed the generalizability of this model by external validation.

Impact: The discovery of the DL model would change treatment strategies. For patients with high-risk metastasis, a more aggressive systemic examination and shorter follow-up should be considered and may contribute to improved outcomes.

0719

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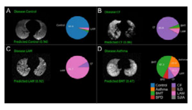
Screen 30



Disease Classification of 129Xe Ventilation MRI using Artificial Intelligence

Alexander M Matheson[1], Abdullah Bdaiwi[2], Matthew M Willmering[2], Erik B Hysinger[2], Francis X McCormack[3], Laura L Walkup[2], Zackary I Cleveland[2], and Jason C Woods[2]

[1]Pulmonary Medicine, Cincinnati Children's Hopsital, Cincinnati, OH, United States, [2]Pulmonary Medicine, Cincinnati Children's Hospital, Cincinnati, OH, United States, [3]Pulmonary, Critical Care and Sleep Medicine, University of Cincinnati, Cincinnati, OH, United States

Keywords: Lung, Hyperpolarized MR (Gas)

Motivation: *Xenon ventilation MRI shows distinct defect patterns that appear disease-specific but are difficult to measure. Deep learning, via neural networks, can generate texture features to classify images. Image classification has applications in diagnostics, phenotyping and predicting outcomes.*

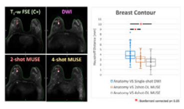
Goal(s): *To determine if neural networks could determine disease classification from xenon MRI.*

Approach: *2D neural networks were trained on data from eight disease states (including healthy controls) and assessed on top-1, top-3 accuracy and recall.*

Results: *The top performing network had a 54% top-1 and 86% top-3 accuracy.*

Impact: Artificial intelligence can classify disease from xenon MRI alone with moderate accuracy and differentiate between similar conditions. In the future, deep learning could be used diagnostically, for phenotyping disease subgroups and predicting outcomes.

0720 Pitch: 15:45 Poster: 16:45 Screen 31



[Deep Learning Based Reconstruction for Multi-shot DWI of the Breast: Comparison of Quantitative ADC and Distortion]

Ning Chien[1], Yi-Hsuan Cho[1], Yi-Chen Chen[1], Cheng-Ya Yeh[1], Yeun-Chung Chang[2], Chia-Wei Lee[3], Chien-Yuan Lin[3], Patricia Lan[4], Xinzeng Wang[5], Arnaud Guidon[6], and Kao-Lang Liu[1]

[1]*Department of Medical Imaging, National Taiwan University Cancer Center and National Taiwan University College of Medicine, Taipei, Taiwan,* [2]*Department of Medical Imaging, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan,* [3]*GE Healthcare, Taipei, Taiwan,* [4]*GE Healthcare, Menlo Park, CA, United States,* [5]*GE Healthcare, Houston, TX, United States,* [6]*GE Healthcare, Boston, MA, United States*

Keywords: Breast, Machine Learning/Artificial Intelligence, Breast Imaging, Multiplexed Sensitivity Encoding (MUSE), Diffusion Weighted Imaging

Motivation: Diffusion-weighted imaging (DWI) in breast imaging is constrained by image distortion, which can be mitigated through the utilization of multi-shot DWI (MUSE).

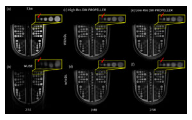
Goal(s): We conducted a pilot study to investigate the impact of deep-learning reconstruction (DLRecon) on MUSE image quality.

Approach: Compared with the non-DL MUSE images, the MUSE DLRecon showed higher SNR without affecting the mean ADC value. Moreover, employing a higher shots in MUSE DL with reduced NEX could provide less-distortion DWI.

Results: Our preliminary results suggest the feasibility of MUSE-DWI in breast imaging with a higher number of shots.

Impact: Our results suggest that the DLRecon could be beneficial for the regions prone to distortion and requiring a high density of diffusion direction information, in the complex diffusion modeling, all while maintaining a feasible scan time in breast MUSE imaging.

0721 Pitch: 15:45 Poster: 16:45 Screen 32



[Motion-robust distortion-free breast diffusion-weighted MRI using DW-PROPELLER with deep learning reconstruction]

Pingni Wang[1], Debosmita Biswas[2], Lisa Wilmes[3], Nola Hylton[3], Bonnie N Joe[3], Michael Senff[4], Arnaud Guidon[5], Patricia Lan[6], Xinzeng Wang[7], and Savannah C Partridge[2]

[1]*Research and Scientific Affairs, GE Healthcare, Menlo Park, CA, United States,* [2]*Radiology, University of Washington, Seattle, WA, United States,* [3]*Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States,* [4]*Fred Hutchinson Cancer Center, Seattle, WA, United States,* [5]*GE Healthcare, Boston, MD, United States,* [6]*GE Healthcare, Menlo Park, CA, United States,* [7]*GE Healthcare, Houston, TX, United States*

Keywords: Breast, Breast

Motivation: EPI-based DWI suffers from ghosting, chemical shift, and distortion artifacts. FSE-based DW-PROPELLER has been shown to overcome the above artifacts but at the cost of longer scanner time.

Goal(s): To evaluate the combination of DW-PROPELLER with a deep learning (DL)-based reconstruction to provide motion-robust distortion-free high spatial resolution breast DWI.

Approach: Phantom and in-vivo breast images were acquired using DW-PROPELLER followed by both conventional and DL reconstruction.

Results: DW-PROPELLER with DL showed less distortion, less chemical shift artifacts, and increased SNR and sharpness compared with multi-shot DW EPI in both phantom and in-vivo breast imaging.

Impact: This work demonstrated the feasibility of using a deep learning-based approach to improve image sharpness, reduce noise, and chemical shift artifacts for motion-robust and distortion-free high spatial resolution diffusion-weighted breast imaging.

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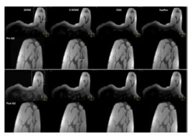
Screen 33



Deep learning-based super-resolution imaging for routine clinical T1- and T2-weighted breast MRI at 1.5T

Shuo Zhang[1,2,3], Jihun Kwon[4], Teresa Lemainque[3], Hans Peeters[2], Masami Yoneyama[4], Maike Bode[3], and Christiane Kuhl[3]

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Keywords: Breast, Cancer, deep learning; super resolution; screening

Motivation: High-resolution images in breast MRI are desired for lesion detection and characterization but are restricted due to scan time constraint in routine clinical settings.

Goal(s): Our goal was to use deep learning (DL)-based reconstructions to improve image resolution and quality of routine clinical breast MRI.

Approach: We applied a dedicated Precise-Image-Net for both 2D T1- and T2-weighted imaging in breast cancer patients at 1.5T and compared it to conventional parallel imaging, compress sensing, and convolutional neural network (CNN) reconstructions.

Results: Initial clinical data demonstrated a clear improvement of sharpness in breast T1- and T2-weighted images compared with standard reconstructions.

Impact: Deep learning-based super-resolution reconstruction provides improved image resolution and sharpness in breast MRI, showing promises for better lesion detection and characterization in routine clinical settings without prolonging scan time, which is of particular importance in dynamic contrast enhanced-MRI.

0723 Pitch: 15:45
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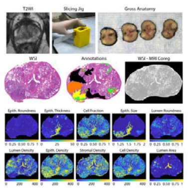
Screen 34



Radio-pathomic maps of complex histo-morphometric features trained with whole mount prostate histology differentiate prostate cancer on MPMRI

Savannah Duenweg[1], Michael Flatley[2], Aleksandra Winiarz[2], Samuel Bobholz[2], Allison Lowman[2], Biprojit Nath[2], Fitzgerald Kyereme[2], Kenneth Iczkowski[3], Anjishnu Banerjee[2], and Peter LaViolette[2]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Medical College of Wisconsin, Milwaukee, WI, United States, [3]University of California - Davis, Sacramento, CA, United States

Keywords: Prostate, Body

Motivation: The motivation of this study is to develop novel methods for mapping non-invasively the underlying history-morphometric features of prostate cancer.

Goal(s): The goal of this study is to develop and demonstrate radio-pathomic mapping techniques to enable noninvasive detection of prostate cancer presence and distinction from benign tissue using MRI.

Approach: Our approach was to align multiparametric MRI with digitized histology slides from prostatectomy specimens, then predict quantitative histological features from MRI intensities, and use these predicted features to classify cancer versus noncancer regions.

Results: Our models can distinguish cancerous from noncancerous prostate tissue with 70% accuracy.

Impact: This study uses radio-pathomic mapping for noninvasive prostate cancer detection, demonstrating the potential to differentiate cancerous vs benign prostate tissue using imaging surrogates of microstructural features discernible only on histology.

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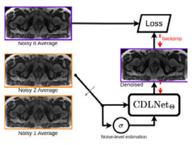
Screen 35



Advanced Deep Learning Denoising for Accelerated 0.55T Prostate MRI

Nikola Janjusevic[1,2,3], Mary Bruno[1,3], Yuhui Huang[1,3], Jingjia Chen[1,3], Yao Wang[2], Hersh Chandarana[1,3], and Li Feng[1,3]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Department of Electrical and Computer Engineering, NYU Tandon School of Engineering, Brooklyn, NY, United States, [3]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Prostate, Prostate

Motivation: Low-Field MR offers a great platform for low-cost high-performance screening of prostate cancer, but it suffers from low SNR. Prolonged scan times are typically needed to achieve adequate SNR at low field.

Goal(s): In this work, we developed an advanced deep learning denoising method for rapid high spatial resolution prostate MRI at 0.55T.

Approach: The proposed approach was tested in T2-weighted prostate MRI. Supervised training was performed to denoise images acquired with different numbers of averages, corresponding to different scan times.

Results: Deep learning was able to denoise prostate images at high spatial resolution resulting acquisition time with 1-2 average.

Impact: The proposed denoising technique holds significant potential to promote the use of 0.55T MRI and other types of low-field MRI for prostate imaging and screening for prostate cancer, with reduced cost and greater accessibility.

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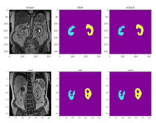
Screen 36



3D Kidney Segmentation in MRI using Transformers

Kanishka Sharma[1,2], Kywe Kywe Soe[2], Joao Periquito[2], Francesco Santini[2,3], Bashair Alhummiany[4], David Shelley[4], Andrew Forbes Brown[5], Jonathan Fulford[5], Mark Gilchrist[5], Angela Shore[5], Bixente Dilharreguy[6], Nicolas Grenier[6], Maria F. Gomez[7], Kim Gooding[5], and Steven Sourbron[2]

[1]Antaros Medical AB, Mölndal, Sweden, [2]The University of Sheffield, Sheffield, United Kingdom, [3]Basel Muscle MRI, Department of Biomedical Engineering, University of Basel, Basel, Switzerland, [4]University of Leeds, Leeds, United Kingdom, [5]University of Exeter, Exeter, United Kingdom, [6]University of Bordeaux, Bordeaux, France, [7]Department of Clinical Sciences in Malmö, Lund University Diabetes Centre, Malmö, Sweden

Keywords: Kidney, Kidney, Segmentation, TKV, Transformers

Motivation: Convolutional Neural Networks (CNNs) have long been the go-to deep-learning architecture for medical image segmentation, but in recent years transformer-based architectures adapted from large language models are setting a new standard.

Goal(s): The aim of this study was to test if transformers are suitable for 3D kidney segmentation on high-resolution MRI.

Approach: A transformer-based deep-learning architecture (UNETR) was trained and tested against a supervised method on 82 patient datasets from the iBEAt study on diabetic kidney disease.

Results: UNETR provides fast segmentation with comparable results to the supervised method, but additional refinement is needed to reduce the limits of agreement.

Impact: Novel transformer-based architectures for medical image segmentation may be useful for fast 3D segmentation of individual kidneys.

0726

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Screen 37

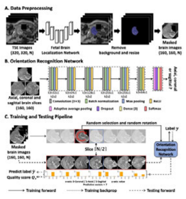

Image Quality Assessment using an Orientation Recognition Network for Fetal MRI

Mingxuan Liu[1], Haoxiang Li[1], Zihan Li[1], Hongjia Yang[1], Jialan Zheng[2], Xiao Zhang[1], and Qiyuan Tian[1]

[1]Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [2]Tanwei College, Tsinghua University, Beijing, China

Keywords: Fetal, Brain, Data Analysis, Data Process, Image Reconstruction

Motivation: Fetal MRI is important in clinical and scientific applications but prone to motion artifacts. Automated image quality assessment (IQA) assists data acquisition and subsequent analyses. However, training neural networks for IQA requires labor-intensive manual annotation.

Goal(s): To develop a model for fetal MRI IQA that doesn't require image quality labels.

Approach: A network is trained to determine the acquisition orientation of 2D T_2-weighted images. The variation of orientation recognition network (ORN) inferences for central images of a brain stack is used to assess motion and the image quality.

Results: High-quality and low-quality images are robustly discriminated. Image super-resolution from brain stacks is improved.

Impact: ORN-IQA eradicates the necessity image quality labels for training, thereby circumventing manual annotation. ORN-IQA simplifies online image quality evaluation and permits image reacquisition during fetal MR scans. Moreover, ORN-IQA improves super-resolution reconstruction results.

0727

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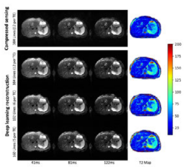
Poster: 16:45

Screen 38



Free-breathing T2 mapping of the abdomen in half the scan time using RADTSE with deep learning reconstruction

Brian Toner[1], Simon Arberet[2], Eze Ahanonu[3], Ute Goerke[4], Kevin Johnson[5], Fei Han[6], Shu Zhang[7], Diego Martin[7], Vibhas Deshpande[8], Mariappan Nadar[2], Ali Bilgin[3,9], and Maria Altbach[5,9]

[1]Applied Mathematics, University of Arizona, Tucson, AZ, United States, [2]Digital Technology & Innovation, Siemens Healthineers, Princeton, NJ, United States, [3]Electrical & Computer Engineering, University of Arizona, Tucson, AZ, United States, [4]Siemens Healthineers, Tucson, AZ, United States, [5]Medical Imaging, University of Arizona, Tucson, AZ, United States, [6]Siemens Healthineers, Los Angeles, CA, United States, [7]Radiology, Houston Methodist Research Institute, Houston, TX, United States, [8]Siemens Healthineers, Austin, TX, United States, [9]Biomedical Engineering, University of Arizona, Tucson, AZ, United States

Keywords: Liver, Image Reconstruction

Motivation: Free-breathing T2 mapping of the abdomen is possible for subjects that cannot hold their breath, but current techniques require long scan times that are not always possible.

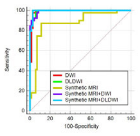
Goal(s): To produce high quality T2 weighted images and T2 parameter map from highly accelerated scans of the abdomen.

Approach: Combining the radial turbo spin echo sequence, navigator triggering, and new deep learning reconstruction techniques to increase the acceleration of the acquisition while maintaining image quality.

Results: Using these techniques, one can produce high quality T2 weighted images and T2 parameter map of the entire abdomen in under 4 minutes.

Impact: Deep learning techniques significantly reduce both scan time and reconstruction time for highly accelerated, navigator-triggered free breathing T2 weighted images and T2 parameter map of the abdomen.

0728 Pitch: 15:45 Poster: 16:45 Screen 39



[Utilizing Synthetic MRI and Deep Learning Reconstruction of DWI to Distinguish Benign from Malignant Breast Lesions]

Wanjun Xia[1], Yong Zhang[1], Kaiyu Wang[2], Guiyong Liu[2], Zhenghao Cao[1], and Jingliang Cheng[1]

[1]Department of Magnetic Resonance, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China, [2]MR Research China, GE Healthcare, Beijing, China

Keywords: Breast, Cancer, Deep Learning Reconstruction, Diffusion-Weighted Imaging, Breast Diagnosis, Synthetic MRI

Motivation: Breast cancer has emerged as the foremost global malignancy, prompting a growing inclination toward exploring novel non-invasive imaging techniques that obviate the need for contrast agent administration.

Goal(s): Enhancing breast diagnostics without reliance on contrast agents.

Approach: Expanding on the foundation of deep learning-based DWI reconstruction, coupled with Synthetic MRI, as a viable alternative to traditional contrast-enhanced diagnostic methodologies, the focus lies in pinpointing valuable parameters for differential diagnosis.

Results: The fusion of deep learning-reconstructed DWI and Synthetic MRI yields an impressive AUC (Area Under the Curve) of 0.995 in distinguishing between benign and malignant breast pathologies.

Impact: The integration of deep learning-reconstructed DWI with Synthetic MRI not only carries substantial diagnostic significance in discerning between benign and malignant breast conditions but also exhibits the promise of supplanting conventional contrast-enhanced methodologies.

Power Pitch

Pitch: Blood Brain Barrier & Neuroinflammation

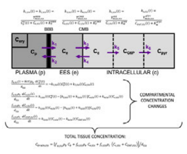
Power Pitch Theatre 3

Tuesday
Pitches: 15:45 - 16:45
Posters: 16:45 - 17:45

Moderators: Shoko Hara

(no CME credit)

0729 Pitch: 15:45 Poster: 16:45 Screen 41



[A new kinetic model for characterization of glucose delivery, transport and metabolism for MRS and dynamic glucose enhanced (DGE) MRI of the brain]

Anina Seidemo[1,2], Linda Knutsson[1,3,4], Nirbhay N Yadav[3,5], Ronnie Wirestam[1], Pia C Sundgren[2,6,7], and Peter C M van Zijl[3,5]

[1]Department of Medical Radiation Physics, Lund University, Lund, Sweden, [2]Diagnostic Radiology, Department of Clinical Sciences, Lund University, Lund, Sweden, [3]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [4]Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [5]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [6]Lund University Bioimaging Center, Lund University, Lund, Sweden, [7]Department of Medical Imaging and Physiology, Skåne University Hospital, Lund and Malmö, Sweden

Keywords: CEST / APT / NOE, CEST & MT, data analysis, kinetic modelling, metabolism, brain, cancer

Motivation: While PET, MR spectroscopy, and DGE CEST MRI can describe sugar uptake and utilization using a 2-tissue-compartment model, such a model is not appropriate for DGE CEST MRI of tumors, as the exchange properties of sugar hydroxyl protons may differ between tissue compartments.

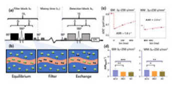
Goal(s): To develop a 3-tissue-compartment model (blood, EES and cell) suitable for DGE MRI.

Approach: We modified the mass balance equations and simulated compartmental D-glucose concentrations from D-glucose levels of venous plasma.

Results: The 3-tissue-compartment model was able to reproduce MRS literature brain D-glucose dynamic uptake curves, as well as experimental DGE MRI signal in brain tumors at 7 T.

Impact: A 3-tissue-compartment model is necessary for correct quantification of DGE MRI in malignant brain tumors. Our proposed model is expected to improve modeling and assessment for all metabolic substrate uptake imaging methods in situations of BBB breakdown.

0730 Pitch: 15:45
Poster: 16:45
Screen 42



Water exchange across blood-brain barrier in neuromyelitis optica spectrum disorder measured by vascular-water-exchange MRI

Bingjie Jiao[1], Ruili Wei[2], Hui Liang[2], Yi-cheng Hsu[3], and Ruiliang Bai[4]

[1]Key Laboratory of Biomedical Engineering of Education Ministry, College of Biomedical Engineering and Instrument Science, Zhejiang University, Hangzhou, China, [2]Neurology Department, First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou, China, [3]MR Collaboration, Siemens Healthcare, Shanghai, China, [4]Interdisciplinary Institute of Neuroscience and Technology, Zhejiang University School of Medicine, Hangzhou, China

Keywords: Neuroinflammation, Neuroinflammation, blood-brain barrier, vascular-water-exchange imaging, neuromyelitis optica spectrum disorder

Motivation: Limited information exists regarding the spatial characteristics of blood-brain barrier (BBB) disruption at the whole-brain level for neuromyelitis optica spectrum disorder (NMOSD).

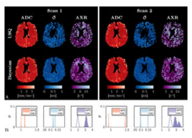
Goal(s): We explored spatial features of BBB changes in NMOSD using noninvasive, quantitative MRI technique.

Approach: Vascular-water-exchange MRI was applied for quantitative analysis.

Results: In the white matter, the apparent exchange rate across the BBB (AXR_{BBB}) was significantly higher in acute-phase patients than in healthy controls, especially in some lesion-prone areas. In the gray matter, acute-phase patients had significantly higher AXR_{BBB} values in the frontal and parietal lobes. AXR_{BBB} was also significantly correlated with clinical-scale scores.

Impact: Exploring the spatial features of BBB disruption will enable better understanding the imaging features of NMOSD and may help clinicians in differentially diagnosing NMOSD from other brain diseases using noninvasive MRI.

0731 Pitch: 15:45
Poster: 16:45
Screen 43



Hierarchical Bayesian Microstructure Modelling Improves Voxelwise Quantification of Blood-Brain Barrier Water Exchange Rates

Elizabeth Powell[1], Geoff J.M. Parker[1,2,3], and Paddy J. Slator[4]

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Keywords: Blood Vessels, Neuro, blood-brain barrier

Motivation: Blood-brain barrier (BBB) water exchange (WEX) imaging techniques are increasingly used to quantify BBB dysfunction. However, WEX imaging is highly noise sensitive, which is typically addressed by averaging data spatially or across subjects.

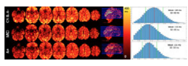
Goal(s): To obtain robust, subject-specific, voxel-wise WEX quantification from BBB filter exchange imaging (FEXI) data.

Approach: We implement a hierarchical Bayesian model fitting method, which, by introducing a Gaussian prior for model parameters (estimated from the data), reduces sensitivity to voxel-wise noise.

Results: Relative to conventional least-squares estimation, Bayesian model fitting improves parameter estimation qualitatively and quantitatively in synthetic and in ten test-retest volunteer datasets.

Impact: Robust, subject-specific, voxel-wise WEX quantification from BBB filter exchange imaging (FEXI) data will enable localised BBB dysfunction to be identified in neurological disease, potentially enabling earlier diagnosis or discrimination between diseases.

0732 Pitch: 15:45 Poster: 16:45 Screen 44



ASL blood-brain barrier permeability is associated with amyloid and cognitive impairment

Beatriz E. Padrela[1], Sandra Tecelão[2], Oliver Geier[3], Markus H. Sneve[4], David Vallez Garcia[1], Amnah Mahroo[5], Lene Pålhaugen[2,6], Bjørn-Eivind Kirsebom[6,7], Klaus Eickel[5], David L. Thomas[8], Atle Bjørnerud[4,9], Anders M. Fjell[4,10], Kristine B. Walhovd[4], Frederik Barkhof[1], Per Selnes[2], Matthias Günther[5], Jan Petr[11], Tormod Fladby[2], and Henk J.M.M. Mutsaerts[1]

[1]Radiology and Nuclear Medicine, Amsterdam UMC locatie VUmc, Amsterdam, Netherlands, [2]Department of Neurology, Akershus University Hospital, Oslo, Norway, [3]Department of Physics and Computational Radiology, Division of Radiology and Nuclear Medicine, Oslo University Hospital, Oslo, Norway, [4]Department of Psychology, Center for Lifespan Changes in Brain and Cognition, University of Oslo, Oslo, Norway, [5]Fraunhofer-Institute for Digital Medicine MEVIS, Bremen, Germany, [6]Institute of Clinical Medicine, Campus Ahus, University of Oslo, Oslo, Norway, [7]Department of Neurology, University Hospital of North Norway, Tromsø, Norway, [8]Department of Brain Repair and Rehabilitation, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [9]Oslo University Hospital, Computational Radiology and Artificial Intelligence, Division of Radiology and Nuclear Medicine, Oslo, Norway, [10]Computational Radiology and Artificial Intelligence, Division of Radiology and Nuclear Medicine, Oslo University Hospital, Oslo, Norway, [11]Helmholtz-Zentrum Dresden-Rossendorf, Institute of Radiopharmaceutical Cancer Research, Dresden, Germany

Keywords: Alzheimer's Disease, Arterial spin labelling, Blood-brain barrier, Biomarkers

Motivation: Blood-brain barrier (BBB) permeability changes may be implicated in Alzheimer's Disease (AD) pathophysiology.

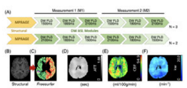
Goal(s): To investigate if the exchange time (Tex) of water across the BBB is associated with cognitive and amyloid status.

Approach: We measured Tex with a multi-echo arterial spin labeling MRI sequence in 116 adults older than 50 years and studied its association with cognition (cognitively normal vs mild cognitive impaired) and amyloid (A- vs A+) status.

Results: BBB water permeability is increased in A+ participants and in patients with MCI, compared to healthy controls

Impact: Our results suggest that multi-TE ASL MRI BBB water permeability can be used as a potential early imaging biomarker of AD pathophysiology.

0733 Pitch: 15:45 Poster: 16:45 Screen 45



Repeatability of Blood-Brain Barrier Diffusion Weighted Arterial Spin Labeling MRI at Different Post-Label Delays

Yufei David Zhu[1], Quimby Nicole Lee[2], and Audrey Peiwen Fan[1,2]

[1]Biomedical Engineering, University of California, Davis, Davis, CA, United States, [2]Neurology, University of California, Davis, Davis, CA, United States

Keywords: Neurofluids, Arterial spin labelling, Blood-brain barrier, Diffusion-weighting

Motivation: Anomalous blood-brain barrier (BBB) water transfer rate (Kw) has the potential to be a novel biomarker for neurological disorders.

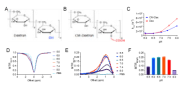
Goal(s): However, additional studies are needed to affirm the reliability of MRI sequences that assess Kw.

Approach: This *in vivo* study sought to determine the intrasession repeatability of the single-delay diffusion-weighted (DW) arterial spin labeling (ASL) MRI sequence at different DW post-label delays (PLDs). [1]

Results: Our findings confirmed that cerebral blood flow (CBF) and Kw were most stable at a DW PLD of 1800ms and that there exists a significant linear correlation between arterial transit time (ATT) and Kw.

Impact: Our findings show that for single-delay diffusion weighted (DW) ASL MRI, properly selecting the DW PLD and consideration of ATT are crucial for robust BBB water permeability measurements. Studies like ours are necessary before Kw imaging in different disease states.

0734 Pitch: 15:45
Poster: 16:45
Screen 46



Dextran CEST MRI Agents for Quantitative Assessment of BBB Leakage in the Macromolecular Size Range.

Safiya Aafreen[1], Wenshen Wang[2,3], Aline Thomas[2,3], and Guanshu Liu[2,3]

[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 School of Medicine, Baltimore, MD, United States, [3]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States

Keywords: CEST / APT / NOE, CEST & MT, Multiple Sclerosis; CEST enhancement; Dex-Cest

Motivation: Dextrans (Dex) -based CEST MRI allows evaluating vascular permeability in the macromolecular size range. However, its signal intensity, similar to most CEST agents, is pH-dependent, which complicates *in vivo* quantification.

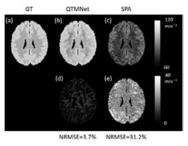
Goal(s): To develop a dextran CEST agent that is less pH sensitive for this application.

Approach: Chemically modified Dex (CM-Dex) has negatively charged carboxylate groups that can retard the exchange rate of OH protons to decrease pH effects.

Results: CM-Dex has a relatively consistent CEST signal across a pH range of 6 to 7.4 and is feasible for detecting blood-brain barrier (BBB) leakage in a mouse model of multiple sclerosis (MS).

Impact: The development of a second-generation dextran-based CEST agent with a more extended pH range of stable MRI signal to facilitate quantitative measurements of vascular permeability in vivo for applications wherein intra- and inter-individual pH can vary.

0735 Pitch: 15:45
Poster: 16:45
Screen 47



Quantitative Water Permeability Mapping using Biophysical-modeling-based Deep Learning

Renjiu Hu[1,2], Qihao Zhang[2], Dominick Romano[1,2], Benjemin Weppner[1,2], Pascal Spincemaille[2], Thanh Nguyen[2], and Yi Wang[1,2]

[1]Cornell University, Ithaca, NY, United States, [2]Weill Cornell Medicine, New York, NY, United States

Keywords: Simulation/Validation, Quantitative Imaging, Arterial Spin Labeling, Brain, Vessels

Motivation: In diffusion-weighted arterial spin labeling (DW-ASL) images, quantification of the water exchange rate $$$k_{w}$$$ uses a single-pass approximation (SPA) which introduces systematic error while fitting the non-linear model is difficult.

Goal(s): Our goal was to reduce the blood-brain-barrier (BBB) water exchange rate ($$$k_{w}$$$) quantification errors in DW-ASL images.

Approach: We introduced the biophysical-modeling-based deep learning method (QTMNet) and tested both the simulated and in vivo data.

Results: On simulated data, QTMNet has 90% less normalized root mean square error (NRMSE) compared to the traditional kinetic model.

Impact: The improvement in evaluation accuracy by QTMNet may benefit Alzheimer's Disease detection where $$$k_{w}$$$ has significant reduction.

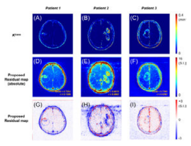
0736

MERIT AWARD MAGNA CUM LAUDE

Pitch: 15:45

Poster: 16:45

Screen 48



Unsupervised PK Model-free BBB Leakage Detection in DCE-MRI using Generative Adversarial Networks

Joon Jang[1], Junhyeok Lee[2,3], Hyochul Lee[2,3], Inpyeong Hwang[3,4,5], Seung Hong Choi[2,3,4,5,6], Jung Hyun Park[7], Hyeonjin Kim[3,8], and Kyu Sung Choi[3,4]

[1]Department of Biomedical Sciences, Seoul National University College of Medicine, Jongno-gu, Korea, Republic of, [2]Interdisciplinary Program in Cancer Biology, Seoul National University College of Medicine, Jongno-gu, Korea, Republic of, [3]Department of Radiology, Seoul National University Hospital, Jongno-gu, Korea, Republic of, [4]Artificial Intelligence Collaborative Network (AICON), Department of Radiology, Seoul National University Hospital, Jongno-gu, Korea, Republic of, [5]Department of Radiology, Seoul National University College of Medicine, Jongno-gu, Korea, Republic of, [6]Center for Nanoparticle Research, Institute for Basic Science (IBS), Gwanak-gu, Korea, Republic of, [7]Department of Radiology, Seoul Metropolitan Goverment-Seoul National University Boramae Medical Center, Seoul, Korea, Republic of, [8]Department of Medical Sciences, Seoul National University College of Medicine, Jongno-gu, Korea, Republic of

Keywords: Diagnosis/Prediction, Perfusion, DCE-MRI, Glioblastoma, Blood-brain barrier, Deep learning, Generative adversarial networks

Motivation: Arterial input function (AIF) in DCE-MRI is often degraded due to noise, motion, and partial volume. This may lower the overall reliability of the resulting pharmacokinetic (PK) parameters.

Goal(s): Our goal was to develop a robust, fast method for detecting blood-brain barrier (BBB) leakage signals without PK models.

Approach: We employed a fast anomaly detection using generative adversarial networks (f-AnoGAN) for unsupervised detection of the leakage signals.

Results: The results were highly correlated with the traditional K^{trans} maps, and more robust against reduced temporal data points, which may be used for shorter scan time and/or higher spatial resolution.

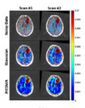
Impact: Our proposed method may allow fast and robust detection of BBB leakage signals in the case where the scan time is highly limited, and consequently, the traditional approach with PK models may not be suitable.

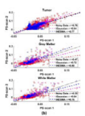
0737

Pitch: 15:45

Poster: 16:45

Screen 49





Improving subtle BBB permeability estimation using iterative nonlocal estimation of multispectral magnitudes (iNESMA) filtering

Jonghyun Bae[1], Zhaoyuan Gong[1], Alex Guo[1], Mary E Faulkner[1], John P Laporte[1], and Mustapha Bouhrara[1]

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

Keywords: Data Processing, DSC & DCE Perfusion, Blood Brain Barrier, NESMA filtering, subtle BBB permeability

Motivation: Recently, Dynamic Contrast-Enhanced MRI studies revealed increased Blood-Brain Barrier (BBB) permeability in aging and in Alzheimer's disease (AD). However, the subtle BBB disruption in aging and in AD yields substantially low contrast extravasation, which results in an intrinsically low signal-to-noise ratio.

Goal(s): An effective filtering method is desirable to suppress noise, while maintaining the spatial variation in contrast dynamics.

Approach: We propose an iterative nonlocal estimation of multispectral magnitudes (iNESMA) filtering approach, which achieves noise-filtering by combining the voxels with similar spectral patterns.

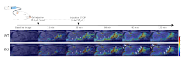
Results: Our results suggest that iNESMA filtering allows accurate and precise determination of kinetic parameters for subtle BBB permeability.

Impact: We propose an effective, yet straightforward, filtering paradigm for improved determination of the kinetic parameters from DCE-MR images. Our proposed iNESMA filtering would allow better characterization of subtle vascular changes in aging and in AD.

0738 Pitch: 15:45

Poster: 16:45

Screen 50



[Loss of AQP4 impairs solute clearance from the CSF space]

Daisuke Kato[1,2], Hiroyuki Kameda[2,3,4], Naoya Kinota[1,2,3], Takaaki Fujii[1,2,3], Yoichiro Abe[5], Masato Yasui[5], and Kohsuke Kudo[2,4,6]

[1]Department of Diagnostic Imaging, Graduate School of Medicine, Hokkaido University, Sapporo, Japan, [2]Department of Diagnostic and Interventional Radiology, Hokkaido University Hospital, Sapporo, Japan, [3]Department of Dental Radiology, Hokkaido University Hospital, Sapporo, Japan, [4]Department of Diagnostic Imaging, Faculty of Medicine, Hokkaido University, Sapporo, Japan, [5]Department of Pharmacology, Keio University School of Medicine, Tokyo, Japan, [6]Global Center for Biomedical Science and Engineering, Faculty of Medicine, Hokkaido University, Sapporo, Japan

Keywords: Neurofluids, Neurofluids, Glymphatic

Motivation: Aquaporin-4 (AQP4) water channels are thought to play an important role in cerebrospinal fluid (CSF) and interstitial fluid (ISF) exchange. However, the effect of AQP4 on CSF drainage and dynamics has not been well-established.

Goal(s): To investigate the effects of AQP4 on CSF drainage and dynamics using in vivo imaging.

Approach: We performed a whole-brain analysis including CSF spaces and drainage pathways of AQP4 knockout rats using dynamic contrast-enhanced (DCE) MRI with intrathecal gadolinium-based contrast agent administration.

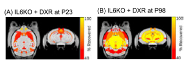
Results: DCE-MRI showed that loss of AQP4 impairs solute clearance from the CSF space and reduces CSF-ISF exchange.

Impact: Loss of AQP4 impairs CSF-ISF exchange as well as solute clearance from the CSF space, suggesting that AQP4 expression might affect the entire CSF dynamics.

0739 Pitch: 15:45

Poster: 16:45

Screen 51



[IL-6 knockout reduces doxorubicin-induced neurotoxicity]

Jonas Yeung[1,2], Rosanna Weksberg[3], Sharon L Guger[4], Russell Schachar[5], Shinya Ito[6], and Brian Nieman[1,2]

[1]Translational Medicine, The Hospital for Sick Children, Toronto, ON, Canada, [2]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Departments of Paediatrics, The Hospital for Sick Children, Toronto, ON, Canada, [4]Psychology Department, The Hospital for Sick Children, Toronto, ON, Canada, [5]Department of Psychiatry, The Hospital for Sick Children, Toronto, ON, Canada, [6]Division of Clinical Pharmacology & Toxicology, The Hospital for Sick Children, Toronto, ON, Canada

Keywords: Neuroinflammation, Cancer, chemotherapy, treatment, late effects, pediatric, development

Motivation: Doxorubicin (DXR) is a widely used chemotherapy agent associated with inflammation and neurocognitive impairment in cancer survivors. Given that DXR has limited access to the brain, indirect mechanisms, such as the generation of systemic pro-inflammatory cytokines, are proposed to induce neurotoxicity and neuroinflammation.

Goal(s): This study aims to probe this hypothesized pro-inflammatory pathway of DXR-induced neurotoxicity.

Approach: We identified an elevation of the pro-inflammatory cytokine IL-6 in DXR-treated mice. Consequently, we utilized MRI to assess neuroanatomical changes after DXR treatment in wildtype and *Il-6* knockout mice.

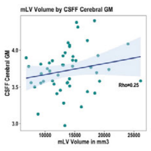
Results: Our findings revealed that *Il-6* knockout partially mitigated the neurotoxic effects induced by DXR.

Impact: DXR leads to cognitive impairment that diminishes quality of life for cancer survivors. We demonstrated the involvement of IL-6 in the neurotoxic mechanism of DXR, suggesting a strategy for targeting IL-6 to limit neurotoxicity of cancer treatments.

0740 Pitch: 15:45

Poster: 16:45

Screen 52



Impaired Glymphatic Clearance Linked to Neuroinflammation and Disability in Multiple Sclerosis

Dinesh K Sivakolundu[1], Susan Gauthier[2], and Thanh Nguyen[2]

[1]Yale University, New Haven, CT, United States, [2]Weill-Cornell Medicine, New York, NY, United States

Keywords: Multiple Sclerosis, Multiple Sclerosis, Brain Lymphatics

Motivation: Multiple sclerosis (MS) involves a proinflammatory state leading to cellular waste accumulation and disability. This study investigates the glymphatic system's waste clearance role, hypothesizing that lymphatic dysfunction contributes to MS-related disability.

Goal(s): Explore the relationship between glymphatic function, meningeal lymphatic vessels (mLV), and MS-related disability.

Approach: The study examined 49 MS patients using MRI to visualize mLVs and evaluate glymphatic stasis via CSF fraction (CSFF), analyzing links between mLV volume, CSFF, and MS outcomes

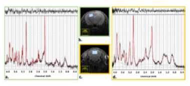
Results: With age, cortical CSFF increases. mLV volume also increases with CSFF. Higher cortical CSFF is associated with more lesions and disability, suggesting glymphatic dysfunction contributes to MS-related disability.

Impact: Our study suggests that glymphatic dysfunction contributes to lesion burden and disability in multiple sclerosis, highlighting the importance of lymphatic clearance mechanisms in disease progression.

0741 Pitch: 15:45

Poster: 16:45

Screen 53



Evaluating metabolic disruption following radiotherapy in the developing brain: a preclinical juvenile model

Shannon Helsper[1], Edmond Sterpin[2], and Uwe Himmelrecih[1]

[1]Biomedical MRI / Dept. Imaging & Pathology, KU Leuven, Leuven, Belgium, [2]Department of Oncology, KU Leuven, Leuven, Belgium

Keywords: Neuroinflammation, Radiotherapy, 1H MRS

Motivation: Cognitive performance in paediatrics is severely impacted by current brain tumour treatment plans such as radiotherapy.

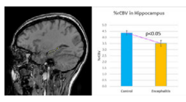
Goal(s): Our goal is to decipher the underlying mechanism of this cognitive decline, which remains unknown and is particularly difficult to decipher in paediatric patients due to confounding developmental variables.

Approach: Longitudinal ^{1}H MRS analysis in the brain following radiotherapy in a juvenile rat model provides valuable insight into metabolic disruption.

Results: Myo-inositol levels, linked to other neurodegenerative and cognitive conditions, were elevated in the hippocampus and cerebellum. Deviance in N-acetyl-aspartate levels between irradiated and healthy rats over a developmental period of 12.5 weeks was also revealed.

Impact: ^{1}H MR spectroscopy reveals valuable insight into longitudinal impacts of radiotherapy on the developing brain. A juvenile rat model enables acute and chronic alterations in inflammatory markers, membrane synthesis, bioenergetics and viability to be monitored, distinguishing irradiation and development effects.

0742 Pitch: 15:45 Poster: 16:45 Screen 54



Brain metabolites and regional cerebral blood volume altered in anti-NMDAR encephalitis patients

Mariano G Uberti[1], Balasrinivasa Sajja[1], Lakshman Arcot Jayagopal[2], Audrina Mullane[3], Yan Zhang[1], Matthew L White[1], and Olga G Taraschenko[2]

[1]Radiology, University of Nebraska Medical Center, Omaha, NE, United States, [2]Neurological Sciences, Division of Epilepsy, University of Nebraska Medical Center, Omaha, NE, United States, [3]Neurological Sciences, Division of Neuropsychology, University of Nebraska Medical Center, Omaha, NE, United States

Keywords: Epilepsy, Neuroinflammation, anti-NMDAR, Spectroscopy, rCBV

Motivation: The chronic phase of autoimmune encephalitis includes persistent loss of cognitive and adaptive functions leading to long-term disability. MR-based modalities help in longitudinal studies to understand disease progression and response to treatment.

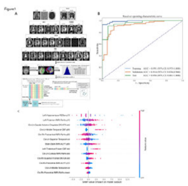
Goal(s): To investigate the *in vivo* MRI-based methods sensitive to detecting the alterations in metabolites and perfusion in encephalitis patients.

Approach: ^{1}H-MRS and rCBV were performed on encephalitis patients with memory deficits and healthy controls.

Results: Changes in metabolite concentrations in the hippocampus and cortex suggest the long-term effect of neuroinflammation in patients. Reduced hippocampal rCBV in memory deficit patients is consistent with clinical cognitive assessments.

Impact: Altered brain metabolite concentrations and regional blood volume were detected with ^{1}H-MRS and rCBV in autoimmune encephalitis and memory deficit patients. This approach can support the investigation of the role of angiogenesis and neurogenesis in memory loss in chronic encephalitis.

0743 Pitch: 15:45 Poster: 16:45 Screen 55



Multiomics analysis of the gut-microbiota-brain axis shows neural signatures of Crohn's disease and its underlying mechanisms

Ruonan Zhang[1], YANGDI WANG[2], Xiaodi Shen[2], Li Huang[2], Mengzhu Wang[3], Chen Zhao[3], Ren Mao[2], Shi-ting Feng[2], and Xuehua Li[2]

[1]Department of Radiology, The First Affiliated Hospital, Sun Yat-Sen University, Guangzhou, China, [2]The First Affiliated Hospital, Sun Yat-Sen University, Guangzhou, China, [3]MR Research Collaboration, Siemens Healthineers Ltd., Beijing, China

Keywords: Digestive, Infectious disease

Motivation: Neural alterations affect intestinal conditions. However, these neural alterations and their potential formation mechanisms remain unclear.

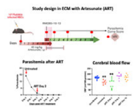
Goal(s): We integrated brain radiomics, the fecal microbiome, and blood metabolomics to investigate neural characteristics in patients with Crohn's disease (CD) by establishing putative links between the gut microbiota, blood metabolites, and brain alterations.

Approach: Multiomics data were compared between CD patients and healthy controls.

Results: We developed a novel multiparameter brain MRI-based radiomics model to characterize the neural features of CD patients. Causal mediation analysis revealed significant pathways supporting the pivotal role of the gut-brain axis in neural alterations in CD patients.

Impact: We developed a novel multiparameter MRI-based radiomics model to comprehensively characterize neural alterations in patients with Crohn's disease. We presented biologically plausible evidence of the formation mechanism underlying these alterations from a gut-microbiota-brain axis perspective.

0744 Pitch: 15:45 Poster: 16:45 Screen 56



[Unfolding evolving pathology in experimental cerebral malaria model treated with artesunate with in vivo MRI]

Min-Hui Cui[1], Cheryl Sachdeva[2], Roman Fleysher[1], Craig A Branch[1], and Johanna P Daily[2]

[1]*Radiology, Albert Einstein College of Medicine, Bronx, NY, United States,* [2]*Microbiology & Immunology and Infections Diseases, Albert Einstein College of Medicine, Bronx, NY, United States*

Keywords: Infectious Disease, Infectious disease, cerebral malaria

Motivation: Artesunate is the first-line treatment of *P. falciparum* malaria. However, despite artesunate therapy, there is a 15% fatality rate in severe malaria and survivors can suffer long-term neurocognitive deficits.

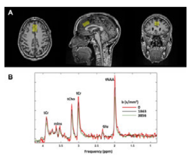
Goal(s): Describe the evolving pathology in experimental cerebral malaria (ECM) model treated with artesunate, to develop a model for testing adjunctive therapy in cerebral malaria.

Approach: In vivo MRI was applied on ECM mice prior to and post artesunate treatment.

Results: Despite rapid clearance of the parasite by artesunate, significantly reduced CBF and subsequent reperfusion/reoxygenation injury is detected by MRI, and may ultimately cause neurocognitive deficits in CM survivors.

Impact: It is critical to understand the evolving pathology after antimalarial cure with artesunate in cerebral malaria in order to design effective adjunctive therapy, to reduce mortality and neurocognitive impairment. Reduced CBF and its rapid recovery may contribute to CM neuropathology.

0745 Pitch: 15:45 Poster: 16:45 Screen 57



Neuroimaging signatures of severe depression in people with HIV

Arish Mudra Rakshasa-Loots[1,2], Nicholas G. Dowell[3], Jaime H. Vera[1], and Itamar Ronen[3]

[1]*Department of Global Health and Infection, Brighton & Sussex Medical School, University of Sussex, Brighton, United Kingdom,* [2]*Edinburgh Neuroscience, The University of Edinburgh, Edinburgh, United Kingdom,* [3]*Clinical Imaging Sciences Centre, Brighton & Sussex Medical School, University of Sussex, Brighton, United Kingdom*

Keywords: Infectious Disease, Diffusion/other diffusion imaging techniques, HIV

Motivation: People with HIV and co-morbid severe depression are rarely included in research, despite a critical need for identifying biomarkers for early detection of depression in this group.

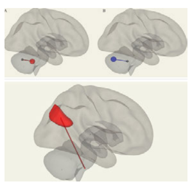
Goal(s): We explored whether neuroimaging biomarkers may distinguish between people with HIV experiencing severe or mild depressive symptoms.

Approach: We recruited 11 participants with HIV and severe or mild depressive symptoms, who underwent standard and diffusion-weighted MR spectroscopy and dynamic contrast-enhanced MRI.

Results: We found no significant group differences, but observed correlations of depressive symptom severity with creatine (ρ = 0.66) and NAA (ρ = 0.64) diffusion, though these findings did not survive multiple comparisons correction.

Impact: This is the first study to successfully quantify neurometabolite diffusion in people with HIV and depression. Intracellular diffusion of neurometabolites may be associated with depressive symptom severity in this community, and well-powered studies are needed to resolve this relationship.

0746 Pitch: 15:45 Poster: 16:45 Screen 58



Assessment of Functional connectivity in Myalgic Encephalomyelitis/Chronic Fatigue Syndrome using 7Tesla MRI.

Maira Inderyas[1], Kiran Thapaliya[1], Sonya Marshall-Gradisnik[1], Markus Barth[1,2], and Leighton Barnden[1]

[1]*Griffith University, Gold Coast, Australia,* [2]*University of Queensland, Brisbane, Australia*

Keywords: Infectious Disease, Brain Connectivity, fMRI (task-based), High-Field MRI

Motivation: To assess Functional Connectivity (FC) differences between healthy individuals and Myalgic Encephalomyelitis or chronic fatigue syndrome (ME/CFS) patients using ultra-high-field fMRI.

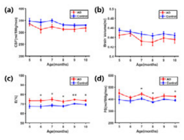
Goal(s): Are there significant FC differences between brainstem and cerebellum regions comparing ME/CFS and healthy controls? Is there any association between clinical measures and FC in ME/CFS?

Approach: fMRI data were acquired on 7Tesla scanner during cognitive Stroop color-word task. Using *a-priori* regions, FC was assessed in CONN toolbox.

Results: Weaker FC was observed between brainstem and cerebellum regions along with altered FC within the intrinsic network hubs which supports our hypothesis of connectivities being defective in ME/CFS within those regions.

Impact: FC analyses using ultra-high-field MRI facilitates our understanding of the underlying patho-mechanisms of the cognitive deficits in ME/CFS and their progression.

0747 Pitch: 15:45 Poster: 16:45 Screen 59



[Longitudinal Changes of BBB Permeability and transcytolemmal permeability in Alzheimer’s Disease Mice: A Non-Contrast MRI Study]

Chuhan Xiong[1], Yu Yin[2], Qinfeng Zhu[1], Ruicheng Ba[1], Zhecheng Jin[1], Zhiliang Wei[3], Zixuan Lin[1], and Dan Wu[1]

[1]College of Biomedical Engineering and Instrument Science, Zhejiang University, Hangzhou, China, [2]Department of Chemistry, Zhejiang University, Hangzhou, China, [3]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States

Keywords: Alzheimer's Disease, Alzheimer's Disease

Motivation: BBB disruption is demonstrated in Alzheimer’s disease (AD) but how does it change during the progression of disease, and its relationship with transcytolemmal water exchange are not clear.

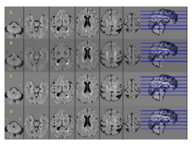
Goal(s): We aimed to evaluate the longitudinal changes of water exchange across BBB and across cytomembrane in AD mice.

Approach: BBB permeability and transcytolemmal permeability to water were assessed in 3xTg-AD mouse from 6 to 10 months of age using WEPCAST and tDKI MRI, respectively.

Results: Elevation of BBB permeability in AD mice started as early as 6 months. Transcytolemmal permeability was found to increase in the hippocampus.

Impact: Current results suggested the potential role of BBB and transcytolemmal permeability as a biomarker in the early detection of AD. Their co-increase may be related to the altered glymphatic function.

0748 Pitch: 15:45 Poster: 16:45 Screen 60



[Harmonizing 2D and 3D FLAIR MRIs in white matter hyperintensity quantification]

Yasheng Chen[1], Chia-Ling Phuah[1], Chunwei Ying[2], Xing Dai[1], Peter Kang[1], Jin-Moo Lee[1], Andria Ford[1], and Hongyu An[2]

[1]Neurology, Washington University School of Medicine, St. Louis, MO, United States, [2]Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, MO, United States

Keywords: White Matter, White Matter, FLAIR, harmonization, white matter hyperintensity

Motivation: Harmonizing neural imaging datasets respectively acquired with 2D and 3D FLAIR MRI.

Goal(s): Converting 2D FLAIRs to high-resolution 3D FLAIRs.

Approach: We employed a ResUNet-based deep learning approach to learn the complex transformation from 2D to 3D FLAIR.

Results: The converted 3D FLAIRs bear a high resemblance to the acquired 3D FLAIR in terms of image similarity measures and white matter hyperintensity segmentation.

Impact: With this proposed approach, we can harmonize the 2D FLAIRs from the ADNI study with the 3D FLAIRs in the UK Biobank study.

Other
Journal Reviewer Training with the MRM and JMRI editors
Room 303-304 Tuesday 16:45 - 17:45

(no CME credit)

Study Group Business Meeting
Ultra-High Field MR Business Meeting
Room 324 Tuesday 16:45 - 17:45

(no CME credit)

Wednesday, 08 May 2024

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Sunrise Course
Cardiology for Physicists: Non-Ischemic Cardiomyopathy
Organizers: Michael Atalay, Teresa Correia, Tarique Hussain, Christopher Nguyen, Hajime Sakuma, Andrew Scott, Tobias Wech

Hall 606 Wednesday 7:00 - 8:00 *Moderators:* Kim-Lien Nguyen & Vlad Zaha

7:00 [Non-Ischemic Causes of Decreased Heart Function: Infiltrative Processes, Autoimmune Reactions, Inflammation & Drug Reactions]
Tevfik Ismail

7:30 What Can CMR Contribute to the Characterization of Non-Ischemic Cardiomyopathies?
Edythe Tham

Sunrise Course
Absolute Beginner's Guide to fMRI
Organizers: Sune Jespersen, Sila Kurugol, Shaihan Malik, Henrik Odéen, Yasuhiko Tachibana, Cristian Tejos, Richard Thompson

Nicoll 2 | Wednesday 7:00 - 8:00 | *Moderators:* Marta Bianciardi & Patricia Figueiredo

7:00 Getting Started with fMRI: Biophysics & Acquisition
Kamil Uludag

7:30 Getting Started with fMRI: Analysis Methods
Susan Francis

Sunrise Course
Pulmonary MRI: State of the Art
Organizers: Yoshiharu Ohno

Nicoll 3 | Wednesday 7:00 - 8:00 | *Moderators:* Yoshiharu Ohno & Yoshiyuki Ozawa

7:00 State-of-the-Art Lung MRI for Cystic Fibrosis
Mark Oliver Wielpütz

7:20 State-of-the-Art Lung MRI for Lung Nodule & Cancer Staging
Hidtake Yabuuchi

7:40 State-of-the-Art Lung MRI for Pulmonary Hypertension
Mark Schiebler

Sunrise Course
Unlocking Productivity & Impact in Teaching & Publishing III
Organizers: Agah Karakuzu, Shin-Lei Peng

Room 325-326 | Wednesday 7:00 - 8:00 | *Moderators:* Li-Wei Kuo & Fa-Hsuan Lin

7:00 How To Coach Mentees Who Have Little to No Prior Knowledge of MRI
Yu-Chieh Kao

7:30 Communications/Corporations Between M.D. & Ph.D.
Hanzhang Lu

Sunrise Course
All About Head & Neck: Imaging Brain Microstructure
Organizers: Wei-Tang Chang, Seena Dehkharghani, Xiao-Qi (Juliana) Huang

Room 331-332 | Wednesday 7:00 - 8:00 | *Moderators:* Yingxue Gao & Lirong Yan

7:00 Imaging Brain Microstructure in Neuropsychiatric Disorders
Ileana Jelescu

7:30 Imaging Brain Microstructure with Diffusion-Based Techniques
Els Fieremans

Sunrise Course
Quantification & Analysis: MRSI
Organizers: HyungJoon Cho, Rita Nunes, Khin Tha, Mingming Wu

Room 334-336 | Wednesday 7:00 - 8:00 | *Moderators:* Yan Li & Malgorzata Marjanska

7:00 MRSI: State-of-the-Art and Emerging Methods
Xin Yu

7:30 MRSI: Application
Moyoko Tomiyasu

Sunrise Course
Quantitative Cartilage Imaging
Organizers: Fang Liu, Jamie MacKay

Summit 1 | Wednesday 7:00 - 8:00 | *Moderators:* Hyungseok Jang & Lauren Watkins

7:00 Quantitative Cartilage Imaging: Do We Need It? YES
Steven Wong

7:15 Quantitative Cartilage Imaging: Do We Need It? NO
James Linklater

7:30 Quantitative Cartilage Imaging: What Is Missing & How To Bridge the Gap
Xiaojuan Li

7:45 Panel Discussion and Q&A

Sunrise Course
Surprising Aspects of MRI Physics: Beware or Befriend Eddy Currents & Lorenz Force
Organizers: Brian Hargreaves, Shaoying Huang, Rita Schmidt, Rolf Schulte, Ramesh Venkatesan, Andrew Webb

Summit 2 | Wednesday 7:00 - 8:00 | *Moderators:* Silvia De Santis & David Porter

7:00 Lorenz Force on Conductors: From Nuisance to Driver Actuation for MRE & Music Composition
Ralph Sinkus

7:30 Eddy Currents: From Artifacts to Conductivity Imaging
Jiaen Liu

Study Group Business Meeting
X-Nuclei Imaging Business Meeting
Room 303-304 | Wednesday 8:15 - 9:15

(no CME credit)

Study Group Business Meeting
Diffusion Business Meeting
Room 324 | Wednesday 8:15 - 9:15

(no CME credit)

Weekday Course
From Low Field to High Field
Organizers: Berkin Bilgic, HyungJoon Cho

Summit 1 | Wednesday 8:15 - 10:15 | *Moderators:* SoHyun Han & Yang Yang

8:15 Pros/Cons from Low to High Field: How To Tailor Sequence/Reconstruction
Clarissa Cooley[1]

[1]*Massachusetts General Hospital, Charlestown, MA, United States*

8:39

Low-Field Imaging: Acquisition Technology & Applications

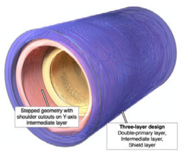
Masaaki Hori[1,2], Akifumi Hagiwara[2], Kouhei Kamiya[1,2], Koji Kamagata[2], and Shigeki Aoki[2,3]

[1]Toho University, Tokyo, Japan, [2]Radiology, Juntendo University School of Medicine, Tokyo, Japan, [3]Department of Data science, Juntendo University, Urayasu, Japan

Keywords: Physics & Engineering: Low-Field MRI

Low-field MRI systems, historically seen as underperforming, are gaining renewed interest due to advancements in technology. These systems now enable techniques previously limited to high-field MRI, offering considerable clinical value with improved imaging modalities like 3D SWI at 0.55T. The application of AI and deep learning in image reconstruction and noise reduction enhances image quality and reduces imaging times. Despite inherent limitations in signal-to-noise ratio and spatial resolution, low-field MRI provides unique advantages, especially in reducing susceptibility artifacts near metal implants, making it a valuable tool in clinical diagnostics and MRI-guided interventions.

9:03



Encoding/Reconstruction To Exploit High-Performance Gradients

Gabriel Ramos Llordén[1,2]

[1]Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States

Keywords: Physics & Engineering: Hardware, Image acquisition: Sequences, Image acquisition: Reconstruction

Advancements in gradient technology and hardware have significantly enhanced the capabilities of human MRI scanners. To fully utilize these high-performance gradients, sophisticated encoding and reconstruction techniques are essential. This educational session delves into acquisition and reconstruction methodologies designed to maximize the potential of high-performance gradients and overcome concomitant challenges, thereby ensuring high-fidelity MRI imaging. Additionally, the session will highlight various medical applications that benefit from these technological advancements, e.g., hardware and dedicated image encoding/reconstruction frameworks.

9:27

Clinical Applications @ UHF

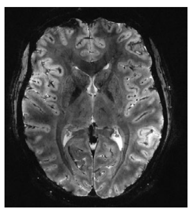
Daniel Paech[1]

[1]Radiology, Mass General Brigham, Harvard University, Boston, MA, United States

Keywords: Cross-organ: Cancer, Neuro: Brain, Physics & Engineering: High-Field MRI

The talk delves into the potential transformative impact of ultra high field (UHF) magnetic resonance imaging on medical diagnostics and treatment. Key applications highlighted include advanced brain imaging for neurological disorders, enhanced visualization of musculoskeletal structures, and improved cancer detection and characterization. The speaker emphasizes the potential for UHF MRI to unlock new insights into disease mechanisms, facilitate early diagnosis, and tailor personalized treatment plans. Challenges such as accessibility, patient safety, and regulatory hurdles are also discussed, alongside future directions for integrating UHF MRI into routine clinical practice.

9:51



What Lies Beyond 7T on the Horizon

Nicolas Boulant[1], Franck Mauconduit[1], Vincent Gras[1], Alexis Amadon[1], Caroline Le Ster[1], Michel Luong[2], Aurélien Massire[3], Christophe Pallier[4], Laure Sabatier[5], Michel Bottlaender[1], Denis Le Bihan[1], and Alexandre Vignaud[1]

[1]NeuroSpin/CEA, Gif sur Yvette, France, [2]Irfu/CEA, Gif sur Yvette, France, [3]Siemens France, Courbevoie, France, [4]INSERM-CEA Unicog, CNRS, Gif sur Yvette, France, [5]Jacob, CEA, Gif sur Yvette, France

Keywords: Physics & Engineering: High-Field MRI, Neuro: Brain

The supralinear gains of signal-to-noise and contrast-to-noise ratios have been a driving force for ultra-high field MRI. Many exciting projects worldwide have emerged to leverage this gain and boost the spatiotemporal resolution of brain images, gain sensitivity in fMRI and increase the spectral peak separation. In this context, the highest magnetic field used to date in vivo on humans is 11.7T at CEA, Saclay France. This work presents the latest achievements at this unprecedented field strength, including the first images ever acquired in vivo, as well as a few lessons learnt on the way.

Oral

Cardiac & Abdominal Motion Correction: Freeze, Don't Move!

Hall 606 | Wednesday 8:15 - 10:15 | *Moderators:* Thomas Küstner & Thomas Olausson

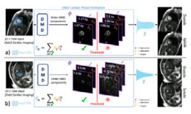
8:15

Introduction

Thomas Küstner
University Hospital Tuebingen, Germany

0749 8:27

MERIT AWARD SUMMA CUM LAUDE



Dynamic Mode Decomposition (DMD) Cardiac Phase Estimation for adult and fetal real-time MRI

Ecrin Yagiz[1], Bilal Tasdelen[1], Ibrahim K. Ozaslan[1], Mihailo R. Jovanovic[1], Ye Tian[1], and Krishna S Nayak[1]

[1]*Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States*

Keywords: Motion Correction, Fetus, retrospective-gating

Motivation: Cardiac synchronization in adult and fetal imaging requires external devices (electrocardiogram, Doppler-ultrasound), which may compromise image quality and increase scan time. Self-gating with real-time imaging can mitigate this but may be less reliable for irregular motions and limited in fetal applications.

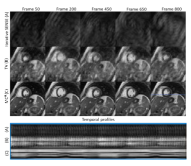
Goal(s): To develop a fast image-based cardiac phase estimation method with no assumption on the heart rate and minimal user input.

Approach: Dynamic Mode Decomposition is used to estimate cardiac motion signal for retrospective-gating.

Results: DMD cardiac phase estimation captures cardiac motion despite the irregularities and other bulk motions, as demonstrated in real-time adult and fetal cardiac imaging, including a twin gestation.

Impact: The proposed technique, Dynamic Mode Decomposition cardiac phase estimation, constructs cardiac signal with no assumption on periodicity, no iterations, and only minimal user input. This may be valuable in fetal cardiac imaging, where the cardiac signal is not readily available.

0750 8:39



TR-resolved Real-Time Low-Field CMR using Hermitian Motion Corrected Reconstructions

Gastao Cruz[1], Jesse Hamilton[1,2], Evan Cummings[1,2], Vikas Gulani[1], and Nicole Seiberlich[1,2]

[1]*Radiology, University of Michigan, Ann Arbor, MI, United States,* [2]*Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States*

Keywords: Motion Correction, Low-Field MRI, Real-time

Motivation: Real-time cardiac MR could provide new insights into function of the myocardium while avoiding artefacts arising from cardiac and/or respiratory motion.

Goal(s): High temporal resolution real-time cardiac MR is particularly challenging at low field (0.55T) due reduced SNR and coil elements available on commercial systems.

Approach: Here, we leverage motion compensated reconstructions and Hermitian symmetry to enable the highly undersampled reconstructions required for real-time cardiac MR at low field.

Results: Experiments at 0.55T show that the proposed approach enables imaging with a temporal resolution of 6 ms (R~48x) with minimal aliasing, outperforming conventional compressed sensing (considerable aliasing) and parallel imaging (aliasing dominated).

Impact: TR-resolved (6ms temporal resolution) real-time cardiac is demonstrated at 0.55T where SNR is limited. Such highly accelerated imaging may reveal finer details in myocardial function. Additionally, the high acceleration factors achieved here could also be leveraged for 3D real-time imaging.

0751 8:51

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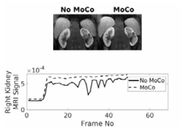


[Pilot Tone Navigated Motion Correction in DCE-MRI]

Cemre Ariyurek[1], Jeanne Chow[1], Onur Afacan[1], and Sila Kurugol[1]

[1]Radiology, Boston Children's Hospital and Harvard Medical School, Boston, MA, United States

Keywords: Motion Correction, DSC & DCE Perfusion, Motion Correction

Motivation: Addressing the challenge of respiratory motion in abdominal DCE-MRI, especially in pediatric patients, to improve image quality and enhance quantitative DCE-MRI analysis.

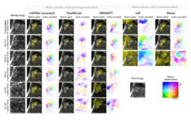
Goal(s): To develop a motion correction method using PilotTone navigators (PTnavs) to enhance DCE-MRI quality and reliability.

Approach: We extract PTnav, create a linear motion model using binning based reference motion parameters. We then apply the motion model to the PTnav for each spoke to estimate its motion and correct for it. We evaluate the method on non-contrast volunteer and pediatric DCE-MRI data.

Results: Successful elimination of motion artifacts and improved image quality, reduced image alignment and improved signal-time-intensity curves.

Impact: The proposed PT-based motion correction effectively overcomes the challenges of previous motion correction methods, eliminating respiratory motion artifacts and enhancing image quality and misalignment in high-temporal-resolution DCE-MRI. This advancement improves diagnostic accuracy, particularly in pediatric cases with unpredictable breathing patterns.

0752 9:03



[Learning non-rigid registration in k-space from highly-accelerated cardiac and respiratory MR data]

Aya Ghoul[1], Kerstin Hammernik[2], Daniel Rueckert[2,3,4], Sergios Gatidis[1,5], and Thomas Küstner[1]

[1]Medical Image And Data Analysis (MIDAS.lab), Department of Diagnostic and Interventional Radiology, University Hospital of Tuebingen, Tuebingen, Germany, [2]School of Computation, Information and Technology, Technical University of Munich, Munich, Germany, [3]Klinikum Rechts der Isar, Technical University of Munich, Munich, Germany, [4]Department of Computing, Imperial College London, London, United Kingdom, [5]Department of Radiology, Stanford University, Stanford, CA, United States

Keywords: Motion Correction, Motion Correction, Image registration, motion estimation, Cardiovascular, Lung, MR-Guided Radiotherapy, motion-compensated reconstruction, Multimodal motion correction

Motivation: Time-resolved motion estimation from accelerated MR data enables high-quality imaging, intra-modality motion correction and real-time tracking during MR-guided radiotherapy. Conventionally, image registration is solved in the image domain and, therefore, remains susceptible to aliasing artifacts for highly-accelerated acquisitions.

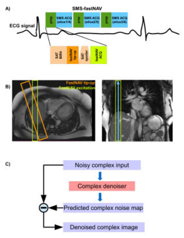
Goal(s): We aim to propose a robust non-rigid image registration framework from highly-accelerated data without additional information.

Approach: We introduce a novel Local-All-Pass Attention Network (LAPANet) that performs accurate motion estimation directly from the acquired k-space.

Results: LAPANet provides reliable estimates for fully-sampled and undersampled data, up to 104-fold for cardiac motion and 148-fold for respiratory motion, and outperforms established image-based registrations in different trajectories.

Impact: Our framework can reliably estimate non-rigid motion from highly-accelerated data without a-priori information. This enables faster acquisition through integration into motion-compensated reconstructions, intra-modality motion correction for other imaging methods and real-time motion characterization and tracking for guided radiotherapy and interventions.

0753 9:15



Free-breathing SMS-bSSFP myocardial perfusion imaging with prospective slice-tracking and AI-based reconstruction

Naledi Lenah Adam[1], Ronald Mooiweer[1,2,3], Andrew Tyler[1], Karl Kunze[1,2], Peter Speier[4], Daniel Stäb[5], Amedeo Chiribiri[1], and Sébastien Roujol[1]

[1]School of Biomedical Engineering and Imaging Sciences, Faculty of Life Sciences and Medicine, King's College London, London, United Kingdom, [2]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [3]MR Physics, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom, [4]Cardiovascular predevelopment, Siemens Healthcare GmbH, Erlangen, Germany, [5]MR Research Collaborations, Siemens Healthcare Limited, Melbourne, Australia

Keywords: Motion Correction, Perfusion, free breathing, myocardial perfusion, simultaneous multi-slice, prospective motion-correction, machine learning/artificial intelligence

Motivation: Simultaneous multi-slice-bSSFP shows promise for myocardial perfusion imaging with high spatial coverage/resolution. Free-breathing acquisitions are desirable but currently result in large through-plane motion.

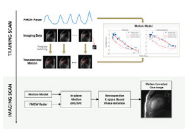
Goal(s): To develop a free-breathing SMS-bSSFP myocardial perfusion technique with high spatial coverage/resolution and prospective through-plane motion correction.

Approach: Prospective slice-tracking using fastNAV was implemented into an SMS-bSSFP perfusion sequence. Image reconstruction used TGRAPPA combined with a deep learning-based complex-value image denoiser. This technique was evaluated in 10 patients undergoing two rest SMS perfusion scans with/without fastNAV.

Results: The proposed approach resulted in significant motion reduction, low noise-level reconstruction, and no degradation of myocardial sharpness.

Impact: This study demonstrates the feasibility of prospective slice tracking in an SMS perfusion sequence. Combined with the proposed deep learning-based reconstruction, it provides a myocardial perfusion protocol with increased spatial coverage, high spatial resolution, and feasible under free-breathing conditions.

0754 9:27



Frequency Modulated Continuous Wave Radar-based respiratory motion correction for cardiac MRI: Initial Results

Jemon Diao[1], Yang Liu[1], Jiayu Zhu[2], Jian Xu[3], Zijian Zhou[1], Haikun Qi[1,4], and Peng Hu[1,4]

[1]ShanghaiTech University, Shanghai, China, [2]United Imaging Healthcare, Shanghai, China, [3]UIH America, Inc., Houston, TX, United States, [4]Shanghai Clinical Research and Trial Center, Shanghai, China

Keywords: Motion Correction, Motion Correction

Motivation: Cardiac MRI is susceptible to motion-induced artifacts because of the sequential data acquisition process.

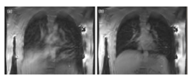
Goal(s): Evaluate the feasibility of utilizing a Frequency Modulated Continuous Wave (FMCW) Radar as a quantitative respiratory motion correction signal for free-breathing cardiac MRI.

Approach: A short calibration scan was performed to establish a motion model relating the FMCW Radar signal to the respiratory-induced heart motion. The established model was then applied during the imaging scan to perform retrospective motion correction for each k-space readout line.

Results: The FMCW radar showed good correlation to the respiratory-induced heart motion, and the proposed method effectively improved the image quality.

Impact: This study demonstrated the feasibility of utilizing FMCW radar as a surrogate to accomplish motion correction in free-breathing cardiac MRI.

0755 9:39



Respiratory Triggered MRI using an NMR-on-a-chip Sensor

Fabian Bschorr[1], Thomas Hüfken[1], Tobias Lobmeyer[1], Frederik Dreyer[2], Jianyu Zhao[2], Jens Anders[2], and Volker Rasche[1]

[1]Internal Medicine II, Ulm University Medical Center, Ulm, Germany, [2]Institute of Smart Sensors, University of Stuttgart, Stuttgart, Germany

Keywords: Motion Correction, Motion Correction

Motivation: We propose an NMR-on-a-chip sensor as contactless und hysteresis-free alternative for conventional respiratory belts in respiratory-triggered MRI.

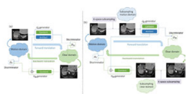
Goal(s): The objective of this work was to demonstrate the feasibility of a local field probe for monitoring respiratory motion induced magnetic field changes as respiratory motion surrogate.

Approach: Respiratory belt and field probe signal were recorded simultaneously clearly showing the accurate identification of the respiratory stage by the field probe.

Results: The field probe signal was analysed and fed back to the MR scanner in real-time for proofing its applicability for triggered lung MRI, yielding a sharp lung-liver interface compared with the non-triggered version.

Impact: The feasibility of NMR-on-a-chip sensors for monitoring physiologically-induced magnetic field variations is shown. They enable contactless, hysteresis-free and easy-to-use monitoring of physiologically-induced field variations, which can be fed back to the scanner for real-time respiratory motion monitoring and triggering.

0756 9:51



Motion Correction with Combination of Disentangled Cycle-GAN and k-space Subsampling for the gadoxetic acid-enhanced liver MRI

Gang Chen[1,2], Xinglong Rao[1], Martins Otikovs[3], Yang Lian[4], Peng Sun[5], Xin Zhou[1,2,6], Chaoyang Liu[1,2,6], and Qingjia Bao[1,2]

[1]State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, Wuhan, China, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Weizmann Institute of Science, Rehovot, Israel, [4]Department of Radiology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [5]Clinical & Technical Support, Philips Healthcare, Beijing, China, [6]Optics Valley Laboratory, Hubei, China

Keywords: Motion Correction, Motion Correction

Motivation: The gadoxetic acid-enhanced liver MRI is often accompanied by significant motion artifacts due to drug side effects.

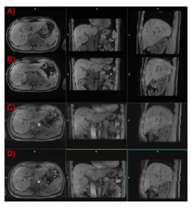
Goal(s): Motion correction by integrating Disentangled Cycle-GAN with the k-space Subsampling (DCGAN-kS) method.

Approach: Convert motion correction to the image domain transfer problem resolved by DCGAN with the aid of the k-space subsampling strategy for reducing features and simplifying the domain transfer problem.

Results: The method can effectively remove artifacts for the arterial phase imaging of the gadoxetic acid-enhanced liver MRI.

Impact: The proposed scheme outperforms the other state-of-the-art methods for motion correction in the gadoxetic acid-enhanced liver MRI, which could enhance the image quality and reduce failed scanning.

0757 10:03 High resolution 3D isotropic non-rigid motion compensated T1 Dixon of Liver at a hybrid PET-MR scanner



Jake Penney[1,2], Khalid Ambarki[1], Aurélien Monnet[1], Hatem Necib[3,4], Valérie Vilgrain[5,6], Karl-Philipp Kunze[7,8], René Michael Botnar[7,9], Claudia Prieto[7,9], and Ralph Sinkus[2,7]

[1]Siemens Healthcare France, Courbevoie, France, [2]INSERM U1148 Laboratory for vascular translational science, Paris, France, [3]CHU de Nantes, Nantes, France, [4]UMR_S 1307 Centre de Recherche en Cancérologie et Immunologie Intégrée Nantes Angers, Nantes, France, [5]Hôpital Beaujon AP-HP, Clichy, France, [6]INSERM U1149 Centre de Recherche sur l'Inflammation, Paris, France, [7]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [8]MR Research Collaborations, Siemens Healthcare GmbH, Frimley, United Kingdom, [9]Escuela de Ingeniería, Pontificia Universidad Católica de Chile, Santiago, Chile

Keywords: Motion Correction, Motion Correction, MRI, PET-MRI, liver, navigator, HCC, cancer, free-breathing MRI

Motivation: In current clinical practice, liver MRI scans often suffer from motion artifacts. This issue typically arises because patients struggle to maintain breath-holding.

Goal(s): Our goal is to produce a high-quality, isotropic 3D Dixon T1 scan without the need for breath-holding.

Approach: . Our method involves using a navigator to estimate liver motion, enabling us to calculate non-rigid motion fields for image reconstruction

Results: This approach yields high-quality free-breathing isotropic T1 3D Dixon liver data with a voxel size of 1.3mm³, surpassing the quality of the gold standard non-isotropic breath-hold Dixon T1 liver scan.

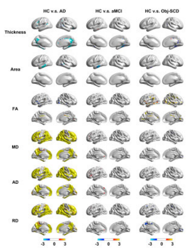
Impact: This work aims to deliver previously unseen high-quality free-breathing isotropic 3D Dixon liver data that can surpass the current clinical standard breath-hold non-isotropic T1 3D Dixon liver scans.

Oral

AD Imaging: From Early Detection to Treatment Follow-Up

Nicoll 1 | Wednesday 8:15 - 10:15 | *Moderators:* Suchandrima Banerjee & Leonardo Rivera Rivera

0758 8:15 Exploring Preclinical Imaging Biomarkers and Progressive Degeneration in Alzheimer's Disease



Yu-Chen Liu[1], Chu-Chung Huang[2], Ching-Po Lin[3,4], and Chun-Yi Zac Lo[5,6]

[1]Fudan University, shanghai, China, [2]East China Normal University, Shanghai, China, [3]Institute of Neuroscience, National Yang Ming Chiao Tung University, Taipei, Taiwan, [4]Department of Education and Research, Taipei City Hospital, Taipei, Taiwan, [5]Institute of Science and Technology for Brain-Inspired Intelligence, Fudan University, Shanghai, China, [6]Department of Biomedical Engineering, Chung Yuan Christian University, Taoyuan, Taiwan

Keywords: Alzheimer's Disease, Alzheimer's Disease

Motivation: Preclinical stages of AD offer potential windows for intervention. Investigating individuals in this stages can yield valuable biomarkers and deepen our understanding of disease progression mechanisms.

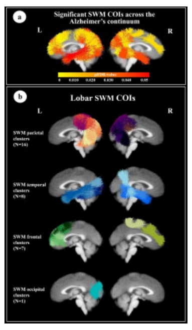
Goal(s): We aim to investigate brain degeneration mechanisms during AD's preclinical stages and explore early diagnostic markers in gray matter and superficial white matter alterations.

Approach: This study involved 411 participants (including preclinal stages, aMCI and AD) and their diffusion and structural MRI and neuropsychological tests, to assess brain changes.

Results: Cortical atrophy in the temporal lobe may be a trigger for disease onset, while extensive SWM degeneration appears to be associated with disease progression in AD.

Impact: This study provides crucial insights into brain changes in early stages of AD. Identified imaging biomarkers are valuable for early diagnosis and interventions, and the proposed degeneration patterns enhance our understanding of AD's pathophysiology.

0759 8:27



Alterations in superficial white matter tracts are associated with pathological deposition in early-stage Alzheimer's disease

Shuyue Wang[1], Fan Zhang[2], Qingze Zeng[1], Hui Hong[1], Yeerfan Jiaken[1], Xinfeng Yu[1], Xiao Luo[1], Kaicheng Li[1], Xiaopei Xu[1], Peiyu Huang[1], Jianzhong Sun[1], Minming Zhang[1], and Lauren J. O'Donnell[3]

[1]The Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China, [2]University of Electronic Science and Technology of China, Chengdu, China, [3]Harvard Medical School, Boston, MA, United States

Keywords: Alzheimer's Disease, Brain, diffusion magnetic resonance imaging, superficial white matter

Motivation: Between-cortical connections largely depend on the superficial white matter (SWM) fibers, which are less studied in the AD continuum.

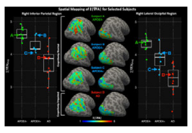
Goal(s): To determine the relationship between superficial white matter (SWM) fiber microstructure and local pathology, and the SWM's impact on cognition.

Approach: We defined cohort groups in the early AD continuum. We quantified the microstructure of SWM fiber tracts (diffusion MRI) and the regional pathological deposition (PET). We analyzed associations between SWM fiber microstructure and regional pathologies in cortical areas connected by the tract.

Results: SWM tract microstructure is affected by pathology in the cortical regions connected by the tract, and this affects memory.

Impact: We localize pathology-affected SWM connections, assess their roles in cognition, and provide new insights into white matter abnormalities in the AD continuum.

0760 8:39



High-Resolution DTI Cortical Column Analysis for Early Detection of Alzheimer's Disease in High-Risk Pre-Symptomatic Subjects

Devon K. Overson[1,2], Trong-Kha Truong[1,2,3], Yixin Ma[4], David J. Madden[1,5], Jeffrey R. Petrella[1,2,3], and Allen W. Song[1,2,3]

[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States, [2]Medical Physics Graduate Program, Duke University, Durham, NC, United States, [3]Department of Radiology, Duke University, Durham, NC, United States, [4]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States, [5]Department of Psychiatry and Behavior Sciences, Duke University, Durham, NC, United States

Keywords: Alzheimer's Disease, Gray Matter, Microstructure, Cortical Column, APOE4

Motivation: Microstructural changes in cortical gray matter, occurring potentially well before cognitive decline in Alzheimer's disease (AD), could serve as an early diagnosis biomarker.

Goal(s): We use high-resolution diffusion tensor imaging to identify such changes among AD subjects, cognitively normal but high-risk (APOE4+) subjects, and healthy controls (APOE4-).

Approach: The variation in fractional anisotropy along cortical columns was analyzed within 68 regions.

Results: 20 regions exhibited a lower variation in the high-risk group compared to the control group. The AD risks of individual high-risk subjects could be further differentiated based on similarities and differences with the AD or control groups.

Impact: Our cortical column-based analysis of high-resolution diffusion tensor imaging data can detect microstructural changes within specific cortical regions of pre-symptomatic subjects with high risk for Alzheimer's disease, potentially providing a more definitive biomarker for its early diagnosis and treatment.

0761 8:51

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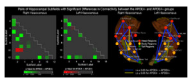


Intra-Hippocampal Connectivity Differences in Cognitively Normal Subjects with/without Genetic Risk for Alzheimer's Disease

Devon K. Overson[1,2], Sasha Hakhu[3], Scott C. Beeman[3], Allen W. Song[1,2], and Trong-Kha Truong[1,2]

[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States, [2]Medical Physics Graduate Program, Duke University, Durham, NC, United States, [3]School of Biological and Health Systems Engineering, Arizona State University, Tempe, AZ, United States

Keywords: Structural Connectivity, Brain Connectivity, Hippocampus, APOE4, Streamlines

Motivation: Microstructural changes within the hippocampus, which may occur well before cognitive decline in Alzheimer's disease (AD), could serve as an early diagnosis biomarker in pre-symptomatic subjects.

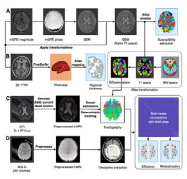
Goal(s): We assessed differences in intra-hippocampal connectivity between cognitively normal carriers and non-carriers of the APOE4 allele, a genetic risk factor for AD.

Approach: We segmented the hippocampus into 12 subfields per hemisphere and performed fiber tractography on multi-shell diffusion tensor imaging data to determine the number of streamlines connecting each subfield pair.

Results: 22 subfield pairs had a significantly lower connectivity in the APOE4 carrier group compared to the APOE4 non-carrier group.

Impact: Our analysis shows differences in intra-hippocampal connectivity between cognitively normal subjects with and without a genetic risk factor for Alzheimer's disease, which could potentially serve as a more definitive biomarker for its early diagnosis and treatment in pre-symptomatic subjects.

0762 9:03



Associations of quantitative susceptibility mapping with cortical atrophy and brain connectome in Alzheimer's disease: a multi-modal study

Aocai Yang[1] and Guolin Ma[2]

[1]Department of Radiology, China–Japan Friendship Hospital, Beijing, China, [2]China–Japan Friendship Hospital, Beijing, China

Keywords: Alzheimer's Disease, Alzheimer's Disease

Motivation: Associations between abnormal quantitative susceptibility mapping (QSM), brain atrophy, and altered brain connectome in AD remain unclear.

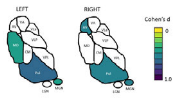
Goal(s): We aim to examine imaging markers from various MRI modalities, with a focus on their spatial correlations, to enhance our understanding of AD pathology.

Approach: By combining multi-contrast MRI techniques, our study provides new insights into the overlapping relationships among brain atrophy, altered regional QSM, and brain connectome.

Results: We observed a remarkable overlap between reduced cortical thickness and abnormal QSM in seven distinct brain regions. In AD patients, we identified specific regional correlations between cortical thickness and network topology from these overlapping brain regions.

Impact: Our study provides new insights into the complex relationships among iron accumulation, brain atrophy, and brain connectome in Alzheimer's disease.

0763 9:15



[Thalamic nuclei atrophy in autosomal dominant Alzheimer's disease]

Manojkumar Saranathan[1], Elizabeth Kaplan[2], Michael Hornberger[3], Ana Baena[4], Diana Munera[2], Justin Sanchez[2], Stephanie Langella[2], Francisco Lopera[4], and Yakeel Quiroz[5]

[1]Radiology, University of Massachusetts Chan Medical School, Worcester, MA, United States, [2]MGH, Harvard Medical School, Charlestown, MA, United States, [3]Norwich Medical School, University of East Anglia, East Anglia, United Kingdom, [4]Neurociencias, Universidad de Antioquia, Medellin, Colombia, [5]Psychiatry, MGH, Harvard Medical School, Charlestown, MA, United States

Keywords: Alzheimer's Disease, Alzheimer's Disease, thalamic nuclei segmentation

Motivation: The thalamus has not been investigated properly in autosomal dominant Alzheimer's disease (ADAD) despite evidence of early involvement.

Goal(s): We investigated thalamic nuclei atrophy in asymptomatic presenilin carriers vs. non-carriers in an ADAD cohort using a recently proposed multi-atlas segmentation method.

Approach: Thalamic nuclear atrophy and correlations of nuclei volumes with age, amyloid, and tau burden were analyzed in mutation carriers vs. non-carriers in an ADAD cohort.

Results: Significant atrophy was seen in mediodorsal, pulvinar, and medial geniculate nuclei in carriers compared to non-carriers. These nuclear volumes correlated significantly with age, amyloid, and tau burden as well.

Impact: The pattern of thalamic nuclear atrophy in ADAD presenilin mutation carriers can help understand mechanisms for disease progression as well as aid in possible treatment targets.

0764 9:27

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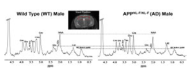

[Sex Specific metabolism of Branched Chain Amino Acids and Relation with Cerebral Glutamate in Alzheimer's Disease: A 1H-MRS Study]

Narayan Datt Soni[1], Anshuman Swain[1], Halvor Juul[1], and Ravinder Reddy[1]

[1]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

Keywords: Alzheimer's Disease, Alzheimer's Disease, 1H MRS, BCAAs, Glutamate

Motivation: Amyloid-β and NFTs are considered hallmarks of Alzheimer's disease (AD) though are often challenged. While branched chain amino acids (BCAA) are known to play role in AD pathogenesis, their role is underexplored. A non-invasive method to study this relation could benefit devising alternate strategies for early AD diagnosis.

Goal(s): To monitor sex-specific changes in BCAA levels and its relationship with glutamate.

Approach: Localized-^{1}H-MRS was performed in AD and WT mice.

Results: Significant reduction in hippocampal BCAA and glutamate levels in male AD mice were observed, while females remained unaffected. BCAA and glutamate levels shown a strong correlation suggesting their close association in AD.

Impact: Establishing a relation between BCAA metabolism and AD pathology could be beneficial for preclinical diagnosis as clear resonances of BCAA around 0.9 ppm on 1H MR spectra is achievable even at lower field strength MRI scanners.

0765 | 9:39

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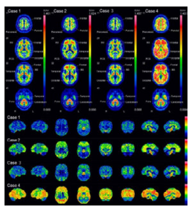


Automated VOI analysis of amyloid PET-MRI

Yasutaka Fushimi[1], Satoshi Nakajima[1], Sachi Okuchi[1], Akihiko Sakata[1], Sayo Otani[1], Azusa Sakurama[1], Hiroshi Tagawa[1], Yang Wang[1], Satoshi Ikeda[1], Shuichi Ito[1], Masaaki Umehana[1], Yongping Ma[1], Katsuhiko Mitsumoto[2], Manabu Kubota[3], Atsushi Shima[4], Nobukatsu Sawamoto[5], and Yuji Nakamoto[1]

[1]Department of Diagnostic Imaging and Nuclear Medicine, Kyoto University Graduate School of Medicine, Kyoto, Japan, [2]Department of Clinical Radiology Service, Kyoto University Hospital, Kyoto, Japan, [3]Department of Psychiatry, Kyoto University Graduate School of Medicine, Kyoto, Japan, [4]Department of Regenerative Systems Neuroscience, Human Brain Research Center, Kyoto University Graduate School of Medicine, Kyoto, Japan, [5]Department of Human Health Sciences, Kyoto University Graduate School of Medicine, Kyoto, Japan

Keywords: Software Tools, PET/MR, Amyloid

Motivation: Automated analysis of amyloid PET becomes available, however, these results have not been well analyzed on PET/MRI.

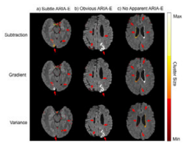
Goal(s): To compare the reference regions and VOIs associated with amyloid positivity between the software and Centiloid project on Amyloid PET/MRI.

Approach: We analyzed Amyloid PET/MRI data of 84 subjects automatically and values, SUVr, Centiloid scale were compared.

Results: The reference VOIs and VOIs associated with amyloid positivity showed good correlation between the software and Centiloid project.

Impact: The values obtained with the automated software on amyloid PET/MRI can be utilized with the other quantitative MR data, which may lead to comprehensive analysis of amyloid deposition.

0766 | 9:51



Temporal Dynamics of ARIA-E: Quantifying Longitudinal Changes in Amyloid-Related Imaging Abnormalities

Ela Kanani[1], Elizabeth Powell[1], Daniel C. Alexander[1], Frederik Barkhof[1,2,3,4], Millie Beament[2], Nick Fox[2], Ian Malone[2], Catherine Mummery[2], Miguel Rosa-Grilo[2], David Thomas[2], and Geoff J.M. Parker[1,2,4,5]

[1]Centre For Medical Image Computing, Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]Dementia Research Centre (DRC), Queen Square Institute of Neurology, University College London, London, United Kingdom, [3]Department of Radiology and Nuclear Medicine, Amsterdam UMC, Amsterdam, Netherlands, [4]Queen Square Analytics, London, United Kingdom, [5]Bioxydyn Limited, Manchester, United Kingdom

Keywords: Data Processing, Alzheimer's Disease, Amyloid Related Imaging Abnormalities

Motivation: Using anti-amyloid monoclonal antibodies to treat Alzheimer's disease (AD) can lead to 'Amyloid-Related Imaging Abnormalities' (ARIA), indicative of oedema (ARIA-E). ARIA-E's transient nature poses diagnostic challenges, necessitating efficient detection and monitoring, which is critical for drug development for AD.

Goal(s): This study aims to develop methods for quantifying and tracking ARIA-E across multiple longitudinal scans, including subtle manifestations.

Approach: Temporal variance and gradient maps were computed using serial ultra-rapid 3D FLAIR scans. Data-driven methods were employed to assess statistical significance of changes.

Results: The proposed maps highlight significant regions of change in the presence of varying levels of ARIA-E.

Impact: This work has facilitated the tracking of statistically significant ARIA-E over multiple serial scans, which will enable further automatic detection methods. These methods may inform dose adjustment and patient safety measures, which is important as anti-amyloid monoclonal antibodies become commonplace.

10:03

Discussion

Suchandrima Banerjee

GE Healthcare, United States

Oral

Close to the Bone: Osteology & Soft Tissues

Nicoll 2 | Wednesday 8:15 - 10:15 | *Moderators:* Jung-Ah Choi & Catherine muchuki

8:15

Introduction

Jung-Ah Choi

Hallym University Dongtan Sacred Heart Hospital, Korea, Republic of

0767 8:27

Comprehensive evaluation of wrist kinematics using 3D real-time MRI

Ye Tian[1], Abhijit J. Chaudhari[2], and Krishna S. Nayak[1]

[1]Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States, [2]Department of Radiology, University of California Davis, Davis, CA, United States

Keywords: Functional/Dynamic, MSK, wrist, low-field, real-time

Motivation: A thorough understanding of wrist kinematics and kinetics is essential for diagnosing and treating wrist pain and instability. Current MRI methods are limited to tracking just a few thick slices and therefore use hand supports to restrict motion to pre-selected, simplified orientations.

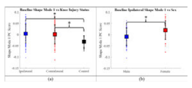
Goal(s): To develop a 3D real-time MRI method at 0.55T for comprehensive evaluation of wrist kinematics.

Approach: A bSSFP 3D stack-of-spiral sequence with long spiral readout was implemented for evaluating wrist kinematics during maneuvers.

Results: Comprehensive 3D coverage at 10 frames/second was achieved without any restriction on wrist motion, providing measurements of ligament intervals in 3D and during active wrist motion.

Impact: The proposed 3D real-time method can potentially improve diagnosis of wrist injury and dysfunction and treatment planning, by providing a unique 3D evaluation of wrist kinematics and kinetics during the performance of clinically-important maneuvers involved in activities of daily living.

0768 8:39



Patella Shape is Associated with ACL Injury and Changes in KOOS and T1rho Following ACLR

James R Peters[1], Nancy Obuchowski[1], Naveen Subhas[1], Valentina Pedoia[2], Sharmila Majumdar[2], Hollis Potter[3], Matthew Koff[3], Kimberly Amrami[4], Cale Jacobs[5], Carl Winalski[1], Kurt R Spindler[1], and Xiaojuan Li[1]

[1]The Cleveland Clinic Foundation, Cleveland, OH, United States, [2]University of California, San Francisco, San Francisco, CA, United States, [3]Hospital for Special Surgery, New York, NY, United States, [4]Mayo Clinic, Rochester, MN, United States, [5]Brigham and Women's Hospital, Boston, MA, United States

Keywords: Osteoarthritis, Bone, Patella, Shape, ACL, PTOA

Motivation: PTOA progression is poorly understood and there is a relative dearth of data available on the impact of the patellofemoral joint on PTOA.

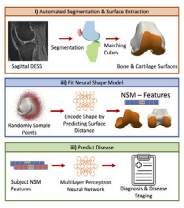
Goal(s): The goal of this study was to elucidate the relationship between PTOA, knee function, and patella shape and to investigate possible indicators for PTOA progression.

Approach: A shape model of the patella was used to explore longitudinal shape changes and associations with injury, sex, KOOS, and cartilage T1rho in 67 patients following ALR and 11 controls.

Results: Ipsilateral patella shape was found to be associated with ACL injury, sex, and the degenerative changes accompanying PTOA.

Impact: This study suggests patella shape may play a role in ACL injury and PTOA. These results should inform future biomechanical studies of the knee joint which could lead to the development of preventative orthoses and novel interventions.

0769 8:51



Neural Shape Models Meaningfully Localize Features Relevant to Osteoarthritis Disease: Data from the Osteoarthritis Initiative

Anthony A Gatti[1], Louis Blankemeier[1], Dave Van Veen[1], Brian A Hargreaves[1], Scott L Delp[1], Feliks Kogan[1], Garry E Gold[1], and Akshay S Chaudhari[1]

[1]Stanford University, Stanford, CA, United States

Keywords: Osteoarthritis, MSK, shape model, MOAKS, osteophytes

Motivation: Osteoarthritis is a whole joint disease that requires quantification, localization, and visualization of disease related features of bones and cartilage.

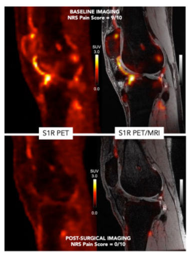
Goal(s): To develop a novel neural shape model (NSM) that can encode and reconstruct bone and cartilage shape, while quantifying localized features of OA.

Approach: We trained a NSM on 6,325 knees and compared its reconstructions to a conventional statistical shape model and its ability to predict localized disease to a convolutional neural network.

Results: The NSM reconstructed tissues with cartilage thickness correlations >0.993. NSM representations accurately diagnosed OA and predicted localized severity of osteophytes and cartilage defects better than a CNN.

Impact: Our NSM can reconstruct whole bone and cartilage morphology, while encoding localized pathology specific information. Research use of the NSM can unlock novel insights into OA pathophysiology. Clinical deployment would enable automated insights into whole joint health.

0770 9:03



Sigma-1 receptor changes in chronic knee pain using PET/MRI: Preliminary results of fifteen patients

Rianne A van der Heijden[1], Luke Yoon[2], Paul Yoon[2], Guido Davidson[2], and Sandip Biswal[1]

[1]University of Wisconsin-Madison, Madison, WI, United States, [2]Radiology, Stanford University School of Medicine, Stanford, CA, United States

Keywords: Whole Joint, Molecular Imaging, Knee, Pain

Motivation: Diagnosis of chronic knee pain remains a challenge with conventional diagnostic methods leading to unsatisfactory treatment in a large group of patients.

Goal(s): To investigate the use of sigma-1 receptor (S1R) radioligand, $[^{18}F]$ FTC-146 in conjunction with positron emission tomography/magnetic resonance imaging (PET/MRI) for identifying the pain generator in chronic knee pain.

Approach: Comparison of $[^{18}F]$ FTC-146 PET-MRI imaging findings in patients with unresolved chronic knee pain to healthy volunteers.

Results: All 15 patients showed statistically significant increased uptake of S1R compared to healthy control subjects in a variety of locations. At sites of abnormal PET uptake, MRI often did not demonstrate abnormalities.

Impact: Future clinical implementation of S1R-PET/MR can potentially help reveal previously unidentified pain generator in patients with chronic knee pain that have exhausted standard clinical care leading to better-targeted treatment.

0771 9:15

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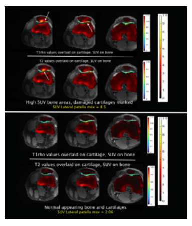

[Bone Metabolic-Morphologic relation is Mediated by Gait; Cartilage Compositional-Morphologic relation isn't: PET/MRI in Isolated PFJOA]

Rupsa Bhattacharjee[1], Eric Hammond[2], Chotigar Ngarmsrikam[1], Fei Jiang[3], Misung Han[1], Richard B Souza[1,2], Valentina Pedoia[1,4], and Sharmila Majumdar[1]

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Keywords: Cartilage, PET/MR

Motivation: Whether the compositional, metabolic, and biomechanical relationships have a mediated effect on one another is the next crucial step toward decoding the isolated PFJOA mechanism.

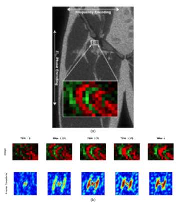
Goal(s): To investigate whether the relationship of morphological-joint-degradation with SUV-values from ^{18}NaF-PET and cartilage-T_2 in isolated-PFJOA are mediated by gait-biomechanics.

Approach: Linear regression was performed between (i)$WORMS_{BME}$(predictor) vs. Medial-SUV_{max}, Lateral-SUV_{max} (outcomes), and (ii) $WORMS_{Cartilage}$(predictor) vs. Mean-$T_{2\text{-Deep-Medial}}$, $T_{2\text{-Superficial-Medial}}$, $T_{2\text{-Deep-Lateral}}$, $T_{2\text{-Superficial-Lateral}}$ (outcomes) patellar and trochlear. For significant correlations, mediation analyses were done to examine the role of Normalized-Mean-Peak $vGRF_{IP}$ as a mediator.

Results: $WORMS_{BME}$ vs. Medial-SUV_{max}, Lateral-SUV_{max} relationships are mediated by gait; $WORMS_{Cartilage}$ vs. Mean-$T_{2\text{-Deep-Medial}}$, $T_{2\text{-Superficial-Medial}}$, $T_{2\text{-Deep-Lateral}}$, $T_{2\text{-Superficial-Lateral}}$ aren't mediated.

Impact: This is the first step towards understanding the flow of causalities and mediated interrelationships of bone remodeling (SUV), morphological degradation (WORMS), cartilage loss (T_2), and gait biomechanics in a complex joint developing isolated PFJOA

0772 9:27



[Ripple Artifact Quantification in Slice Encoding for Metal Artifact Correction (SEMAC) using MR Bloch Simulation]

Jonas Wahlen [1,2], Sebastian Kozerke[2], Daniel Nanz[1], Reto Sutter[3], and Constantin von Deuster[1,4]

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Keywords: Other Musculoskeletal, Artifacts, Bloch Simulator, Metal Artifacts, Implant

Motivation: Commonly used methods for the quantification of metal-induced image artifacts, such as measuring the extent of signal voids, do not capture spatial frequencies of ripple artifacts, as seen in dedicated metal artifact reduction sequences including SEMAC or MAVRIC.

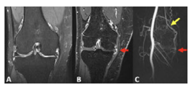
Goal(s): To propose a new method for the quantification of SEMAC ripple artifacts which may serve as quality metric for sequence optimizations.

Approach: We applied a k-space-based metric to MR Bloch simulations of SEMAC sequences with variable slice thicknesses and RF pulse shapes (time-bandwidth product, TBW).

Results: A trend towards higher absolute artifact intensity and lower spatial frequency can be observed for higher TBWs.

Impact: The proposed metal artifact metric extends current quantification methods by taking the spatial frequency distribution of ripple artifacts into account. This may serve as a basis for metal artifact reduction sequence optimization, with a particular focus on RF pulse parameters.

0773 9:39



Joint Embolization: Feasibility of Targeted Treatment and Response Assessment in the Shoulder, Hip and Knee Using Dynamic Contrast-Enhanced MRI

Eric M Bultman[1], Lisa Mandl[2], and Sirish Kishore[1]

[1]Radiology, Stanford University, Palo Alto, CA, United States, [2]Rheumatology, Weill Cornell Medical College, New York, NY, United States

Keywords: Osteoarthritis, Perfusion, Embolization

Motivation: Embolization, a new treatment for chronic joint pain, may be more clinically effective when treatment is targeted using pre-procedural dynamic contrast-enhanced (DCE)-MRI.

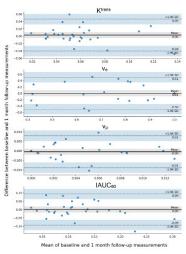
Goal(s): Assess presence of synovitis and identify culprit arterial vessels using pre-procedural DCE-MRI.

Approach: Representative patients with mild-moderate osteoarthritis of the shoulder, hip and knee underwent fat-suppressed DCE-MRI using CDT-VIBE. Imaging was performed with high temporal (6-7 sec/frame) and spatial (0.6 mm isotropic interpolated) resolution with 3-minute acquisition and 5cc/sec contrast injection.

Results: DCE-MRI readily identifies regions of synovitis and its contributory arterial vessels. By exploiting contrast kinetics whole-joint synovial volumes can be semi-automatically calculated.

Impact: MRI-targeted joint embolization therapy has the potential to result in improved pain and functional outcomes with reduced side effects. Rapid calculation of whole-joint synovial volumes may enable their use as a biomarker of arthritis severity and embolization treatment response.

0774 9:51



Dynamic contrast-enhanced MRI of the synovium and synovial subregions in knee osteoarthritis

Jacob Marijn Mostert[1], Tijmen A. van Zadelhoff[1], Dirk H.J. Poot[1], Edwin H.G. Oei[1], and Rianne A. van der Heijden[1,2]

[1]Radiology & Nuclear Medicine, Erasmus MC, Rotterdam, Netherlands, [2]Radiology, University of Wisconsin Madison, Madison, WI, United States

Keywords: Osteoarthritis, DSC & DCE Perfusion, Synovium

Motivation: A precise method to quantify the degree of synovial inflammation in patients with knee osteoarthritis (OA) is needed to evaluate response to new disease modifying treatments in clinical trials.

Goal(s): To evaluate the repeatability of quantitative dynamic contrast enhanced (DCE) MRI derived biomarkers for synovitis quantification in the whole synovium and synovial subregions.

Approach: Test-retest study comprising DCE-MRI at baseline and 1 month follow-up in knee OA patients. Vessel mapping was used to determine synovial subregions.

Results: DCE-MRI biomarkers have good test-retest repeatability in both the whole synovium and synovial subregions, with Ktrans showing the best performance.

Impact: Quantitative DCE-MRI can provide precise biomarkers for synovitis quantification in knee osteoarthritis. Subregional evaluation using vessel mapping is an important tool for more precise treatment response evaluation in clinical trials with targeted local interventions, such as selective arterial embolization.

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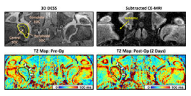


Temporal response of T2 and adiabatic T1ρ and T2ρ relaxation times to acute ischemic injury to the femoral head: an in vivo piglet model study

Casey P. Johnson[1,2], Erick O. Buko[1,2], Suhail Parvaze[1,2], Douglas Albrecht[1], Alaina L. Falck[1], Alexandra R. Armstrong[1], Jennifer C. Laine[3,4], and Ferenc Toth[1]

[1]Department of Veterinary Clinical Sciences, University of Minnesota, Saint Paul, MN, United States, [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [3]Gillette Children's Specialty Healthcare, Saint Paul, MN, United States, [4]Department of Orthopedic Surgery, University of Minnesota, Minneapolis, MN, United States

Keywords: Bone, Ischemia

Motivation: Relaxation time mapping may be clinically useful to inform the severity of ischemic injury to bone marrow in osteonecrosis of the femoral head.

Goal(s): To compare the temporal response of T2, adiabatic T1ρ, and adiabatic T2ρ mapping to acute ischemic injury to the femoral head.

Approach: 24 piglets were imaged using 3D relaxation time mapping at 3T MRI before and after surgical induction of unilateral femoral head ischemia. Corresponding cellular changes were evaluated histologically.

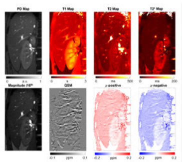
Results: T2 and adiabatic T2ρ were the most sensitive in detecting acute injury to the femoral head, as early as 24 hours after onset of ischemia.

Impact: T2 and/or adiabatic T2ρ relaxation time mapping can potentially address a clinical need for a non-contrast-enhanced imaging technique to establish the severity and extent of bone marrow necrosis in the earliest stages of osteonecrosis of the femoral head.

Oral
Urinary Disturbance

Nicoll 3 | Wednesday 8:15 - 10:15 | *Moderators:* Yuki Arita & Wen-Chau Wu

0776 8:15



Simultaneous Multiparametric Quantitative MRI for Abdominal Imaging in a Single Breath-hold with MRF-EPTI

Di Cui[1], Zhen J Wang[1], Yan Li[1], Duan Xu[1], Peder E.Z. Larson[1], and Xiaoxi Liu[1]

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

Keywords: Kidney, New Trajectories & Spatial Encoding Methods, Abdomen

Motivation: Multiparametric mapping is essential in the assessment of renal physiology and physiopathology, while the conventional quantitative MR methods requires long acquisition time and multiple breath-hold periods.

Goal(s): To develop an efficient simultaneous multiparametric quantification method for abdomen imaging.

Approach: MRF-EPTI technique was applied for quantitative abdomen imaging. The repeatability was evaluated by in-vivo scans on two healthy volunteers. Motion sensitivity was evaluated with/without breath-hold.

Results: Simultaneous multiparametric quantification of T_1, T_2, T_2*, proton density and quantitative susceptibility mapping including susceptibility source separation for abdominal imaging was achieved in a single breath-hold time (16s).

Impact: We acquired simultaneous multiparametric quantification of T1, T2, T2*, proton density and quantitative susceptibility mapping including susceptibility source separation, and generated high-quality multi-contrast synthetic images for abdominal imaging in a single breath-hold with MRF-EPTI technique.

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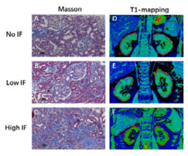

Native T1-mapping as a Predictor of Progressive Renal Function Decline in Chronic Kidney Disease Patients

Zhaoyu Shi[1], Chen Sun[1], Fei Zhou[1], Jianlei Yuan[1], Minyue Chen[1], Xinyu Wang[2], Xinquan Wang[1], Dmytro Pylypenko[3], and Li Yuan[1]

[1]Affiliated Hospital of Nantong University, Nantong, China, [2]Nantong University Medical School, Nantong, China, [3]GE Healthcare, Beijing, China

Keywords: Kidney, Kidney

Motivation: Chronic kidney disease (CKD) is recognized as a global public health problem. Thus, there is a pressing need for a non-invasive method to predicting the evolution of CKD.

Goal(s): This study aimed to investigate the potential of Native T1-mapping in predicting the prognosis of patients with CKD.

Approach: In our study of 119 CKD patients, there was a statistically significant difference in prognosis between the high and low T1 groups in terms of the occurrence of kidney endpoint events.

Results: Native T1-mapping has the potential to significantly improve the identification of CKD patients with a higher risk of progressing to end-stage renal disease.

Impact: CKD is increasingly recognized as a global public health problem. Traditional examination methods, such as renal biopsy, have many limitations. Therefore, we need to find a non-invasive, alternative method to evaluate the prognosis of CKD.

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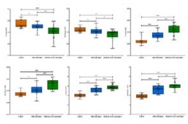

Noninvasive assessment of renal function and pathology of CKD using amide proton transfer weighted imaging and diffusion kurtosis imaging

Guanjie Yuan[1], Zhouyan Liao[1], Ping Liang[1], Ting Yin[2], Wei Chen[2], Chuou Xu[1], and Zhen Li[1]

[1]Department of Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, [2]MR Research Collaborations, Siemens Healthineers Ltd., Shanghai, China

Keywords: Kidney, Kidney, Amide Proton Transfer; Diffusion kurtosis imaging; Chronic kidney disease; Renal function; Renal pathology

Motivation: To explore a noninvasive and sensitive method for detecting the renal insufficiency and pathological abnormality of chronic kidney disease (CKD).

Goal(s): To investigate the potential of amide proton transfer-weighted imaging (APTWI) and diffusion kurtosis imaging (DKI) as viable tools for assessing renal function and pathology of CKD.

Approach: To analyze the differences and diagnostic performances of MRI metrics between different renal dysfunction and pathological injury groups.

Results: Both APTWI and DKI can be feasible tools for the noninvasive assessment of renal functional and pathological changes associated with CKD. APT exhibits superior diagnostic efficacy than MD in detecting early renal dysfunction and pathological abnormalities.

Impact: The study suggests that APTWI and DKI provide valuable information regarding the renal function and pathology, which has great significance in guiding risk stratification and longitudinal follow-up of CKD.

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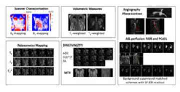


The Application of FunctIonal Renal MRI to improve assessment of Chronic Kidney Disease (AFiRM) Study

Susan T Francis[1], Charlotte E Buchanan[1], Alexander J Daniel[1], David M Morris[2], Andrew Priest [3], Kevin Teh[4], David Thomas[5,6,7], Mark Gilthorpe[8], Philip Kalra[9], Iosif Mendichovszky[10], Maarten Taal[11], Steven Sourbron[4], Nicholas Selby[11], and On behalf of the AFiRM investigators[12]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Centre for Cardiovascular Science, University of Edinburgh, Edinburgh, United Kingdom, [3]Department of Radiology, University of Cambridge, Cambridge, United Kingdom, [4]Department of Infection, Immunity and Cardiovascular Disease, University of Sheffield, Sheffield, United Kingdom, [5]Neuroradiological Academic Unit, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [6]Dementia Research Centre, Queen Square Institute of Neurology, University College London, London, United Kingdom, [7]Wellcome Centre for Human Neuroimaging, UCL Queen Square Institute of Neurology, University College London, London, United Kingdom, [8]Obesity Institute, Leeds Beckett University, Leeds, United Kingdom, [9]Salford Royal NHS Foundation Trust, Salford, United Kingdom, [10]Department of Radiology, Addenbrooke's Hospital, Cambridge, United Kingdom, [11]Centre for Kidney Research and Innovation, University of Nottingham, Nottingham, United Kingdom, [12]Lead study site: University of Nottingham, Nottingham, United Kingdom

Keywords: Kidney, Kidney

Motivation: The need for better biomarkers to assess progression of Chronic Kidney Disease (CKD).

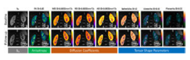
Goal(s): To determine if multiparametric MRI can detect changes in structure and function in CKD.

Approach: In the Application of Functional Renal MRI (AFiRM) study, multiparametric MRI is to be collected on 400 CKD participants at baseline and Year 2. The MRI protocol comprises T_2- and T_1-weighted scans, B_0 and B_1 mapping, T_1, T_2 and T_2* relaxometry, DWI, MTR, PC-MRI and ASL perfusion.

Results: To date, 387 have been scanned, with preliminary MRI analyses on 300 datasets for B_0 and B_1, T_1, T_2*, MTR, and Total Kidney Volume (TKV).

Impact: Application of the UKRIN-MAPS multiparametric renal MRI protocol to study changes in renal structure and function in CKD progression. This will provide definitive evidence on the question of whether MRI is better at tracking disease progression than conventional biomarkers.

0780 9:03



Monitoring diabetic kidney disease progression with DTI and tractography

Joao Periquito[1], Kanishka Sharma[1,2], Kywe Soe[1], Bashair Alhummiany[3], Jonathan Fulford[4], David Shelley[3], Mark Gilchrist[4], Angela Shore[4], Kim Gooding[4], Michael Mansfield[5], Maria Gomez[6], and Steven Sourbron[1]

[1]The University of Sheffield, Sheffield, United Kingdom, [2]Antaros Medical AB, Mölndal, Sweden, [3]Department of Biomedical Imaging Sciences, University of Leeds, Leeds, United Kingdom, [4]University of Exeter Medical School, Exeter, United Kingdom, [5]Leeds Teaching Hospitals NHS Trust, Leeds, United Kingdom, [6]Department of Clinical Sciences, Lund University Diabetes Centre, Malmö, Sweden

Keywords: Kidney, Kidney

Motivation: Previous studies have shown that DTI and tractography may act as early indicator of DKD.

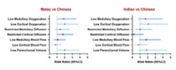
Goal(s): The aim of this study was to identify DTI biomarkers that may be sensitive to changes over a relatively short 2-year time frame in early-stage DKD.

Approach: Thirteen type-2 diabetic patients were scanned two times during a two-year period on a 3T MRI scanner using a free-breathing diffusion protocol. 180 biomarkers from DTI and tractography were calculated with DIPY.

Results: 46 biomarkers showed a significant change over the 2 years, with mean changes that reach over ½ of a standard-deviation and *cohen-d* effect-sizes up to 0.6

Impact: DTI biomarkers show strong changes in early-stage diabetic kidney disease over 2-years, a time frame where clinical biomarkers are typically stable. This finding may have significant implications for clinical practice if confirmed in the larger population.

0781 9:15 **Multiparametric Renal MRI Reveals Ethnic Disparities in Multiple Kidney Function Markers in Asian Preadolescents**



Navin Michael[1], Liangjian Lu[2], Delicia Shu Qin Ooi[3], Chang-Yien Chan[2,3], Kashthuri Thirumugan[1], Yeshe Kway[1], Suresh Anand Sadananthan[1], Marielle Fortier[4], Bernd Kuhn[5], Mary Foong-Fong Chong[6], Jia Ying Toh[1], Kok Hian Tan[7,8], Fabian Yap[8,9,10], Yap Seng Chong[11], Keith M Godfrey[12], Peter Gluckman[1,13], Johan G Eriksson[1,11,14,15], Yung Seng Lee[3], Karen Moritz[16], Shiao-Yng Chan[11], Mary Wlodek[17,18], and S. Sendhil Velan[1]

*[1]Agency for Science, Technology and Research (A*STAR), Singapore Institute for Clinical Sciences (SICS), Singapore, Singapore, [2]Khoo Teck Puat-National University Children's Medical Institute, National University Health System, Singapore, Singapore, [3]Department of Paediatrics, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [4]Department of Diagnostic and Interventional Imaging, KK Women's and Children's Hospital, Singapore, Singapore, [5]Siemens Healthcare GmbH, Erlangen, Germany, [6]Saw Swee Hock School of Public Health, National University of Singapore and National University Health System,, Singapore, Singapore, [7]Department of Maternal Fetal Medicine, KK Women's and Children's Hospital, Singapore, Singapore, [8]Duke-NUS Medical School, Singapore, Singapore, [9]Department of Pediatrics, KK Women's and Children's Hospital, Singapore, Singapore, [10]Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, Singapore, [11]Department of Obstetrics and Gynaecology and Human Potential Translational Research Programme, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [12]MRC Lifecourse Epidemiology Centre and NIHR Southampton Biomedical Research Centre, University of Southampton and University Hospital Southampton NHS Foundation Trust, Southampton, United Kingdom, [13]Liggins Institute, University of Auckland, Auckland, New Zealand, [14]14Department of General Practice and Primary Health Care, University of Helsinki, Helsinki, Finland, [15]Folkhälsan Research Center, Helsinki, Finland, [16]School of Biomedical Sciences, Faculty of Medicine, The University of Queensland, St Lucia, Australia, [17]Obstetrics and Gynaecology, University of Melbourne, Parkville, Australia, [18]School of Molecular Sciences, The University of Western Australia, Crawley, Australia*

Keywords: Kidney, Kidney, Volumetry, Diffusion, Perfusion, Oxygenation

Motivation: Within Singapore's multiethnic population, Indians and Malays have a higher burden of chronic kidney disease than Chinese. While this has been attributed to higher prevalence of hypertension, diabetes and dyslipidemia, it is not clear if Indians and Malays already have preexisting subclinical renal alterations.

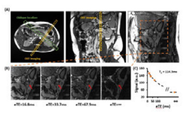
Goal(s): Assess ethnic differences in kidney function markers in healthy Asian preadolescents using multiparametric MRI and physiological assessments.

Approach: Identify adverse renal function using multiparametric MRI (volumetry, diffusion, perfusion, oxygenation) and physiological assessments (urine albumin, estimated glomerular filtration rate, blood pressure)

Results: Indian and Malay preadolescents showed multiple renal alterations which predate the development of diabetes, hypertension or dyslipidemia.

Impact: Detailed renal phenotyping of Asian preadolescents using multiparametric renal MRI and physiological assessments identified ethnic disparities in multiple renal function markers, which predate the development of diabetes, hypertension or dyslipidemia, and may help explain the predisposition for chronic kidney disease.

0782 9:27 **Quantification of renal oxygenation with field-insensitive T2-preparation and fast acquisition**



Zixuan Lin[1], Dengrong Jiang[2], Yi Zhang[1], Yi-Cheng Hsu[3], Hanzhang Lu[2], and Dan Wu[1]

[1]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States, [3]MR Collaboration, Siemens Healthineers Ltd., Shanghai, China

Keywords: Kidney, Kidney

Motivation: T_2-based method was recently extended to measure renal oxygen metabolism. However, MLEV T_2-preparation can be less robust due to field inhomogeneity in abdomen.

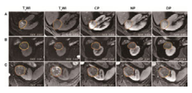
Goal(s): The goal is to propose a field-insensitive method for renal oxygenation quantification.

Approach: An adiabetic T_2-preparation (BIR-n) method was proposed. Simulation and phantom studies was performed to demonstrate the field-insensitivity. In-vivo experiements were conducted to examine the test-retest reproducibility.

Results: A robust T_2 quantification at different B0 and B1 offsets were demonstrated. In-vivo experiments showed a good test-retest reproducibility. Oxygenation was also found to be consistent between left and right renal veins, and showed significant correlation with blood flow.

Impact: The proposed method has the potential to provide accurate and stable estimation of renal oxygen extraction and metabolism in a number of renal diseases.

0783 9:39



Deep Learning-based Fully-Automated Detection and Segmentation of Small Renal Masses on Multi-sequences MRI: A Multi-center Study

Mengqiu cui[1], Zilong Zeng[2], He Wang[3], Jiahui Jiang[4], Jian Zhao[1], Xu Bai[1], Yuwei Hao[1], Huiyi Ye[1], and Haiyi Wang[5]

[1]Department of Radiology, the First Medical Center, Chinese PLA General Hospital, Beijing, China, [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [3]Radiology Department, Peking University First Hospital, Beijing, Beijing, China, [4]Department of Radiology, Beijing Friendship Hospital, Capital Medical University, Beijing, China, [5]Department of Radiology, Chinese PLA General Hospital, Beijing, China

Keywords: Kidney, Kidney

Motivation: Automated detection and segmentation method could serve as a fundamental step for diagnosis of small renal mass (SRM)

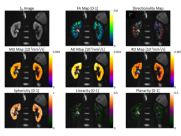
Goal(s): To develop and assess automated segmentation method for SRM using a deep learning method based on multi-sequences MRI

Approach: A total of 913 SRM patients from three institutions was used in deep learning model training and testing for five sequences (T_2WI, T_1WI, CP, NP, DP). The model was evaluated on internal and external test set using DSC (dice similarity coefficient)

Results: The overall median DSC of five sequences (T_2WI, T_1WI, CP, NP, and DP) yield 0.824, 0.769, 0.845, 0.847, 0.855 on whole test set.

Impact: The value of radiomics in preoperative diagnosis of benign and malignant SRM had been proven. However, manual segmentation impeded the conduction of radiomics. Automated segmentation models could help efficiently build radiomics model and reduce radiologists' workloads.

0784 9:51



Repeatability of DTI and tractography biomarkers in healthy kidneys

Joao Periquito[1], Kanishka Sharma[1,2], Kywe Soe[1], Bashair Alhummiany[3], Jonathan Fulford[4], David Shelley[3], Mark Gilchrist[4], Kim Gooding[4], Angela Shore[4], Maria Gomez[5], and Steven Sourbron[1]

[1]The University of Sheffield, Sheffield, United Kingdom, [2]Antaros Medical AB, Mölndal, Sweden, [3]Department of Biomedical Imaging Sciences, University of Leeds, Leeds, United Kingdom, [4]University of Exeter Medical School, Exeter, United Kingdom, [5]Department of Clinical Sciences, Lund University Diabetes Centre, Malmö, Sweden

Keywords: Kidney, Kidney

Motivation: For clinical application uncertainty of DTI and tractography biomarkers is critical to avoid that management decisions are made based on changes that are due to measurement error.

Goal(s): Provide a comprehensive reference guide of estimated uncertainties for DTI and tractography renal biomarkers and use the data to screen these biomarkers based measurement precision.

Approach: Five healthy-volunteers were scanned 4 times on 3T MRI scanner using a diffusion free-breathing protocol. DTI and tractography parameters were calculated using DIPY.

Results: Tractography markers are less precise than DTI, sphericity is the most reliable of all DTI metrics, and histogram metrics kurtosis and skewness are inherently imprecise.

Impact: This study presents comprehensive reference values for error ranges in renal DTI that will help to identify real (patho)physiological changes in future clinical results

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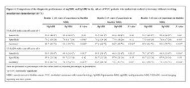
0785 10:03 [Diagnosis of muscle-invasive urothelial carcinoma with variant histology using biparametric MRI and VI-RADS in a radical cystectomy cohort]



Yuki Arita[1,2], Thomas C Kwee[3], Joao Miranda[2], Keisuke Shigeta[4], Ryota Ishii[5], Hiromi Edo[6], Lisa Ruby[2], Josip Nincevic[2], Yuma Waseda[7], Daiki Tamada[8], Ada Muellner[2], Sunny Nalavenkata[9], and Hedvig Hricak[2]

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Keywords: Urogenital, Bladder, VI-RADS

Motivation: To determine if contrast-free biparametric MRI (bpMRI), which offers potential cost, comfort and safety advantages, could replace multiparametric MRI (mpMRI) in diagnosing muscle-invasive bladder cancer (MIBC) in patients with urothelial carcinoma of variant histology (VUC).

Goal(s): To compare the diagnostic accuracy of bpMRI and conventional mpMRI for detecting MIBC in patients with VUC who underwent radical cystectomy (the optimal reference standard).

Approach: A retrospective, multicenter diagnostic study using radical cystectomy as the reference standard.

Results: The diagnostic performance of bpMRI was confirmed to be weaker than that of mpMRI in the assessment of muscle invasion in bladder VUC.

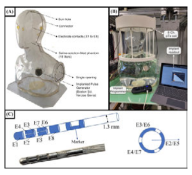
Impact: When applying VI-RADS, bpMRI had weaker diagnostic performance than mpMRI in assessing muscle invasion in patients with bladder VUC who had radical cystectomy (the optimal reference standard). Consequently, we recommend employing mpMRI-based methods for evaluating muscle invasion in bladder VUC.

Oral

Taking Off the Heat: Ensuring RF Safety

Room 331-332 | Wednesday 8:15 - 10:15 | *Moderators:* Daniel Wenz & Joseph Rispoli

0786 8:15 [Built-in RF safety for active implants: Harnessing impedance measurements from a commercial deep brain stimulator]



Berk Silemek[1], Mevlüt Yalaz[2], Frank Seifert[1], Reiner Montag[1], Michael Höft[2], Bernd Ittermann[1], and Lukas Winter[1]

[1]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, [2]Chair of Microwave Engineering, Christian-Albrechts-Universität zu Kiel, Kiel, Germany

Keywords: Safety, Safety, Deep brain stimulation, Active implantable medical devices, RF safety

Motivation: MRI of neurostimulators is severely constrained due to RF safety concerns.

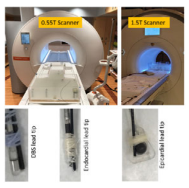
Goal(s): *D*emonstrate that built-in sensors in commercial devices, such as a deep brain stimulator, can provide all necessary information to detect and improve RF safety.

Approach: We investigated and utilized built-in impedance measurements of two commercial DBS systems for the detection and mitigation of RF-induced currents on the electrodes of a DBS lead.

Results: Impedance measurements were correlated at various RF power levels. Temperature rise at the tip of DBS electrodes could be reduced to 0.02 K from 17.14 K at the same total powers (16.85±0.45 W).

Impact: Our demonstration of mitigation of RF-induced heating in active implants through built-in sensor measurements from a commercial DBS system indicated up to ~850× improvement in temperature rise proving the unmet value of sensors for MR imaging patients with active implants.

0787 8:27



[From Low-Field to High Risk: Analyzing RF Heating of Neuromodulation and Cardiac Devices during MRI at 0.55T relative to 1.5T]

Bhumi Bhusal[1], Pia Panravi Sanpitak[1], Fuchang Jiang[2], Jasmine Vu[1,2], Jacob Richardson[3], Nicole Seiberlich[3], and Laleh Golestanirad[1,2]

[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Biomedical Engineering, Northwestern University, Evanston, IL, United States, [3]Radiology, University of Michigan, Ann Arbor, MI, United States

Keywords: Low-Field MRI, Safety, Medical Implants

Motivation: Radiofrequency-induced heating of elongated medical implants during MR imaging on newly introduced commercial 0.55T systems has not been thoroughly investigated.

Goal(s): We aim to evaluate and compare the RF heating of elongated medical implants during MRI at 0.55T and 1.5T scanners.

Approach: Neurological and cardiac implant leads were routed along different trajectories inside a tissue mimicking gel phantom, and the temperature increase during MRI at 0.55T and 1.5T was measured at the lead tip.

Results: For certain implant configurations, RF heating at 0.55T MRI can be an order of magnitude higher than that at 1.5T.

Impact: Our findings show that unsafe levels of RF heating, exceeding those at higher field strengths, are possible on commercial 0.55T MRI systems for certain implant configurations. Therefore, extra caution should be taken during low-field MRI of patients with long implants.

0788 8:39

MERIT AWARD
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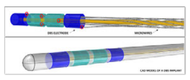


[MRI-conditional deep brain stimulation (DBS) implants: a new engineered design for enhanced safety]

Francesca Marturano[1], Tayeb Anderson Zaidi[2], Aditya Tummala[3], Laleh Golestani Rad[2], and Giorgio Bonmassar[1]

[1]Radiology, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States, [2]Northwestern University, Chicago, IL, United States, [3]Harvard University, Cambridge, MA, United States

Keywords: Safety, Parkinson's Disease, Deep Brain Stimulation

Motivation: Currently, patients with Deep Brain stimulation (DBS) implants cannot leverage the diagnostic potential of Magnetic Resonance Imaging (MRI) as traditional metal-based leads pose several safety concerns.

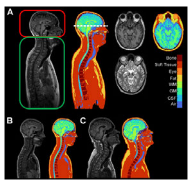
Goal(s): We propose a new technology for manufacturing DBS microwires that ensures their safe operation with MRI up to 3T.

Approach: Through the development of a metamaterial-based design, we have engineered microwires that effectively partially reflect RF-induced current, thereby reducing Specific Absorption Rate (SAR), tip heating, and associated artifacts.

Results: Our manufactured microwires demonstrated minimal tip heating in both 1.5T and 3T MRI scanners when compared to standard wires.

Impact: This innovative design facilitates safe MRI imaging for individuals with DBS implants, marking a pivotal advancement in the study of neural mechanisms involved in medically refractory pathological conditions, such as Parkinson's disease.

0789 8:51



[Individual voxel models for head SAR estimation]

Felix Gabel[1], Georgiy Solomakha[1], Dario Bosch[1,2], Felix Glang[1], Nikolai I Avdievich[1], Klaus Scheffler[1,2], and Jonas Bause[1]

[1]Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Department for Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany

Keywords: High-Field MRI, Segmentation, voxel models, ultra-high field, EM simulation

Motivation: Accurate human tissue models for simulation of RF power absorption are a key safety requirement for transmit coil development especially at ultra-high field.

Goal(s): To create individual voxel models of the human head and torso.

Approach: A pipeline for head and torso segmentation was developed based on a 3T multi-contrast protocol and tailored post-processing. The resulting voxel models were used for electromagnetic simulation of a self-developed Tx array at 9.4T.

Results: Strong agreement was found between measured and simulated B_1^+ maps using the generated voxel model. Simulated worst-case SAR distributions differed significantly between individual and 'off-the-shelf' voxel models.

Impact: We present a pipeline for the creation of individual human tissue voxel models covering head and torso, which is based on multi-contrast MR image segmentation. This meets a central need in safety-related simulations of ultra-high field RF coil arrays.

0790 9:03

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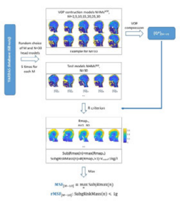

Pediatric neuroimaging at 7 Tesla: towards building and validating VOPs for local SAR management in pTX

Natalia Dudysheva[1], Michel Luong[2], Alexis Amadon[1], Nicolas Boulant[1], and Vincent Gras[1]

[1]BAOBAB, NeuroSpin, University Paris-Saclay, CEA, CNRS, Gif-sur-Yvette, France, [2]IRFU/DACM, University Paris-Saclay, CEA, Gif-sur-Yvette, France

Keywords: Safety, Safety, SAR, ultra-high field, pTX, pediatric

Motivation: Pediatric MRI neuroimaging has become common practice at 1.5 and 3 Tesla and we see the emergence of 7T and parallel transmission (pTX). However, today relevant local SAR prediction models are based on adult standards.

Goal(s): In this work, we study the local SAR at 7T with pTX for children population (6 to 14 years old) using RF electric field simulations.

Approach: We exploit a vast simulation database to build a pediatric local SAR prediction model and propose a methodology for its initial validation using convex optimization.

Results: A large simulation database (above 25) is desirable to combine RF safety and pTX performance.

Impact: This work aims to push pediatric MRI to ultra-high fields by developing safe SAR control for the children population. It also introduces a tool to determine appropriate safety margins to avoid excessive penalizing in the pTX pulse design.

0791 9:15

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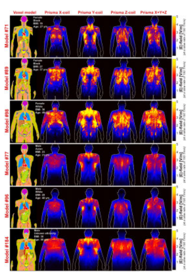


Modeling of cardiac stimulation limits by MRI gradient coils in a population of body models

Valerie Klein[1,2], Mathias Davids[1,2], Natalie G. Ferris[1,3], Lawrence L. Wald[1,2,3], and Bastien Guerin[1,2]

[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, Cambridge, MA, United States

Keywords: Safety, Safety, Cardiac stimulation

Motivation: Our previous modeling of gradient-induced cardiac stimulation (CS) in two body models indicated that the regulatory IEC 60601-2-33 CS limit overestimated CS thresholds by 9- to 46-fold.

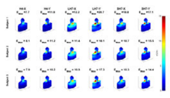
Goal(s): To investigate the expected variance of CS thresholds across a healthy population.

Approach: We deploy our validated cardiac magnetostimulation modeling approach in six body models with varying shape/BMI/age and a commercial gradient system.

Results: Predicted CS thresholds vary up to 2-fold across body models. Worst-case CS thresholds are 7X greater than the IEC CS limit and 4X greater than experimental PNS limits.

Impact: Our modeling allows investigation of the variability of CS thresholds across the population, which is not accessible experimentally. This knowledge is critical to obtain a robust estimate of safe, but not overly restrictive cardiac safety limits for MRI gradients.

0792 9:27



[Subject-specific PNS prediction using a localizer and fast E-field calculation]

Koray Ertan[1], Trevor Wade[2], Peter Roemer[3], and Brian Brian Rutt Rutt[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Robarts Research Institute, University of Western Ontario, London, ON, Canada, [3]Roemer Consulting, Lutz, FL, United States

Keywords: Gradients, Gradients, peripheral nerve stimulation, subject-specific PNS prediction, electric field calculation

Motivation: Given the large population variability in PNS thresholds (~3-fold), rapid and accurately prediction of PNS thresholds for individual subjects would be valuable.

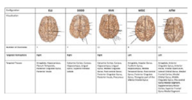
Goal(s): To apply our E-field-based PNS prediction method to individual subjects, and to test the hypothesis that we can predict an individual subject's PNS threshold with reasonable accuracy.

Approach: Subject-specific body models were fit to an individual's anatomy based on a localizer. E-field calculations yielded E_{max} and therefore PNS threshold. We compared to measured PNS thresholds using 3 different head gradient coils and 7 different gradient directions.

Results: Individual subject PNS thresholds values can be predicted to an accuracy of ~35%.

Impact: There would be significant advantages in being able to predict PNS thresholds rapidly and accurately for individual subjects. This would allow much more effective use of high-performance gradient hardware, benefitting the subset of the population with high PNS thresholds.

0793 9:39



[3T Parallel-Transmit for Simultaneous Stereoelectroencephalography and MRI for Realistic Electrode Placement in Epilepsy Patients]

Elizaveta Shegurova[1,2], Rachel Sparks[1], and Özlem Ipek[1]

[1]King's College London, London, United Kingdom, [2]École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

Keywords: Safety, Safety

Motivation: Investigating optimised RF heating and B_1^+ field disturbance with sEEG electrodes placement, covering epileptogenic zones in five configurations, using electromagnetic simulations with 16-channel parallel-transmit coil array at 3T for simultaneous sEEG-MRI.

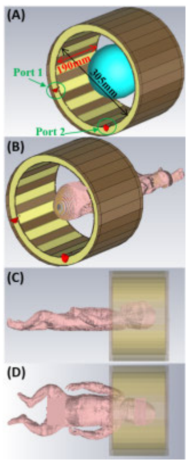
Goal(s): The challenge is reducing RF heating from implanted electrodes.

Approach: We investigated five electrode placements covering epileptogenic zones to control RF heating and local signal increases using computational field simulations on a realistic computational human model.

Results: Implanting electrodes in the left hemisphere improved RF uniformity. Shimming optimisation, integrating B_1^+ and 0.1g SAR, showed negligible SAR differences from electrode-free setups. Lower SAR correlated with reduced RF strength, suggesting a necessary trade-off.

Impact: Our study advances simultaneous EEG/fMRI for drug-resistant epilepsy, optimising electrode safety to better localise seizure onset zones and refine surgical approaches, while ensuring patient safety. It allows for more precise epileptogenic zone resection, potentially advancing therapeutic outcomes.

0794 9:51



A Subject-Specific Workflow for Radiofrequency Safety of Infants Undergoing an MRI Head Scan at 7T

Alireza Sadeghi-Tarakameh[1], Julia Moser[2], Kimberly B Weldon[2], Jeromy Thotland[1], Jed T Elison[3,4], Damien A Fair[2,3,4], Gregor Adriany[1], Essa Yacoub[1], and Yigitcan Eryaman[1]

[1]Center for Magnetic Resonance Research (CMRR), University of Minnesota, Minneapolis, MN, United States, [2]Masonic Institute for the Developing Brain, University of Minnesota, Minneapolis, MN, United States, [3]Institute of Child Development, University of Minnesota, Minneapolis, MN, United States, [4]Department of Pediatrics, University of Minnesota, Minneapolis, MN, United States

Keywords: Safety, Safety

Motivation: Higher SNR promised at higher field strengths can be traded for higher spatial resolution, which is essential for imaging infant brains.

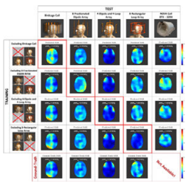
Goal(s): To assess and ensure safe operation of a commercially-available RF head coil at 7T for infant subjects.

Approach: We developed an EM model of the coil and experimentally validated it. Utilizing EM simulations, we calculated local and head SARs for an infant model to determine the safe operation limits.

Results: We showed that the head SAR limit is reached before the local SAR limit. We acquired structural and functional MRI data from an infant's brain at 7T.

Impact: Assessing and ensuring the safe operation of 7T MRI scanners for infant subjects can pave the way to exploring the early stages of human brain development, which is hardly possible at lower field strengths due to lower spatiotemporal resolution.

0795 10:03



Deep Learning Based Local SAR Prediction for Head imaging at 7T: applicability and accuracy for unknown head coils

E.F. Meliado[1,2,3], C.A.T. van den Berg[2,4], and A.J.E. Raaijmakers[1,2,5]

[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Computational Imaging Group for MR diagnostics & therapy, Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [3]Tesla Dynamic Coils BV, Zaltbommel, Netherlands, [4]Department of Radiotherapy, University Medical Center Utrecht, Utrecht, Netherlands, [5]Biomedical Image Analysis, Dept. Biomedical Engineering, Eindhoven University of Technology, Utrecht, Netherlands

Keywords: Safety, Safety, specific absorption rate; deep learning; parallel transmit; convolutional neural network; subject-specific SAR assessment; ultra-high field MRI

Motivation: The methods presented for on-line local SAR evaluation require access to geometric design details of the transmit coil which are not always available.

Goal(s): Evaluate the generalization capabilities of deep learning-based methods when they are used to assess the local SAR distribution for coils not included in the training data.

Approach: We built a diverse synthetic dataset four different coils and trained a neural network: using only samples from each coil, and using samples from all coils except one.

Results: Including a reasonably wide variety of coils in the training process enables local SAR assessment without knowing the design details of the coil.

Impact: The lack of access to design details of the coil makes it challenging to transition the more advanced local SAR assessment methods into clinical practice. Training with a diverse set of coils could enable local SAR assessment without coil information.

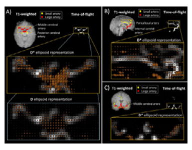
Oral
Diffusion Imaging of Neurofluids

Room 334-336 | Wednesday 8:15 - 10:15 | *Moderators:* Claudia Gandini Wheeler-Kingshott & Denis Le Bihan

8:15 Introduction

Claudia Gandini Wheeler-Kingshott
UCL Institute of Neurology, United Kingdom

0796 8:27



[Characterizing blood and cerebrospinal fluid flow by D* tensor derived from intravoxel-incoherent-motion-diffusion-tensor-imaging]

Paulien Voorter[1,2], Gerald Drenthen[1,2], Merel van der Thiel[1,2,3], Julie Staals[4,5], Oliver Gurney-Champion[6,7], Alida Postma[1,2], Robert van Oostenbrugge[2,4,5], Jacobus Jansen[1,2,8], and Walter Backes[1,2,5]

[1]Department of Radiology and Nuclear Medicine, Maastricht University Medical Center, Maastricht, Netherlands, [2]School for Mental Health and Neuroscience, Maastricht University, Maastricht, Netherlands, [3]Department of Psychiatry and Neuropsychology, Maastricht University, Maastricht, Netherlands, [4]Department of Neurology, Maastricht University Medical Center, Maastricht, Netherlands, [5]School for Cardiovascular Disease, Maastricht University, Maastricht, Netherlands, [6]Department of Radiology and Nuclear Imaging, Amsterdam UMC location University of Amsterdam, Amsterdam, Netherlands, [7]Imaging and Biomarkers, Cancer Center Amsterdam, Amsterdam, Netherlands, [8]Department of Electrical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands

Keywords: IVIM, Diffusion/other diffusion imaging techniques

Motivation: A deeper understanding of brain physiology and pathology can be provided with an intravoxel-incoherent-motion-diffusion-tensor-imaging (IVIM-DTI) MR scan, which simultaneously measures blood and cerebrospinal fluid (CSF) flow and flow directions; parenchymal anisotropy; and microvascular perfusion.

Goal(s): To demonstrate the feasibility of IVIM-DTI to provide a proxy for blood and CSF flow.

Approach: A tensor of the pseudo-diffusion component (**D***) was derived from IVIM-DTI and related to arterial and ventricular physiology.

Results: **D*** ellipsoids align well with arterial blood and CSF flow. **D***'s magnitude and anisotropy correspond to the expected flow in arteries and ventricles, indicating the technique's ability of characterizing flow dynamics.

Impact: Assessing blood and cerebrospinal fluid flow with intravoxel-incoherent-motion-diffusion-tensor-imaging (IVIM-DTI) alongside traditional IVIM and DTI measures can provide comprehensive pathophysiological insights into neurological conditions. The finding that these physiological processes contribute to IVIM-derived *f* and *D** is important for their interpretation.

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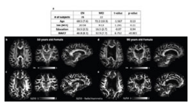


[Exploring radial asymmetry in MR diffusion tensor imaging and its impact on the interpretation of glymphatic mechanisms]

Adam M Wright[1,2], Yu-Chien Wu[2,3], Nan-Kuei Chen[4], and Qiuting Wen[2]

[1]Biomedical Engineering, Purdue University, West Lafayette, IN, United States, [2]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States, [3]Stark Neurosciences Research Institute, Indiana University School of Medicine, Indianapolis, IN, United States, [4]Department of Biomedical Engineering, University of Arizona, Tucson, AZ, United States

Keywords: Neurofluids, Neurofluids

Motivation: Researchers have used diffusion tensor imaging along the perivascular space (DTI-ALPS) to investigate glymphatic function, but the influence of white matter properties on the ALPS-index remains unstudied.

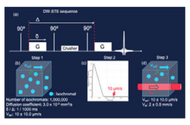
Goal(s): Establish whether a reduction in the ALPS-index could be influenced by axonal changes.

Approach: A key assumption underlying the ALPS-index is that axons demonstrate symmetric radial diffusivities, such that eigenvalue-2 and eigenvalue-3 are equal ($\lambda2=\lambda3$). We investigated this assumption and evaluated $\lambda2/\lambda3$ changes in white matter tracts.

Results: Contrary to the DTI-ALPS assumption, widespread radial asymmetry ($\lambda2/\lambda3\approx1.5$) was observed within all white matter tracts, the extent of which decreased with aging and neurodegeneration.

Impact: This study unveils widespread radial asymmetry of white matter tracts — a phenomenon that has been overlooked in DTI studies. The results provide evidence of axonal contributions to the ALPS-index, prompting researchers to consider axonal influences when interpreting this metric.

0798 8:51



Investigation of Feasibility of Measurement of Neurofluid Movement by Propagator Analysis based on Q-space Imaging

Satoshi Yatsushiro[1,2], Keita Murayama[3], Hideki Atsumi[4], Tomohiko Horie[5], and Kagayaki Kuroda[1,3]

[1]Human and Information Science, Tokai University, Kanagawa, Japan, [2]BioView, Inc., Tokyo, Japan, [3]Course of Electrical and Electronic Engineering, Tokai University, Kanagawa, Japan, [4]Department of Neursurgery, School of Medicine, Tokai University, Kanagawa, Japan, [5]Department of Radiological Technology, Tokai University Hospital, Kanagawa, Japan

Keywords: Neurofluids, Neurofluids

Motivation: To quantitatively measure neurofluid movement in the brain parenchyma of mouse and human by propagator analysis of q-space imaging (QSI).

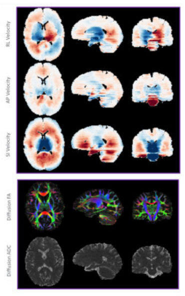
Goal(s): The accuracy of the propagator analysis to measure the neurofluid movement including the pulsation and the blood flow was investigated by Bloch simulation.

Approach: The propagator analysis of pulsatile neurofluid or capillary blood flow in a voxel was conducted by Bloch simulation. The accuracy of the technique in the constant flow was validated by experiments.

Results: The propagator analysis indicated the high accuracy of the velocity measurement of the pulsatile neurofluid movement and the blood flow.

Impact: The high accuracy of the velocity measurement of QSI-based propagator analysis of pulsatile movement and blood flow in the voxel was validated by Bloch simulation. The technique may reveal neurofluid movement and clearance mechanism of neurowastes in human brain.

0799 9:03



Optimization of Simultaneous Coherent/Incoherent Motion Imaging (SCIMI): Combined Diffusion and Velocimetry for Glymphatic Circulation

Isabelle Heukensfeldt Jansen[1], Nastaren Abad[1], Afis Ajala[1], J Kevin DeMarco[2,3], H. Doug Morris[2], Vincent B Ho[2,3], Kent Werner[2], Angeliki Pollatou[2], Gail Kohls[3], Haymanot Yalewayker[2], Maureen Hood[2,3], Sonja Skeete[2,3], Elizabeth Metzger[2,3], Robert Shih[2,3], Thomas K.F. Foo[1], and Luca Marinelli[1]

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Keywords: Neurofluids, Neurofluids, Glymphatic, MRI Velocimetry, Phase-Sensitive Diffusion

Motivation: To study glymphatic circulation in the brain parenchymal tissue, methods to measure sub-millimeter velocities of fluid flow in tissue must be developed.

Goal(s): We evaluate the feasibility of imaging both coherent and incoherent motion (SCIMI) in brain tissue using phase-sensitive reconstruction of dMRI.

Approach: Approach: By modifying a DTI sequence to achieve physiologically relevant low VENC, we demonstrate the simultaneous reconstruction of diffusion metrics highlighting incoherent motion in the brain and velocity data showing coherent motion by leveraging phase and magnitude information.

Results: We measure velocity maps in the whole brain in conjunction with clinically relevant diffusion metrics.

Impact: SCIMI acquisition and reconstruction of velocity in brain parenchymal tissue shows to be an important addendum that can be run parallel to existing DTI methods and provides novel insights into glymphatic circulation.

0800 9:15

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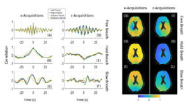


[Dynamics of Respiratory Motion in Slow Flow Measurement using Simultaneous Coherent and Incoherent Motion Imaging Method]

Afis Ajala[1], Isabelle Heukensfeldt Jansen[1], Seung-Kyun Lee[1], Nastaren Abad[1], Thomas KF Foo[1], J Kevin DeMarco[2,3], Robert Y Shih[2,3], Gail Kohls[3], H Doug Morris[2], Angeliki Pollatou[2], Haymanot Yalewayker[2], Maureen N Hood[2,3], Sonja Skeete[2,3], Elizabeth Metzger[2,3], Vincent B Ho[2,3], J Kent Werner[2], and Luca Marinelli[1]

[1]GE HealthCare, Niskayuna, NY, United States, [2]Uniformed Services University of the Health Sciences, Bethesda, MD, United States, [3]Walter Reed National Military Medical Center, Bethesda, MD, United States

Keywords: Neurofluids, Neurofluids

Motivation: The impact of respiration on fluid flow in brain parenchyma is poorly understood and remains an on-going research topic in MRI velocimetry.

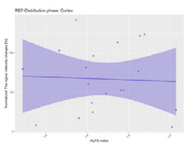
Goal(s): To analyze the sensitivity of the simultaneous coherent and incoherent motion imaging (SCIMI) method to respiratory-induced phase in the brain parenchyma and to regress this phase contribution from the underlying slow-flow-induced phase.

Approach: Prospectively cardiac-gated SCIMI acquisitions were obtained during three different breathing schemes.

Results: Existence of strong correlations (p<0.005) between the breathing profiles and measured phase in various brain regions indicated the presence of respiration-induced phase in the SCIMI acquisition, and regression of such phases showed promising results.

Impact: This study showed the sensitivity of simultaneous coherent and incoherent motion imaging method to respiration-induced phase in the brain, and an initial attempt to regress such phase accrual from the desired brain slow flows$$$–$$$an important biomarker of glymphatic function.

0801 9:27



[Brain Clearance Assessment Using the DTI-ALPS Index and Intrathecal Contrast Enhanced Magnetic Resonance Imaging]

Ingrid Mossige[1,2], Tryggve Holck Storås[1], Kyrre Eeg Emblem[1], Per Kristian Eide[2,3], and Geir André Ringstad[4]

[1]Division of Radiology and Nuclear Medicine, Department of Physics and Computational Radiology, Oslo University Hospital, Oslo, Norway, [2]Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, Oslo, Norway, [3]Department of Neurosurgery, Oslo University Hospital-Rikshospitalet, Oslo, Norway, [4]Department of Radiology, Oslo University Hospital-Rikshospitalet, Oslo, Norway

Keywords: Neurofluids, Neurofluids

Motivation: To investigate if DTI-ALPS as a non-invasive method compared to intrathecal contrast enhanced magnetic resonance (gMRI) imaging can be used for evaluating human brain clearance function.

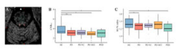
Goal(s): To investigate whether or not DTI-ALPS can be used as a non-invasive alternative to gMRI.

Approach: This study compared the ALPS index with brain clearance parameters derived from gMRI in a reference group (REF).

Results: No significant relationships were found between the ALPS index and change in normalized T1w signal intensity from the gMRI data in both the distribution phase and clearance phase.

Impact: The proposed DTI-ALPS index may not be a valid marker of glymphatic function.

0802 9:39



[Locus Coeruleus Influence on Cognitive Function via the Glymphatic System in Parkinson's Disease]

Xinhui Wang[1], Ewart Mark Haacke[2,3], Naying He[4], Yu Liu[4], Peng Wu[5], and Fuhua Yan[3,6]

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Keywords: Parkinson's Disease, Parkinson's Disease

Motivation: The underlying mechanism of locus coeruleus (LC) in cognitive function of Parkinson's disease (PD) has not been clearly elucidated.

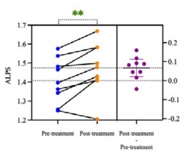
Goal(s): To investigate the relationship among LC degeneration, cognitive function, and the glymphatic system in PD.

Approach: All participants underwent neuromelanin-sensitive magnetic resonance imaging (NM-MRI) and diffusion tensor image scanning. The whole brain glymphatic activity was measured using diffusion along the perivascular space (ALPS) index, while LC degeneration was estimated using the NM contrast-to-noise ratio of LC (CNR_{LC}).

Results: Mediation analysis demonstrated that the ALPS index acted as a significant mediator between CNR_{LC} and the MoCA score in PD subjects.

Impact: These findings enhance our grasp of how the LC noradrenergic system influences cognitive function through the glymphatic system. This research offers a promising starting point for exploring potential therapies and further research into cognitive impairment in Parkinson's disease.

0803 9:51



[Human Umbilical Cord Blood-Mononuclear Cell Transplantation Improves Glymphatic System Activity in Patients with Multiple System Atrophy]

Chuanying Shi[1], Dianrong Gong[2], Peng Wu[3], Xiance Zhao[3], and Peiji Song[4]

[1]*Department of radiology, Liaocheng People's Hospital, Liaocheng, China,* [2]*Department of neurology, Liaocheng People's Hospital, Liaocheng, China,* [3]*Philips Healthcare, Shanghai, China,* [4]*Department of radiology, Jinan Central Hospital, Jinan, China*

Keywords: Parkinson's Disease, Parkinson's Disease, Diffusion tensor image

Motivation: Glymhatic system as a therapeutic target for multiple system atrophy (MSA) lacks imaging markers.

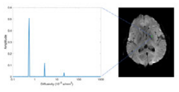
Goal(s): Our goal was to determine changes in imaging parameters after human umbilical cord blood mononuclear cells (hUCB-MCs) transplantation.

Approach: Diffusion tensor image analysis along the perivascular space (DTI-ALPS) of MSA patients were compared with healthy controls and the ALPS indices of patients were compared before and after hUCB-MCs transplantation.

Results: We found that MSA patients had lower ALPS values than health controls and that ALPS values increased after treatment.

Impact: Our demonstration of a detectable decline in MSA patients and an uptick after treatment utilizing ALPS metrics provides an imaging marker to monitor the glymphatic system after hUCB-MCs transplantation.

0804 10:03 [Aberrant interstitial fluids may be associated with cognitive impairment in patients on chronic kidney disease]



Wenbo Yang[1], Lijun Song[1], Mingan Li[1], Boyan Xu[2], Zhenghan Yang[1], Hao Wang[1], and Zhen-chang Wang[1]

[1]Department of Radiology, Beijing Friendship Hospital, Capital Medical University, Beijing, China, [2]MR Research, GE Healthcare, Beijing, China

Keywords: Neurofluids, Neurofluids

Motivation: Chronic kidney disease (CKD) leads to cognitive impairment; however, the pathophysiology remains unclear.

Goal(s): This study aims to evaluate differences in interstitial fluids (ISF) between patients with CKD and healthy controls, and investigate correlation between ISF circulation with cognitive impairment.

Approach: Spectral diffusion analysis was applied to measure the ISF fraction (f_{int}).

Results: A significant difference in fint was detected between the HD and HC groups in the right basa gangliaand biliteral centrum semiovale(CSO). In the CKD group, MoCA scores were negatively correlated with fint in the biliteral CSO.

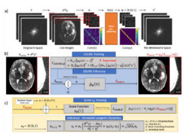
Impact: A novel approach to measure ISF exhibits the potential for detecting brain glymphatic dysfunction in patients with CKD, which provides unique insights into the pathological mechanisms of patients on CKD with cognitive impairment.

Oral

AI/ML-Supported Image Reconstruction

Summit 2 | Wednesday 8:15 - 10:15 | *Moderators:* Peter Dawood & Shanshan Wang

0805 8:15 [GSURE Denoising enables training of higher quality generative priors for accelerated Multi-Coil MRI Reconstruction]



Asad Aali[1], Marius Arvinte[1,2], Sidharth Kumar[1], Yamin Ishraq Arefeen[1], and Jonathan I. Tamir[1]

[1]Chandra Family Department of Electrical and Computer Engineering, The University of Texas at Austin, Austin, TX, United States, [2]Intel Corporation, Hillsboro, OR, United States

Keywords: AI/ML Image Reconstruction, Image Reconstruction, Deep Generative Models, Inverse Problems, Unsupervised Learning, Denoising

Motivation: Publicly available k-space data used for training are inherently noisy with no available ground truth.

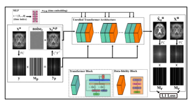
Goal(s): To denoise k-space data in an unsupervised manner for downstream applications.

Approach: We use Generalized Stein's Unbiased Risk Estimate (GSURE) applied to multi-coil MRI to denoise images without access to ground truth. Subsequently, we train a generative model to show improved accelerated MRI reconstruction.

Results: We demonstrate: (1) GSURE can successfully remove noise from k-space; (2) generative priors learned on GSURE-denoised samples produce realistic synthetic samples; and (3) reconstruction performance on subsampled MRI improves using priors trained on denoised images in comparison to training on noisy samples.

Impact: This abstract shows that we can denoise multi-coil data without ground truth and train deep generative models directly on noisy k-space in an unsupervised manner, for improved accelerated reconstruction.

0806 8:27



Diffusion Modeling with Unrolled Transformers for Self-Supervised MRI Reconstruction

Yilmaz Korkmaz[1,2,3], Vishal M. Patel[1], and Tolga Cukur[2,3]

[1]Dept. of Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, United States, [2]Dept. of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey, [3]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, Image reconstruction, diffusion models, deep learning

Motivation: Diffusion models can reconstruct high-quality MR images, but their training neglects physical constraints and requires supervision via ground-truth images derived from fully-sampled acquisitions.

Goal(s): Our goal was to devise a diffusion-based method that incorporates physical constraints and that can be trained using undersampled acquisitions.

Approach: We introduced a novel diffusion model (SSDiffRecon) based on a physics-driven unrolled transformer architecture; and self-supervised training was achieved by predicting held-out subsets of acquired k-space data from remaining subsets.

Results: SSDiffRecon achieved superior reconstructions to alternative self-supervised methods, and performed on par with a supervised benchmark trained on fully-sampled acquisitions.

Impact: The improvement in image quality and acquisition speed through SSDiffRecon, combined with the ability to train on undersampled acquisitions, may facilitate adoption of AI-based reconstruction for comprehensive MRI exams in many applications, particularly in pediatric and elderly populations.

0807 8:39

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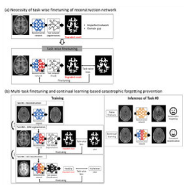


MOST: MR reconstruction Optimization for multiple downStream Tasks via continual learning

Hwihun Jeong[1], Se Young Chun[1], and Jongho Lee[1]

[1]Department of electrical and computer engineering, Seoul national university, Seoul, Korea, Republic of

Keywords: AI/ML Image Reconstruction, Image Reconstruction, Deep learning clinical adpatation

Motivation: This research aims to address the problem of performance degradation when a reconstruction network and a downstream network are cascaded. The proposed solution, MOST, optimizes a MR reconstruction network for multiple downstream tasks.

Goal(s): Our objective is to sequentially finetune a reconstruction network using losses from multiple downstream tasks while preventing catastrophic forgetting such that the same reconstruction network can be used for the multiple tasks.

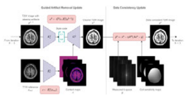
Approach: We introduce replay-based continual learning into finetuning for multiple downstream tasks.

Results: Our method successfully circumvents catastrophic forgetting, exhibiting stable performance across all downstream tasks, enabling a single reconstruction network to be used for multiple tasks.

Impact: When k-space reconstruction and downstream tasks are performed using two separate networks (individually optimized), the cascade may introduce suboptimal results. Here, we propose a solution when multiple downsteam tasks exist, addressing challenges in realistic user environment.

0808 MERIT AWARD MAGNA CUM LAUDE

8:51



Guided Multicontrast Reconstruction based on the Decomposition of Content and Style

Chinmay Rao[1], Laurens Beljaards[1], Matthias van Osch[1], Mariya Doneva[2], Jakob Meineke[2], Christophe Schülke[2], Nicola Pezzotti[3,4], Elwin de Weerdt[5], and Marius Staring[1]

[1]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Philips Research Hamburg, Hamburg, Germany, [3]Cardiologs, Paris, France, [4]Department of Mathematics and Computer Science, Eindhoven University of Technology, Eindhoven, Netherlands, [5]Philips, Best, Netherlands

Keywords: AI/ML Image Reconstruction, Multi-Contrast

Motivation: Scans within an MR exam share redundant information due to the same underlying structures. One contrast can hence be used to guide the reconstruction of another, thereby requiring less measurements.

Goal(s): Multimodal guided reconstruction to reduce scanning times.

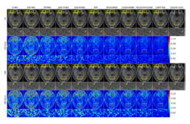
Approach: Our method exploits AI-based content/style decomposition in an iterative reconstruction algorithm. We explored this concept via numerical simulation and subsequently validated it on *in vivo* data.

Results: Compared to a conventional compressed sensing baseline, our method showed consistent improvement in simulations and produced sharper reconstructions from undersampled *in vivo* data. By enforcing data consistency, it was also more reliable than blind image translation.

Impact: In the clinic, this can potentially enable a reduced MR exam time for a given image quality or improve image quality given a scan time budget. The former can reduce strain on the patient, whereas the latter can improve diagnosis.

0809

9:03



CAMP-Net: The Application of Consistency-Aware Multi-Prior in Deep Learning for Rapid MRI

Liping Zhang[1] and Weitian Chen[1]

[1]Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong, China

Keywords: AI/ML Image Reconstruction, Brain

Motivation: Accelerated MRI acquisitions offer reduced imaging scan times but pose challenges in image reconstructions. Tremendous progress has been made to reconstruct accelerated MRI, but it remains challenging to restore high-frequency image details in highly undersampled data.

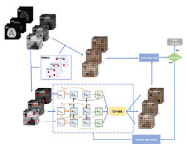
Goal(s): Our goal is to develop a solution that can restore subtle structures even for highly accelerated MRI.

Approach: We propose CAMP-Net, a consistency-aware multi-prior framework, that leverages scan-specific features with both image and $$$k$$$-space domain knowledge for MRI reconstruction.

Results: Results on a publicly available brain dataset demonstrated that CAMP-Net can achieve high-quality reconstructions with fine brain anatomical structures even at an acceleration factor of 10X.

Impact: The successful restoration of subtle structures for MRI with high acceleration factors can significantly reduce MRI scan time in clinical routines, benefiting patients, increasing the access to MRI, and significantly reducing healthcare cost of MRI.

0810 9:15



Multidimensional MR Spatiospectral Reconstruction Integrating Subspace Modeling and a Plug&Play Denoiser with Recurrent Features

Ruiyang Zhao[1,2], Zepeng Wang[1,3], and Fan Lam[1,2,3]

[1]Beckman Institute for Advanced Science and Technology, University of illinois Urbana-Champaign, Champaign, IL, United States, [2]Department of Electrical and Computer Engineering, University of illinois Urbana-Champaign, Champaign, IL, United States, [3]Department of Bioengineering, University of illinois Urbana-Champaign, Champaign, IL, United States

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence, Image reconstruction, High dimensional imaging

Motivation: Multidimensional MR spatiospectral imaging (MD-MRSI) has many applications but is challenging due to high dimensionality and limited SNR. Subspace and learning-based methods have both demonstrated success.

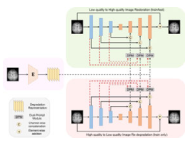
Goal(s): To develop a new MD-MRSI reconstruction method synergizing subspace modeling and a spatiospectral denoiser that can be 'pre-learned' without noisy/clean image pairs.

Approach: A self-supervised training strategy was proposed to learn a network-based denoiser combining convolutional, fully-connected, and recurrent features and effectively exploiting multidimensional "correlations". A plug-and-play ADMM-based algorithm was used to integrate the denoising prior and subspace reconstruction.

Results: Impressive SNR-enhancing reconstruction was demonstrated using simulations and in vivo data from different MD-MRSI acquisitions.

Impact: A new approach is proposed for multidimensional MR spatiospectral image reconstruction integrating low-dimensional modeling and a prelearned denoiser trained via multidimensional interpolation using only noisy data. Potential impacts on quantitative molecular imaging are demonstrated using different MRSI acquisitions.

0811 9:27



High-Quality Brain MRI Reconstruction against Unknown Degradation: A Unified Framework with Prompt Learning

Ning Jiang[1,2,3] and Yao Sui[1,2]

[1]National Institute of Health Data Science, Peking University, Beijing, China, [2]Institute of Medical Technology, Peking University, Beijing, China, [3]School of Medical Technology, Beijing Institute of Technology, Beijing, China

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence

Motivation: Spatial resolution, signal-to-noise ratio, and motion artifacts critically matter in any MRI practices. Current methods focus on a single source of known degradation of imaging. A unified framework is desired, which allows for high-quality reconstruction in the face of multiple unknown sources of degradation.

Goal(s): We reconstruct high-quality brain MRI against degradations by motion, noise, and low resolution, with an image-to-image translation-based deep neural framework.

Approach: We developed a prompt-based learning approach and assessed it on a public brain MRI dataset.

Results: Our method offered remarkably improved reconstructions (PSNR=30.96dB, SSIM=0.9133), as compared to two other state-of-the-art methods.

Impact: We developed a new methodology that enables high-quality MRI reconstruction from scans corrupted by a mixture of multiple unknown sources of degradations, which commonly happen in clinical and research MRI studies, with a unified reconstruction framework.

0812 9:39

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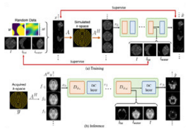


Simultaneous Off-Resonance Correction and Fat-Water Separation From Center-Out Spiral Acquisition Using a Physics-Informed DL Framework

Alfredo De Goyeneche[1], Shreya Ramachandran[1], Ke Wang[1], Ekin Karasan[1], Joseph Cheng[2], Stella Yu[1,3], and Michael Lustig[1]

[1]UC Berkeley, Berkeley, CA, United States, [2]Radiology, Stanford University, Palo Alto, CA, United States, [3]Computer Science and Engineering, University of Michigan, Michigan, MI, United States

Keywords: AI/ML Image Reconstruction, Fat, Off-Resonance

Motivation: Accelerated MRI protocols and fat/water separation are critical in clinical imaging but are compromised by off-resonance artifacts from B0 inhomogeneities, particularly in non-Cartesian trajectories with longer readouts.

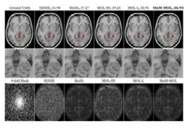
Goal(s): We aim to develop a deep learning framework that enables off-resonance correction from Center-Out Spiral acquisitions, enhancing scan efficiency and image fidelity without extended acquisition times, with the added value of performing fat/water separation.

Approach: Our physics-informed framework employs a multi-frequency bin model trained on synthetic noise data, enabling off-resonance deblurring and extraction of fat and water components without additional acquisition steps.

Results: We showcase our model's efficacy through phantom and in-vivo reconstructions.

Impact: Our physics-informed deep learning framework offers off-resonance correction in Non-Cartesian Spiral MRI, enabling rapid imaging. Our model handles partial volume effects, with the added value of providing fat/water image separation.

0813 9:51



Memory-efficient and robust model-based deep learning using non-montone monotone operator learning (MnM-MOL)

Maneesh John[1], Jyothi Rikhab Chand[1], and Mathews Jacob[1]

[1]Electrical and Computer Engineering, University of Iowa, Iowa City, IA, United States

Keywords: AI/ML Image Reconstruction, Machine Learning/Artificial Intelligence

Motivation: The high memory demand of model-based deep learning algorithms restricts their application in large-scale (eg., 3D/4D) applications. Moreover, their robustness to input perturbations is not well-studied.

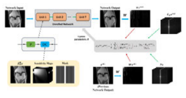
Goal(s): To realize a memory efficient MoDL framework with similar theoretical guarantees as compressed sensing methods, while offering state-of-the-art performance.

Approach: We introduce a memory-efficient deep equilibrium framework with theoretical guarantees on uniqueness, convergence, and robustness.

Results: The proposed scheme offers comparable performance to state of the art methods, while being 10 times more memory-efficient. Additionally, the proposed scheme is significantly more robust to Gaussian and adversarial input perturbations.

Impact: The proposed approach results in greater than 10x reduction in memory demand, which enables the application of MoDL algorithms in large-scale (3D/4D) applications. The theoretically guaranteed robustness of the proposed algorithm reduces the error amplification in highly under-sampled settings.

0814 10:03



[Compressibility-Based Unsupervised Loss for Physics-Driven MRI Reconstruction Networks]

Yasar Utku Alcalar[1,2], Merve Gulle[1,2], and Mehmet Akçakaya[1,2]

[1]Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN, United States, [2]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

Keywords: AI/ML Image Reconstruction, Image Reconstruction, Accelerated imaging, compressed sensing, unsupervised learning

Motivation: Alternative unsupervised training methods are needed for training physics-driven deep learning reconstruction without fully-sampled data.

Goal(s): We propose a novel loss formulation, inspired by compressibility, to evaluate reconstruction quality in supervised, unsupervised and zero-shot settings.

Approach: We leverage reweighted $$$\ell_1$$$-norm, which corresponds to $$$\ell_0$$$-norm of a sparse signal, to evaluate reconstruction quality. In supervised setting, reference weights are used for reweighting, while in unsupervised case, they are updated after each reweighting.

Results: Our findings demonstrate that the networks trained with this loss outperform conventional compressed sensing, while performing similarly to deep learning methods trained using established supervised and unsupervised techniques.

Impact: This work proposes an alternative compressibility-inspired loss formulation that is applicable to supervised, unsupervised and zero-shot learning problems for the training of physics-driven reconstruction neural networks. This approach utilizes compressibility and convexity for learning.

Power Pitch

Pitch: Perinatal MRI

Power Pitch Theatre 1

Wednesday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Jana Hutter & Minhui Ouyang

(no CME credit)

0815 Pitch: 8:15

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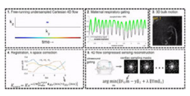
Poster: 9:15

Screen 1



[Retrospective Motion Correction for Fetal 4D Flow MRI]

Reagan M. Tompkins[1], Takashi Fujiwara[2], Eric M. Schrauben[1], Lorna P. Browne[2], Joost van Schuppen[1], Sally-Ann Clur[3], Richard M. Friesen[4], Erin K. Englund[2], Pim van Ooij[1], and Alex J. Barker[2,5]

[1]Department of Radiology & Nuclear Medicine, Amsterdam University Medical Center, location University of Amsterdam, Netherlands, [2]Department of Radiology, Section of Pediatric Radiology, Children's Hospital Colorado, University of Colorado Anschutz Medical Campus, Denver, CO, United States, [3]Department of Pediatric Cardiology, Emma's Children's Hospital, Amsterdam University Medical Center, location University of Amsterdam, Netherlands, [4]Department of Pediatrics, Section of Cardiology, Children's Hospital Colorado, University of Colorado Anschutz Medical Campus, Denver, CO, United States, [5]Department of Bioengineering, University of Colorado Anschutz Medical Campus, Denver, CO, United States

Keywords: Fetal, Motion Correction

Motivation: Maternal breathing and fetal bulk motion frequently limit the utility of fetal 4D flow MRI.

Goal(s): To demonstrate the effects of maternal respiratory and fetal bulk motion correction on 4D flow MRI

Approach: Prospective undersampled fetal 4D flow data were acquired in two subjects, followed by compressed sensing reconstruction that included maternal respiratory gating and bulk motion correction. Standard SENSE-accelerated 4D flow acquisitions without motion correction (N=22) provided reference for the ability to quantify flow.

Results: Comparisons of the motion corrected data to normative performance illustrate the technique's potential for mitigating motion in fetal 4D flow, with equivalence to standard SENSE accelerated scans.

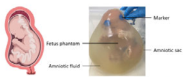
Impact: The proposed sequence and flexible reconstruction workflow provide motion robustness for fetal 4D flow MRI. Further exploration of motion correction techniques has potential to enhance spatial and temporal resolution and to mitigate motion-related errors over extended scanning durations.

0816

Pitch: 8:15

Poster: 9:15

Screen 2



MERIT AWARD SUMMA CUM LAUDE

Development of a cross-modality tissue-mimicking and anatomic mimicking Fetal Phantom to improve image based fetus assessment

Remi Hattat[1], Mariela Zambrano[2], Zhongzheng He[1], Erwan Bozec[3], Mbaimou Auxence Ngremmadji[1], Marine Beaumont[1,2], Olivier Morel[1,4], Gaëlle Ambroise Grandjean[1,4], and Bailiang Chen[1,2]

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Keywords: Fetal, Phantoms, Fetus, Biometrics, Tissue mimicking, Cross-modality imaging

Motivation: Fetal MRI necessitates extra care due to inherent safety concerns, complicating the optimization of MRI protocols and calibration with ultrasound assessments.

Goal(s): To mitigate the aforementioned safety problems, we aim to create a cross-modality, tissue-mimicking, anatomically correct fetal phantom.

Approach: We designed a fetus phantom encapsulated within a natural rubber balloon filled with mimicking amniotic fluid, creating an amniotic sac analogue. This design utilized varying compositions of agarose, gadolinium, and gelatin to replicate different fetal organs with distinct T1 and T2 values.

Results: The developed phantom comprises various fetal organs and relaxation times, enabling precise fetal biometric comparisons between MRI and ultrasound modalities.

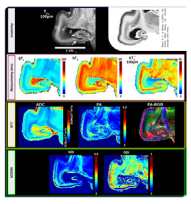
Impact: With the help of the developped cross-modality, tissue-mimicking and anatomical mimicking fetus phantom, the aforementioned constraints on fetal MR protocol optimization and calibration between different MR and ultrasound should be relaxed.

0817

Pitch: 8:15

Poster: 9:15

Screen 3



EX VIVO 11,7T MR MESOSCOPIC MULTIMODAL IMAGING OF FETAL BRAIN DEVELOPMENT

Lucas Arcamone[1,2], Cyril Poupon[3], Suonavy Khung[4], Marianne Alison[5], Homa Adle-Biassette[6], Lucie Hertz-Pannier[1,7], and Yann Leprince[8]

[1]UMR 1141 NeuroDiderot, Eq inDEV, INSERM, Univeristé Paris Cité, Hôpital Robert Debré, Paris, France, [2]UNIACT, NeuroSpin, CEA, Université Paris-Saclay, Gif-sur-Yvette, France, [3]BAOBAB, NeuroSpin, Université Paris-Saclay, CNRS, CEA, Gif-sur-Yvette, France, Metropolitan, [4]Unité fonctionnelle de fœtopathologie, AP-HP, Hôpital Universitaire Robert-Debré, Paris, France, Metropolitan, [5]Service d'imagerie pédiatrique, AP-HP, Hôpital Robert-Debré, Paris, France, [6]Service d'Anatomie Pathologique, AP-HP, Hôpital Lariboisière, Paris, France, Metropolitan, [7]UNIACT, NeuroSpin, CEA, Université Paris-Saclay, Gif-sur-Yvette, France, Metropolitan, [8]UNIACT, NeuroSpin, CEA, Université Paris-Saclay, Paris, France, Metropolitan

Keywords: Data Acquisition, Multimodal, Quantitative imaging, Mesoscopic

Motivation: White matter injuries are common in very premature babies and carry a significant risk of lifelong motor/cognitive disabilities.

Goal(s): Create mesoscopic resolution anatomical imaging, relaxometries, and diffusion MRI data to collect full 3D coverage of multiparametric information on tissue composition and connectivity, and compare to co-registered histology.

Approach: Each brain is imaged in situ at 3T shortly after death for registration purposes. After sample preparation, brains are imaged at 7T, then at 11.7T.

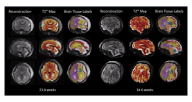
Results: We develop a unique multimodal mesoscopic (~100µm isotropic) post-mortem MRI atlas of brain development during the prenatal period (from 20 to 41 gestational weeks -GW) using 11,7T MRI.

Impact: The premature Human Connectome Project (p-HCP) provides the first mesoscopic multimodal quantitative MRI data at 11.7T of the anatomy, connectivity, cytoarchitecture, and microstructure of normal prenatal neurodevelopment during the second and third trimester of pregnancy.

0818 Pitch: 8:15

Poster: 9:15

Screen 4



[T2* relaxometry of Fetal Brain Tissues using Low Field MRI]

Kelly Payette[1,2], Alena U. Uus[1,2], Jordina Aviles Verdera[1,2], Megan Hall[1,2,3], Joseph V. Hajnal[1,2], Mary A. Rutherford[1], Lisa Story[1,2,3], and Jana Hutter[1,2,4]

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Keywords: Fetal, Fetus

Motivation: The complex and rapid changes during human brain development call for a matched analysis of both structure and function. T2* relaxometry delivers non-invasive insights and pairs well with low field MRI. However, regional assessment is currently lacking.

Goal(s): Investigate the ability of low field MRI to quantify regional fetal brain T2*.

Approach: We acquired dynamic multi-echo gradient-echo sequences at 0.55T and developed automatic high-resolution reconstruction and segmentation to obtain the mean T2* values of 7 individual brain tissues.

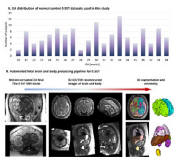
Results: Fetal brain tissues vary both in absolute T2* value and in progression have differing T2* values and growth curves throughout gestation.

Impact: Regional fetal brain T2* values, obtained with an automatic pipeline, match the complexity, speed of change and growth during early human brain development and thus carry the potential to play a significant role in future research studies and clinical monitoring.

0819 Pitch: 8:15

Poster: 9:15

Screen 5



[Normative growth models for T2w 0.55T fetal brain and body MRI: population-averaged 4D atlases and volumetry centiles]

Alena Uus[1,2], Jordina Aviles Verdera[1,2], Kelly Payette[1,2], Megan Hall[2,3,4], Sara Neves Silva[1,2], Kathleen Colford[2], Aysha Luis[2], Jacqueline Matthew[1,2], Maria Deprez[1,2], Sarah Mcelroy[2], Joseph V. Hajnal[1,2], Mary Rutherford[2], Lisa Story[2,3,4], and Jana Hutter[1,2,5]

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Keywords: Fetal, Fetus

Motivation: Low field MRI is a promising direction for fetal imaging. Yet, there are no reported models of fetal development specific to 0.55T.

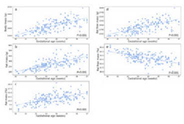
Goal(s): We aim to formalise normal fetal growth models for structural 0.55T MRI.

Approach: We use registration-based approach for generation of spatio-temporal templates from 3D D/SVR reconstructed images of the fetal brain and body and apply deep learning segmentation to parcellate organs for volumetry from >100 control subjects.

Results: This work introduces the first T2w fetal atlases and volumetry growth charts for 0.55T brain and body MRI depicting normal development across 22-38 weeks gestation. All models are publicly available online.

Impact: This work is the first step toward formalisation of analysis protocols for normal fetal brain and body development and optimisation of segmentation methods for low field strength fetal MRI.

0820 Pitch: 8:15 Poster: 9:15 Screen 6



Prenatal fat-water MRI-based body composition reference charts and sexual dimorphism

Aviad Rabinowich[1,2,3], Netanell Avisdris[3,4], Bossmat Yehuda[3,5], Ayala Zilberman[2,6], Bar Neeman[1,2], Tamir Graziani[1,2], Jayan Khawaja[1,2], Sharon Vanetik Klein[2,7], Bella Specktor-Fadida[8], Jacky Herzlich[2,9], Leo Joskowicz[8,10], Liat Ben Sira[1,2], Liran Hiersch[2,6], and Dafna Ben Bashat[2,11,12]

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Keywords: Fetal, Fetus

Motivation: Preterm infants' nutritional management should aim to replicate the intrauterine body composition. However, intrauterine body composition reference charts are lacking.

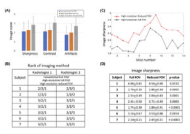
Goal(s): We aimed to construct MRI-based intrauterine body mass (BM), fat mass (FM), percent FM (%FM), fat-free mass (FFM), and percent FFM (%FFM) body composition reference charts.

Approach: Fetal body composition was computed from T_2-weighted and fat-water images. Body and subcutaneous fat volumes were automatically segmented using neural networks, and BM, FM, %FM, FFM, and %FFM were calculated.

Results: Data of 176 participants with apparently normal singleton fetuses were included. All parameters significantly changed throughout gestation, and differences between sexes were seen.

Impact: MRI-based intrauterine BM, FM and FFM body composition reference charts may be used as reference for appropriate prenatal growth and may assist in nutritional management of preterm infants.

0821 Pitch: 8:15 Poster: 9:15 Screen 7



Evaluation of high-resolution fetal brain anatomical imaging with a reduced field of view using outer volume suppression

MinJung Jang[1], Ajay Gupta[1], Arzu Kovanlikaya[1], Jessica E. Scholl[2], and Zungho Zun[1]

[1]Department of Radiology, Weill Cornell Medicine, New York, NY, United States, [2]Department of Obstetrics and Gynecology, Weill Cornell Medicine, New York, NY, United States

Keywords: Fetal, Fetus

Motivation: Conventional anatomical imaging of the fetal brain is limited by low resolution due to an inherently large field-of-view and a restricted matrix size.

Goal(s): To achieve high-resolution fetal brain imaging and evaluate the image quality compared to conventional fetal brain imaging.

Approach: Fetal brain anatomical imaging was performed using optimized outer volume suppression for higher resolution. Image quality was scored by neuroradiologists, and image sharpness was calculated using gradient norms.

Results: High-resolution anatomical images acquired using our approach demonstrated improved image quality both quantitatively and qualitatively, without an increased scan time.

Impact: High-resolution fetal brain anatomical imaging with a reduced field-of-view achieved by optimized outer volume suppression demonstrates improved image quality compared to conventional imaging methods. This approach may help increase diagnostic accuracy in identifying brain abnormalities in utero.

0822 Pitch: 8:15

Poster: 9:15

Screen 8

[Using TE-Dependent Analysis for Multi-Echo fMRI Analysis of the Fetal Brain]

Janina Schellenberg[1], Megan Hall[2,3,4], Lisa Story[2,3,4], Afra Wohlschläger[1,5], and Jana Hutter[2,3,6]

[1]Technical University of Munich, Munich, Germany, [2]Biomedical Engineering, King's College London, London, United Kingdom, [3]Centre for the Developing Brain, King's College London, London, United Kingdom, [4]Women's Health, Guy's & St.Thomas' Hospital, London, United Kingdom, [5]Department of Neuroradiology and TUM-NIC, Klinikum rechts der Isar, Munich, Germany, [6]Smart Imaging Lab, Radiological Institute, University Hospital Erlangen, Erlangen, Germany

Keywords: Fetal, Brain, Multi-Echo Analysis

Motivation: fMRI of the fetus in the womb must overcome the challenges of fetal motion and heterogeneous tissue boundaries. Multi-Echo fMRI reduces signal dropout and thermal noise, improving contrast-to-noise ratio of the BOLD signal. This can produce higher quality fetal MRI and allow adequate functional assessment of fetal brain development.

Goal(s): This study aims to denoise ME-fMRI of the fetal brain with TE-dependent analysis (tedana) in a subset of 10 cases (gestational age >35weeks).

Approach: Multi-echo gradient echo EPI scans were acquired in 80 fetuses. The fetal brain is segmented and passed to the analysis.

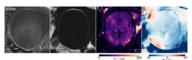
Results: Credible BOLD components are successfully identified using tedana.

Impact: TE-dependent analysis denoises ME-fMRI data of fetuses which undergo motion during scanning and contain heterogeneous tissue boundaries. This study assesses capabilities of ME-fMRI analysis to determine BOLD components in the fetal brain,paving the way for future research and clinical usage.

0823 Pitch: 8:15

Poster: 9:15

Screen 9



Quantitative T_{2}^{*} and B_{0} Mapping of Fetal Brain Using Stack-of-Star Multi-Echo FLASH and Model-Based Reconstruction

Xiaoqing Wang[1], Jian Wang[1], Onur Afacan[1], Serge Vasylechko[1], Simon Warfield[1], and Ali Gholipour[1]

[1]Computational Radiology Laboratory, Boston Children's Hospital, and Harvard Medical School, Boston, MA, United States

Keywords: Fetal, Fetus, model-based recontruction; T2* mapping; QSM

Motivation: Quantitative T_{2}^{*} and susceptibility mapping is of great interest for fetal MRI. While conventional EPI-based approaches are efficient, they usually suffer from motion and field distortion artifacts.

Goal(s): To develop a distortion-free and motion-robust quantitative T_{2}^{*} and susceptibility mapping approach for fetal brain.

Approach: A stack-of-star multi-echo FLASH sequence and model-based reconstruction were developed for quantitative mapping of T_{2}^{*} and B_{0} of fetal brain. Motion estimation and correction is incorporated into the reconstruction to reduce motion artifacts.

Results: Initial findings indicate accurate T_{2}^{*} measurements. Motion-corrected image reconstruction effectively minimized motion artifacts. Fetal T_{2}^{*} and B_{0} maps are obtained with reasonable quantitative T_{2}^{*} values.

Impact: Our technique enables distortion-free and motion-robust quantitative T_{2}^{*} and B_{0} mapping for the fetal brain, utilizing a stack-of-star multi-echo acquisition and model-based reconstruction. It has the potential to address motion and field distortion artifacts typically encountered in EPI-based methods.

0824 Pitch: 8:15
Poster: 9:15
Screen 10

<u>A framework for abnormality detection in developing white matter in utero, applied to fetuses with Congenital Heart Disease</u>

Sian Wilson[1], Daniel Cromb[1], Vyacheslav Karolis[1], Daan Christiaens[2], Alena Uus[1], Russell Macleod[1], Anthony Price[1], Joseph V Hajnal[1], A. David Edwards[1], Jonathan O'Muircheartaigh[1], Jacques-Donald Tournier[1], and Serena J Counsell[1]

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Keywords: Fetal, Fetus

Motivation: In utero neurodevelopment is complex and not well understood, particularly in fetuses with Congenital Heart Disease.

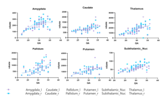
Goal(s): Normatively model microstructural maturation in transient fetal compartments

Approach: Diffusion MRI was acquired in a healthy control cohort of 235 fetuses (22–37 weeks gestation). White matter bundles were estimated and divided into cross-sections. Gaussian Process Regression models were fit to diffusion metrics in each cross-section, and Z-scores calculated along the tract for 26 fetuses with CHD.

Results: We observe gradients of change, highlighting abnormal regions along the white matter unique to each subject. We did not find consistent patterns or associations with a specific diagnosis.

Impact: We establish normative trajectories in diffusion MR signal at the level of individual fetal brain compartments that reflect developing microstructure, improving understanding of dynamic fetal brain development and allowing us to predict deviations from the norm.

0825 Pitch: 8:15
Poster: 9:15
Screen 11



<u>Normal subcortical nucleiand and cortex Growth ， and Lateral Asymmetries at Fetal Brain MRI</u>

Yue Songhong[1], Li Jie[1], Ling Xiao[1], Zheng Weihao[2], and Zhang Jing[1]

[1]Lanzhou University Second Hospital, Lanzhou, China, [2]School of information Science& Engineering,Lanzhou University, Lanzhou, China

Keywords: Fetal, Fetus

Motivation: The subcortical nuclei have important brain connectivity, which are rarely studied in fetal brain development.

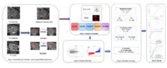
Goal(s): The aim of this study is to analyze the developmental characteristics of fetal subcortical nuclei and their relationship with gestational age and cortical development.

Approach: The subcortical nuclei and cortical volumes were manually segmented from the three-dimensional (3D) volume parameters of tomosynthesis to volume reconstruction (SVR) images

Results: We found a good linear relationship between subcortical nuclei and gestational age, with agreement on the left and right sides. In addition, we found good coupling between the subcortical nuclei and right cerebral cortex development.

Impact: 3D Volumetric MR to assess the developmental characteristics of fetal subcortical nuclei and their relationship with gestational age. The normative values of fetal intracranial structures across a range of gestations could e used as a reference tool in prenatal counseling.

0826 Pitch: 8:15 Poster: 9:15 Screen 12



[Machine learning and the prediction of enlarged lateral ventricular postnatal development trend in fetuses with isolated ventriculomegaly]

Xue Chen[1], Zhou Huang[2], Peng Wu[3], Jibin Zhang[1], and Yonggang Li[2]

[1]Department of Radiology, the Affiliated Suzhou Hospital of Nanjing Medical University, Suzhou Municipal Hospital, Suzhou, China, [2]Department of Radiology, the First Affiliated Hospital of Soochow University, Suzhou, China, [3]Philips Healthcare, Shanghai, China

Keywords: Fetal, Machine Learning/Artificial Intelligence

Motivation: To evaluate the intracranial structures and distinct components (grew matter [GM] and white matter [WM]) adjacent to the occipital horn of the lateral ventricle T2WI radiomics features in healthy fetuses and fetuses with ventriculomegaly (FVs),

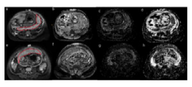
Goal(s): and to predict postnatal changes in the size of the enlarged lateral ventricle in FVs.

Approach: Utilizing WM-radiomics on the affected sides of FVs, the SVM algorithm effectively predicted the changes in ventricle size,

Results: as evidenced by the highest area under the curve (AUC) values of 0.771 and 0.738 in both the training and validation sets based on DeLong's test (all P < 0.05).

Impact: An MRI-based occipital WM-radiomics model holds the potential to predict trends in changing ventriculomegaly.The image-based predictive model exhibits applicability in prenatal care. Leveraging image analysis and machine learning techniques may provide further insight into the pathophysiologic features of ventriculomegaly.

0827 Pitch: 8:15 Poster: 9:15 Screen 13



[MRI-Based Quantitative Analysis of Placenta and Fetal Brain in SGA Pregnancies: Feasibility Insights]

Bingqing Xia[1], Taotao Sun[1], Ling Jiang[1], Zhaoxia Qian[1], Feifei Qu[2], Hongjiang Wei[3,4], and Jiangjie Wu[5]

[1]Radiology, International Peace Maternity and Child Health Hospital, Shanghai, China, [2]MR Research Collaboration, Siemens Healthineers, Shanghai, China, [3]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [4]The National Engineering Research Center of Advanced Magnetic Resonance Technologies for Diagnosis and Therapy (NERC-AMRT), Shanghai Jiao Tong University, Shanghai, China, [5]the School of Information Science and Technology, ShanghaiTech University, Shanghai, China

Keywords: Prenatal, Prenatal

Motivation: Understanding placental dysfunction's role in small-for-gestational-age (SGA) fetal neurodevelopment is crucial; this study seeks to fill that gap, enhancing prenatal care.

Goal(s): The primary goal is to assess whether MRI can effectively quantify the relationship between placental function and fetal brain development in SGA pregnancies.

Approach: The study used IVIM, and T2* mapping to evaluate placental and fetal brain development, applying Pearson correlation and *t* tests for comparative analysis.

Results: Significant differences in placental perfusion and cortical properties between control and SGA groups were reported, demonstrating the feasibility of using MRI for in-utero assessment.

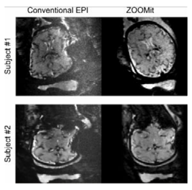
Impact: This study's MRI approach could change prenatal care, allowing earlier detection of small-for-gestational age–related brain development issues, prompting interventions, and guiding research into neurodevelopmental support for affected neonates, with potential long-term cognitive benefits.

0828

Pitch: 8:15

Poster: 9:15

Screen 14



High-resolution Susceptibility Weighted Fetal Brain using ZOOMit EPI and Slice to Volume reconstruction

Xiaoqing Wang[1], Clemente Velasco-Annis[1], Camilo Calixto[1], Ali Gholipour[1], and Camilo Jaimes[2]

[1]Computational Radiology Laboratory, Boston Children's Hospital, and Harvard Medical School, Boston, MA, United States, [2]Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States

Keywords: Fetal, Fetus

Motivation: Susceptibility weighted imaging is of great interest in fetal MRI. Conventional single-shot EPI often suffers from field distortion and motion artifacts due to long readout.

Goal(s): To develop a susceptibility-weighted isotropic fetal brain imaging technique with reduced artifacts.

Approach: ZOOMit EPI was used for data acquisition. A slice-to-volume reconstruction was further employed to correct the motion between slices and reconstruct an isotropic high-resolution volume of the fetal brain.

Results: Zoomit EPI produces images with reduced artifacts due to reduced acquisition time. The slice-to-volume reconstruction further corrects the motion between slices and reconstruct an isotropic high-resolution SWI-weighted volume of the fetal brain.

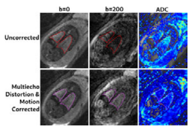
Impact: Zoomit EPI offers faster scan times and produces images with reduced artifacts. With Zoomit EPI, high-resolution SWI-weighted isotropic fetal brain imaging has been achieved using slice-to-volume reconstruction.

0829

Pitch: 8:15

Poster: 9:15

Screen 15



Improved Quantitative Diffusion in Fetal Lungs with Multiecho EPI Distortion and Motion Correction

Liam Timms[1], Mustafa Utkur[1], Ali Gholipour[1], Ryne A. Didier[1], Alireza A. Shamshirsaz[2], Sila Kurugol[1], and Onur Afacan[1]

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Keywords: Fetal, Fetus, fetal lung, diffusion, distortion correction

Motivation: Accurately assessing fetal lung maturity and development with quantitative diffusion parameters could guide critical care for at-risk fetuses, but has been severely limited by artifacts.

Goal(s): Develop an MRI technique to enable reliable diffusion imaging of fetal lungs.

Approach: Investigated a multi-echo spin echo sequence to provide motion/distortion correction.

Results: The technique improved lung analysis, in particular, resulting in more consistent ADC fitting. The method also increased the geometric fidelity of the diffusion image with structural images.

Impact: This work demonstrates a novel MRI technique to enable reliable diffusion imaging of fetal lungs, overcoming current barriers of motion and artifacts. Improving lung maturity assessment during pregnancy has the potential to transform care for at-risk fetuses through earlier interventions.

0830

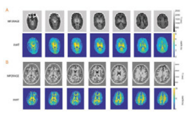
MERIT AWARD

MAGNA CUM LAUDE

Pitch: 8:15

Poster: 9:15

Screen 16



Inhomogeneous Magnetization Transfer Imaging in Extremely Preterm Neonates at 7T.

Inge M. van Ooijen[1,2], Lieke van den Wildenberg[2], Alex Bhogal[2], Ece Ercan[3], Jeroen Dudink[1], Maria Luisa Tataranno[1], Maaike Nijman[1], Manon J.N.L. Benders[1], Fredy Visser[2,4], Dennis W.J. Klomp[2], Jannie P. Wijnen[2], and Evita C. Wiegers[2]

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Keywords: Neonatal, Neonatal, Neuro; Pediatrics; High-Field-MRI

Motivation: Extremely preterm neonates often show myelination delay in the brain, which is associated with long-term neurodevelopmental outcome impairments. Traditional imaging lacks myelin specificity, therefore, we implemented inhomogeneous magnetization transfer (ihMT).

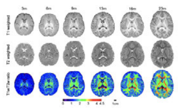
Goal(s): This study explores the use of ihMT at 7 Tesla for myelin assessment in extremely preterm neonates.

Approach: The ihMT data was acquired from a phantom, demonstrating its specificity for myelin content. Six neonates and five adults were scanned with ihMT, and an ROI-based analysis was performed.

Results: Phantom and human data confirm ihMT's potential for myelin evaluation. As expected, neonates exhibit lower ihMTR values in key brain regions compared to adults.

Impact: This study is an important first step in discovering myelin development in the extremely preterm neonatal brain. Differences in myelin development across the extremely preterm population could be used to predict long-term neurodevelopmental outcome in the future.

0831 Pitch: 8:15 Poster: 9:15 Screen 17



[Differential myelination maturation across cortical regions and white matter tracts during infancy]

Ruolin Li[1,2], Wentao Wu[1,2], Sovesh Mohapatra[1,2], Kay L. Sindabizera[1], Ziqin Zhang[1,2], Cheng En Lee[1], Minhui Ouyang[1,3], and Hao Huang[1,3]

[1]Department of Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States, [2]Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

Keywords: Normal Development, Screening, Myelination, Infant Brain, Early Development, Structural MRI

Motivation: While myelination is known to progress rapidly in the infant brain, the specific myelination progression in finer cortical regions and white matter (WM) tracts remain elusive. The precise effects of environmental impacts on infant brain myelination maturation require further investigation.

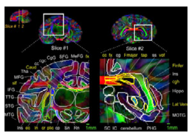
Goal(s): Our goal was to delineate differential myelination maturation trajectories across cortical and WM regions during infancy and explore their associations with environmental factors.

Approach: T1-weighted and T2-weighted images were used to map myelin content and analyzed with generalized additive models.

Results: Differential myelination processes were found across cortical and white matter regions, with significant correlations to socioeconomic status and parental stress.

Impact: This research advances understanding of complicated yet organized patterns in the early developing brain, informing pediatric care strategies. It enables targeted interventions for at-risk groups based on environmental impacts, potentially improving long-term cognitive outcomes. Further studies could investigate intervention efficacy.

0832 Pitch: 8:15 Poster: 9:15 Screen 18



[Common coordinate framework of neonate macaque brain based on ultra-high-resolution diffusion MRI]

Juri Kim[1,2], Tianjia Zhu[1,2], Fengxia Wu[3,4], Andre Sousa[5], Jon Levine[5], Arnold Kriegstein[6], and Hao Huang[1,4]

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Keywords: Normal Development, Normal development, large animals-nonhuman primates, ultra-high resolution, diffusion MRI, common coordinate framework

Motivation: Macaque brain structures change dramatically from birth to adulthood. However, there is no neonate macaque brain common coordinate framework (CCF) serving as neuroanatomical reference for mapping genetic, cellular, and molecular information.

Goal(s): To establish an ultra-high-resolution CCF for macaque brain at birth.

Approach: We acquired ultra-high resolution diffusion MRI (dMRI) of neonate macaque brain and annotated fine neuroanatomical structures and investigated white matter tract development from neonate to adult macaque through dMRI-based tractography.

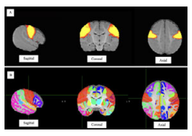
Results: The established neonate macaque brain CCF is featured with 0.2mm isotropic ultra-high diffusion imaging resolution, comprehensive gray and white matter labels, and a coordinate framework.

Impact: This first neonate macaque brain CCF with 0.2mm isotropic ultra-high diffusion imaging resolution serves as neuroanatomical reference, enables mapping genetic, cellular, and molecular information, and provides image templates, laying the foundation for the brain development and evolution discoveries.

0833 Pitch: 8:15

Poster: 9:15

Screen 19



Functional connectivity of motor resting-state networks in infants who are HIV-exposed uninfected in a South African birth cohort study

Simone Rose Williams[1,2], Joanah Madzime[1,2], Michal R Zieff[1,2], Niall Bouke[3], Lauren Davel[1,2], Layla E Bradford[1,2], Reese Samuels[1,2], Chloë A Jacobs[1,2], Sadeeka Williams[1,2], Nwabisa Mlandu[1,2], Tracy Pan[1,2], Zamazimba Madi[1,2], Thandeka Mazubane[1,2], Tembeka Mhlakwaphalwa[1,2], Khanyisa Nkubungu[1,2], Bokang Methola[1,2], Marlie Miles[1,2], Jessica E Ringshaw[1,2,3], Daniel C Alexander[4], Derek K Jones[5], Steven C. R Williams [3], and Kirsten A Donald[1,2]

[1]Paediatrics and Child Health, University of Cape Town, Cape Town, South Africa, [2]Neuroscience Institute, Cape Town, South Africa, [3]King's College London, London, United Kingdom, [4]University College London, London, United Kingdom, [5]Cardiff University, Wales, United Kingdom

Keywords: Neuro, Brain Connectivity, Neurodevelopment, Paediatrics, HIV exposure, resting state fMRI

Motivation: Children who are HIV-exposed uninfected present with an increased risk of adverse motor developmental outcomes. Little is known about the pathophysiological mechanisms governing these outcomes.

Goal(s): This study aimed to investigate functional connectivity within the motor resting-state network in infants who are HIV-exposed uninfected using resting-state functional MRI.

Approach: We used Group Independent Component Analysis to identify the motor resting-state network and multivariate linear regression was used to compare its functional connectivity between groups.

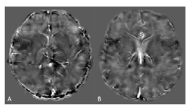
Results: Infants who are HIV-exposed uninfected showed significant connectivity alterations in 26 connections within the motor resting-state network when compared to infants who are unexposed.

Impact: Functional connectivity alterations observed in the motor resting-state network could be linked to adverse motor developmental outcomes in children who are HIV-exposed uninfected. Future research will look at associations between functional connectivity of motor resting state network and motor development.

0834 Pitch: 8:15

Poster: 9:15

Screen 20



Cerebral Quantitative Susceptibility Mapping in Neonates with Congenital Heart Disease

Elizabeth George[1], Jinhee Lee[1], Megan Martin[1], Di Cui[1], Jingwen Yao[1], Duan Xu[1], Shabnam Peyvandi[2], Janine Lupo[1], and Patrick Mcquillen[3]

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Keywords: Neuro, Quantitative Susceptibility mapping, congenital heart disease

Motivation: QSM has potential in monitoring altered cerebral oxygenation and quantifying cerebral microhemorrhages (CMH) in neonates with congenital heart disease (CHD).

Goal(s): To use 1) QSM to detect post-surgical changes in cerebral oxygenation and 2) a deep-learning algorithm to quantify CMH.

Approach: Cerebral susceptibility (χ) normalized to the ventricle was compared pre- vs. post-surgery and between CHD types. Deep-learning based quantification of CMH burden was compared pre- vs. post-surgery and assessed for relationship to cardiac bypass duration.

Results: Normalized post-surgery χ trended lower in neonates with transposition of great arteries compared to single ventricle physiology. Post-operative CMH burden was associated with cardiac bypass duration.

Impact: QSM-derived cerebral susceptibility post-surgery varies based on lesion type in congenital heart disease (CHD), supporting a potential role for QSM in detecting cerebral oxygenation changes. Cerebral microhemorrhages are common in neonates with CHD and are associated with surgical parameters.

Power Pitch

Pitch: Tissue Composition & Characterization

Power Pitch Theatre 2

Wednesday

Pitches: 8:15 - 9:15

Posters: 9:15 - 10:15

Moderators: S. Sendhil Velan & Nan Wang

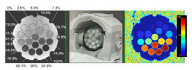
(no CME credit)

0835

Pitch: 8:15

Poster: 9:15

Screen 21



Linearity and Bias of Proton Density Fat Fraction Across the Full Dynamic Range (0-100%): a Multiplatform, Multivendor Phantom Study at Two Sites.

Houchun Harry Hu[1], Henry Chen[1], and Diego Hernando[2]

[1]Radiology, University of Colorado and Children's Hospital Colorado , Anschutz Medical Campus, Aurora, CO, United States, [2]Radiology and Medical Physics, University of Wisconsin-Madison, Madison, WI, United States

Keywords: Liver, Fat, proton density fat fraction, quantitative, reproducibility, repeatability

Motivation: Performance assessment of PDFF in phantoms and in vivo, including linearity and bias, and reproducibility and repeatability, have largely focused between the range of 0-50%.

Goal(s): We analyzed PDFF performance in a two-site phantom study across the full 0-100% PDFF range.

Approach: We used commercially available quantitative 3D chemical-shift-encoded water-fat MRI pulse sequences across three vendors at 1.5T and 3T.

Results: Results demonstrate strong linearity and minimal bias {pooled slope and intercept for 1.5T=0.99 (95% CI: 0.981-0.997), 0.61 (0.17, 1.04); for 3T=1.00 (0.995, 1.005), 0.69 (0.39, 0.97)} of PDFF across 10 MRI systems. Pooled reproducibility coefficient **(RDC)** across 30 phantom exams was 3.92%.

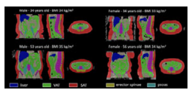
Impact: PDFF across the 0-100% range can be reliably estimated with minimal bias and strong linearity using current commercial offerings from MRI vendors at 1.5T and 3T, with intra-scanner repeatability coefficient<2% (in PDFF%) and inter-scanner, inter-site, and inter-vendor RDC<4% (in PDFF%).

0836

Pitch: 8:15

Poster: 9:15

Screen 22



Age dependency of abdominal fat depot volumes and proton density fat fractions in people with obesity

Mingming Wu[1], Arun Somasundaram[1], Selina Rupp[1], Jessie Han[1], Daniela Junker[1], Anna Reik[2], Stella Naebauer[1], Johannes Raspe[1], Lisa Patzelt[1], Meike Wiechert[2], Daniel Rueckert[3,4], Hans Hauner[2,5], Christina Holzapfel[2,6], and Dimitrios Karampinos[1,7,8]

[1]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Munich, Germany, [2]Institute of Nutritional Medicine, Technical University of Munich, Munich, Germany, [3]TUM School of Computation, Information, and Technology, Technical University of Munich, Munich, Germany, [4]Department of Computing, Imperial College London, London, United Kingdom, [5]Else Kroener Fresenius Center for Nutritional Medicine, Technical University of Munich, Munich, Germany, [6]Department of Nutritional, Food and Consumer Sciences, Fulda University of Applied Sciences, Fulda, Germany, [7]Munich Institute of Biomedical Engineering, Technical University of Munich, Garching, Germany, [8]Munich Data Science Institute, Technical University of Munich, Garching, Germany

Keywords: Endocrine, Aging, Obesity

Motivation: As cardiometabolic risk in obesity is associated with specific body composition types, we aim at deciphering age-related body composition changes in people with obesity.

Goal(s): To assess age-specific abdominal organ volume and proton density fat fraction (PDFF) in people with obesity and predict chronological age.

Approach: An nnU-Net-based automatic pipeline was used to segment abdominal organs. Machine-learning-based methods were applied to predict chronological age based on the organs' volumes and PDFF in chemical-shift encoding-based MRI.

Results: The best predictors for chronological age were increased visceral adipose tissue volume and elevated ectopic fat deposition in the paraspinal muscle, measured via proton density fat fraction.

Impact: Age-specific differences in volumes and PDFF of abdominopelvic fat depots, and ectopic fat in liver and two muscles were found in people with obesity using automated segmentation on quantitative chemical-shift encoding-based MRI scans.

0837 Pitch: 8:15

Poster: 9:15

Screen 23

Region	T1 values	
	N	Mean±SD (ms)
Segment 1	11	517.95±80.04
Segment 2	99	576.13±66.87
Segment 3	79	569.13±70.95
Segment 4	64	520.86±64.49
Segment 5	5	527.99±59.66
Segment 6	1	597.45
Segment 7	0	-
Segment 8	1	421

N=number; SD=standard deviation.

<u>Liver T1 Mapping in a Large Cohort of Healthy Subjects: Normal Ranges and Correlation with Age and Sex</u>

Antonella Meloni[1], Aldo Carnevale[2], Paolo Gaio[2], Vincenzo Positano[1], Alessia Pepe[3], Andrea Barison[1], Giancarlo Todiere[1], Chrysanthos Grigoratos[1], Laura Pistoia[1], Petra Keilberg[1], Melchiore Giganti[2], Filippo Cademartiri[1], and Alberto Cossu[2]

[1]*Fondazione G. Monasterio CNR-Regione Toscana, Pisa, Italy,* [2]*University of Ferrara, Ferrara, Italy,* [3]*University of Padua, Padova, Italy*

Keywords: Liver, Tissue Characterization, normal values

Motivation: To fully exploit the clinical potential of T1 mapping in liver disease detection, normal values should be established.

Goal(s): We defined normal ranges for native hepatic T1 values using a 1.5T General Electric scanner.

Approach: MOLLI sequences were acquired in 100 healthy volunteers and native T1 values were quantified in the visible hepatic segments.

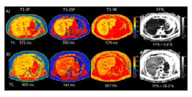
Results: Segmental and global liver T1 values exhibited a good intra- and inter-observer reproducibility. A significant difference in the segmental T1 values was detected. Segmental and global T1 values were not associated with age and were comparable between males and females.

Impact: Liver T1 mapping is feasible and reproducible and the provided normal ranges may help to establish diagnosis and progression of various liver diseases.

0838 Pitch: 8:15

Poster: 9:15

Screen 24



<u>Simultaneous Water-Specific T1 and Fat Fraction Mapping of the Liver using Look-Locker Dixon MRI</u>

Joshua S Greer[1], Mary-Kate Manhard[2], Matt Lanier[2], Jonathan R. Dillman[2], and Amol Pednekar[2]

[1]*Philips, Cincinnati, OH, United States,* [2]*Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States*

Keywords: Liver, Quantitative Imaging

Motivation: Hepatic tissue architecture and water-fat content change concurrently with liver disease progression. Simultaneous measurement of water-specific T1 (T1-W) and proton density fat fraction (PDFF) can serve as a quantitative metric for assessment of liver disease.

Goal(s): To develop and validate a Look-Locker multi-echo Dixon (LLmDIXON) technique to simultaneously measure T1-W and PDFF in a single breath-hold.

Approach: Simultaneous T1-W and PDFF measurements were obtained using LLmDIXON and reference sequences in a phantom (0-40 % PDFF) and four volunteers (4.0-18.2% PDFF).

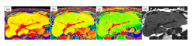
Results: The LLmDixon-based T1-W and PDFF values agreed with simulations and reference sequences in a phantom, and provided comparable PDFF values in volunteers.

Impact: LLmDixon provides simultaneous measurement of water-specific T1 and PDFF in a single 15s breath hold. This technique has the potential to characterize liver disease, where both cellular architecture and fat content can concurrently change as disease progresses.

0839 Pitch: 8:15

Poster: 9:15

Screen 25



<u>Influence of hepatic steatosis on T1 values of the liver: Comparison of T1 mappings at different echo times</u>

Masahiro Tanabe[1], Mayumi Higashi[1], Yosuke Kawano[1], and Katsuyoshi Ito[1]

[1]*Department of Radiology, Yamaguchi University Graduate School of Medicine, Ube, Japan*

Keywords: Liver, Liver, T1 mapping, hepatic steatosis

Motivation: In evaluating T1 values in patients with hepatic steatosis, it is necessary to investigate the effect of fat because MOLLI is sensitive to fat.

Goal(s): To elucidate the clinical importance of MOLLI T1 mapping of the liver using TE=1.8 (AIOP) sequence in daily practice.

Approach: In 122 patients with suspected liver diseases, MOLLI T1 mapping with TE=1.8 (AIOP) was compared with that with TE=1.3 (OP) and TE=2.4 (IP).

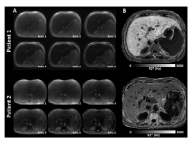
Results: The positive correlation with high correlation coefficient between T1 value of the liver in AIOP sequence and FIB-4 score was observed in patients with hepatic steatosis (PDFF ≥10%).

Impact: T1 mapping using AIOP sequence will be critical for assessing liver fibrosis in patients with hepatic steatosis since T1 mapping obtained by OP and IP sequences have risk of over- and under-estimation of T1 measurements.

0840 Pitch: 8:15

Poster: 9:15

Screen 26



R2* Mapping of Extreme Hepatic Iron Overload Using Free-Breathing UTE Sequence

Fei Peng[1], Chaotian Luo[1], Wei Cui[2], Cheng Tang[1], and Peng Peng[1]

[1]Department of Radiology, The First Affiliated Hospital of Guangxi Medical University, Nanning, China, [2]GE Healthcare, MR Research China, Beijing, China

Keywords: Liver, Quantitative Imaging, free-breathing liver R2* mapping;hepatic iron overload

Motivation: Existing liver iron quantification methods are inadequate for extreme iron deposition, hindering effective guidance for iron chelation therapy.

Goal(s): Evaluate the practicality of a free-breathing, single-echo UTE sequence with varying echo times for multiple acquisitions in assessing severe hepatic iron overload.

Approach: A 3.0T UTE sequence with rigid-based motion correction was used to assess hepatic R2* in nine thalassemia patients, and compared with LIC from Ferriscan and R2* from a 1.5T GRE sequence.

Results: UTE-R2* correlated well with GRE-R2* and Ferriscan-LIC, and could differ hepatic iron content in patients whose Ferriscan-LIC or GRE-R2* reach to upper limit.

Impact: An imaging strategy utilizing a free-breathing, single-echo UTE sequence with variable echo times for multiple acquisitions, combined with rigid-based motion correction, could be employed to evaluate extreme hepatic iron deposition.

0841 Pitch: 8:15

Poster: 9:15

Screen 27

Table1. CT detection of pulmonary nodules in 131patients

Characteristics	Results
Mean age	61.47±10.76
Male	63.52±11.31
Female	60.04±10.179
Location	
Central localization	105
Subpleural localization	136
upper	89
middle	80
	72
Nodule type	
SNs	116
PSNs	58
GGNs	67
Mean diameter（mm）	
total	11.79±5.27
SNs	10.19±4.64
PSNs	14.12±5.32
GGNs	11.56±5.22

Ultrashort Echo Time (UTE) Spiral-VIBE MRI for Lung Nodule Detection and Radiomics Feature Stability Assessment

Rui Li[1], Xiayin Cao[1], Lei Cui[1], Benkert Thomas[2], and Yunzhu Wu[3]

[1]Department of Radiology, Affiliated Hospital 2 of Nantong University, Nantong, China, [2]MR Application Predevelopment, Siemens Healthineers AG, Erlangen, Germany, [3]MR Research Collaboration, Siemens Healthineers Ltd, Shanghai, China

Keywords: Lung, Lung, pulmonary nodules， Ultrashort Echo Time (UTE) Spiral-VIBE MR， Radiomics， Radiomics Stability

Motivation: This study aims to assess the efficacy of UTE-MRI in detecting lung nodules compared to CT and to evaluate the stability of radiomics features, along with the factors influencing them.

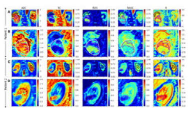
Goal(s): Through the advancement of UTE scanning technology, we strive to enable MRI to achieve lung nodule detection capability and stability on par with CT.

Approach: To facilitate the clinical integration of UTE technology for lung diseases, UTE scanning was conducted on patients presenting with lung nodules.

Results: UTE-MRI demonstrates a high detection rate for lung nodules larger than 6 mm, and it exhibits a high level of stability in radiomics features.

Impact: Our study shows UTE showcasing a remarkable ability to detect lung nodules larger than 6 mm and maintain consistent radiomics features across repeated scans. UTE holds potential as a radiation-reducing alternative to CT for regularly monitored patients with lung nodules.

0842 Pitch: 8:15 Poster: 9:15 Screen 28



Enhanced Non-invasive Characterisation of Renal Tumour Microstructure with VERDICT-MRI

Snigdha Sen[1], Lorna Smith[2], Lucy Caselton[2], Joey Clemente[2], Maxine Tran[3], Shonit Punwani[2], David Atkinson[2], Richard L Hesketh[2], and Eleftheria Panagiotaki[1]

[1]Centre for Medical Image Computing, University College London, London, United Kingdom, [2]Centre for Medical Imaging, University College London, London, United Kingdom, [3]Department of Surgical Biotechnology, University College London, London, United Kingdom

Keywords: Kidney, Kidney, Microstructure Imaging

Motivation: Diffusion-weighted (DW)-MRI may characterise renal cell carcinoma (RCC) by reflecting cellularity, but results using the apparent diffusion coefficient (ADC) model are inconclusive.

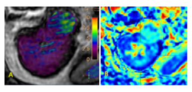
Goal(s): Use advanced modelling with VERDICT-MRI to characterise renal tissue in two different grades and subtypes of RCC, and compare performance to ADC.

Approach: Fit VERDICT and ADC models to DW-MRI data from two patients and compare performance in terms of accuracy of fitted signal and parameter estimates.

Results: The VERDICT model captures the DW-MRI signal more accurately than ADC. It discriminates between tissue types, and shows high cellularity and low vasculature in the grade 3 tumour, agreeing with independent CT.

Impact: We show that VERDICT-MRI can be used to accurately characterise tumour and benign tissue microstructure in two patients with RCC of different grade and subtype, improving performance over ADC and reflecting histological tissue properties such as cellularity and vasculature.

0843 Pitch: 8:15 Poster: 9:15 Screen 29



The feasibility of APT and IVIM in renal malignancies: A Preliminary Study

Xiaofan Liu[1], Xia Wang[1], Sheng Zhang[1], Gang Tian[1], Chanjuan Yu[1], Na Zhao[1], Xiuzheng Yue[2], and Yuedong Han[1]

[1]Department of Radiology, Xi'an GaoXin Hospital, Xi'an, China, [2]Philips Healthcare, Beijing, China

Keywords: Kidney, Kidney, Amide proton transfer; renal malignancies; Intravoxel incoherent motion

Motivation: Amide proton transfer (APT) imaging studies are gradually expanding to the body, with few applications in renal diseases and a lack of tumor studies.

Goal(s): In the present study, we aimed to investigate the ability of APT and voxel-wise intravoxel incoherent motion (IVIM) imaging to detect renal malignancies.

Approach: We preliminarily analyzed the ability of APT imaging to discriminate malignant tumors from normal renal tissues, combined with each parameter of IVIM imaging, which has high diagnostic efficacy.

Results: The results showed that APT imaging was feasible and superior to IVIM imaging in discriminating renal malignant tumors from normal renal tissues.

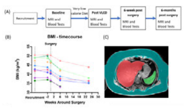
Impact: APT imaging has potential clinical applications in diagnosing of renal malignancies and provides a reference for subsequent accurate studies of APT imaging of renal tumors.

0844

Pitch: 8:15

Poster: 9:15

Screen 30



Multiparametric MRI to study changes across the Surgical Journey in Bariatric Patients with Type 2 diabetes or Prediabetes.

Abi Spicer[1], Rebekah Wilmington[2,3], Stephen Lloyd-Brown[1,4], Chris Bradley[1,5], Martin Craig[1], Elizabeth J Simpson[5,6], Stephen J Bawden[1,5], Gerry McCann[7], Guruprasad Aithal[5], Penny Anne Gowland[1,5], Iskandar Idris[2,3], and Susan T Francis[1,5]

[1]Sir Peter Mansfield Imaging Centre,Physics, University of Nottingham, Nottingham, United Kingdom, [2]Division of Medical Sciences and Graduate Entry Medicine, University of Nottingham, Nottingham, United Kingdom, [3]Bariatric Metabolic Institute, University Hospitals of Derby and Burton NHS foundation Trust, Derby, United Kingdom, [4]Intelligent Modelling and Analysis, University of Nottingham, Nottingham, United Kingdom, [5]National Institute for Health Research Biomedical Research Centre, Queen's Medical Centre and University of Nottingham, Nottingham, United Kingdom, [6]David Green Human Physiology Unit, University of Nottingham, Nottingham, United Kingdom, [7]Department of Cardiovascular Sciences, University of Leicester and NIHR Leicester Biomedical Research Centre, Leicester, United Kingdom

Keywords: Liver, Diabetes, Bariatric, Pre-Diabetes, Liver, Pancreas, Spleen

Motivation: Bariatric surgery is evaluated by weight loss and diabetes remission, but the mechanism of the latter is unclear.

Goal(s): Use MRI to quantify changes in liver, pancreas and subcutaneous adipose tissue (SAT).

Approach: Multiparametric MRI of fat fraction (FF), T_2*, volume, T_1 and T_2 at four timepoints before and after bariatric surgery.

Results: Significant reduction in liver FF from baseline to 6-weeks, and between post-VLCD and 6-weeks, and liver volume from baseline to subsequent time points. Compared to baseline a significant increase in liver T_2* at 6-weeks, reduction in liver T_1 at 6-weeks and 6-months, and decrease in SAT at 6-months

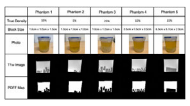
Impact: Multiparametric MRI assessment of changes in liver and pancreas fat, volume and T_1, T_2* and T_2 relaxometry, as well as subcutaneous volume associated with bariatric surgery may serve as markers for longitudinal and cross-sectional assessment of patients.

0845

Pitch: 8:15

Poster: 9:15

Screen 31



In-vitro evaluation of the performance of PDFF against classification-based algorithms in calculation of breast density

Isobel Gordon[1,2], George Ralli[2], Carolina Fernandes[2], Amy Herlihy[2], Sally Collins[1], and Michael Brady[2,3]

[1]Nuffield Department of Women's and Reproductive Health, University of Oxford, Oxford, United Kingdom, [2]Perspectum Ltd., Oxford, United Kingdom, [3]Engineering Science, University of Oxford, Oxford, United Kingdom

Keywords: Breast, Phantoms, Quantitative, fat fraction

Motivation: Operator-independent quantification of breast density with proton density fat fraction (PDFF) may be more accurate than conventional T1-weighted imaging-based methods, which are limited by the partial volume effect (PVE) and require significant user input.

Goal(s): We aimed to assess the accuracy of PDFF against fuzzy clustering (FCM) of T1-weighted images.

Approach: Five phantoms representative of different breast compositions were imaged and the breast density calculated with both methods was compared to the known density.

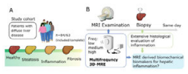
Results: PDFF demonstrated improved accuracy compared to FCM of T1-weighted images. FCM-derived density was more sensitive to the partial volume effect and dependent on the bias correction algorithm.

Impact: The improved accuracy and comparative robustness of proton density fat fraction (PDFF) suggests it is a more reliable and operator-independent approach to breast density calculation than fuzzy clustering. This is particularly important when assessing longitudinal changes to breast structure.

0846 Pitch: 8:15

Poster: 9:15

Screen 32



Hepatic inflammation grading in diffuse liver disease using three-dimensional multifrequency MR elastography

Shan Cai[1,2], Christian Simonsson[2,3], Jens Tellman[1,2], Nils Dahlström[2,4], Simone Ignatova[5], Stergios Kechagias[6], Patrik Nasr[6], Mattias Ekstedt[6], Ralph Sinkus[7], and Peter Lundberg[1,2]

[1]*Department of Radiation Physics, and Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden,* [2]*Center for Medical Image Science and Visualization, Linköping University, Linköping, Sweden,* [3]*Department of Biomedical Engineering, Linköping University, Linköping, Sweden,* [4]*Department of Radiology, and Department of and Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden,* [5]*Department of Clinical Pathology and Clinical Genetics, Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden,* [6]*Department of Gastroenterology and Hepatology, Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden,* [7]*Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom*

Keywords: Liver, Inflammation, Diffuse liver disease, multifrequency MRE, 3D MRE

Motivation: Additional viscoelastic parameters measured using 3D multifrequency MRE have been reported to detect inflammation in the liver. However, a clinical cohort with multiple etiologies has not been well-studied.

Goal(s): Our goal was to determine the role of 3D multifrequency MRE for staging hepatic inflammation in diffuse liver disease with various etiologies.

Approach: Viscoelastic parameters were derived from 3D MRE with low, medium and high vibration frequencies, and compared with histological assessment.

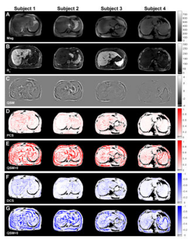
Results: The moduli |G*|, G' and G" and the exponent of power law y were found to be associated with inflammation.

Impact: Three-dimensional multifrequency MRE, with its ability to provide additional viscoelastic parameters, could be a powerful tool for the non-invasive detection of inflammation activity in patients with diffuse liver disease.

0847 Pitch: 8:15

Poster: 9:15

Screen 33



Identifying Subvoxel Diamagnetic and Paramagnetic Components in Liver and Spleen Using DECOMPOSE-QSM

Asli Alpman[1], Jingjia Chen[2,3], Hongjiang Wei[4,5], and Chunlei Liu[1,6]

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Keywords: Liver, Quantitative Susceptibility mapping

Motivation: Fibrotic liver, a condition that may cause cirrhosis if untreated, often contains both paramagnetic iron and diamagnetic collagen. While quantitative susceptibility mapping (QSM) calculates the voxel-wise tissue susceptibility, it cannot distinguish the competing effect of iron and collagen within a voxel.

Goal(s): The purpose of this work is to identify sub-voxel paramagnetic and diamagnetic susceptibility sources within the liver and spleen.

Approach: For this purpose, we applied the DECOMPOSE-QSM method to abdominal 1.5T MR images of patients with various levels of iron overload.

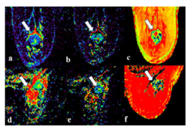
Results: The resulting paramagnetic and diamagnetic susceptibility maps demonstrated improved contrast compared to bulk susceptibility maps provided by QSM.

Impact: Identifying sub-voxel paramagnetic and diamagnetic sources within the liver through DECOMPOSE-QSM can facilitate the diagnosis of conditions such as liver fibrosis and hepatic iron overload.

0848 Pitch: 8:15

Poster: 9:15

Screen 34



Application of Intratumoral and Peritumoral Multimodal MRI in Predicting HER-2 Expression in Breast Cancer

Wen Feng[1], Junqiang Lei[1], Yuhui Xiong[2], Kun Ji[3], Wencheng Dang[3], Jianlin Li[1], and Yuling Gao[1]

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Keywords: Breast, Breast, multimodal; MUSE; MAGIC; IDEAL-IQ; HER-2

Motivation: Human epidermal growth factor receptor-2(HER-2) was a proto-oncogene, and its overexpression was closely associated with the development and prognosis of breast cancer.

Goal(s): To investigate predictive value of intratumoral and peritumoral multimodal magnetic resonance imaging (MRI) before surgery for the expression level of HER-2 in breast cancer.

Approach: The parameters, including apparent diffusion coefficient (ADC), tissue-diffusivity (Dt), pseudo-diffusivity (Dp), perfusion fraction(f), relaxation rate(R2*), fat-fraction (FF), the relaxation value longitudinal relaxation time(T1), transverse relaxation time(T2) and proton density(PD) were used to predict the expression level of HER-2 in breast cancer.

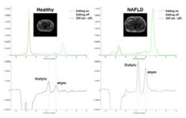
Results: MUSE-Dt-peritumoral predicted HER-2 with the highest AUC(0.724, *P*=0.017).

Impact: There were few studies involving intratumoral and peritumoral multimodal MRI to predict HER-2 in breast cancer. The result was that peritumoral parameters had a momentous part in predictive performance beyond expectation, especially non-invasive techniques which were easy to implement clinically.

0849 Pitch: 8:15

Poster: 9:15

Screen 35



In-vivo measurement of hepatic lipid composition with J-difference-editing-MRS

Yufan Zhou[1], Dingyi Lin[1], Jiaqiang Zhou[2], Shiyang You[1], Yang Cao[1], Chunli Cai[3], Yi-Cheng Hsu[4], Yuchen Zhao[2], and Min Wang[1,2]

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Keywords: Liver, Metabolism, Lipid composition; J-difference-edited-MRS

Motivation: Hepatic lipid composition is important for diagnosis and prognosis of many hepatic diseases and for studying lipid metabolism.

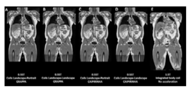
Goal(s): This study aimed to apply J-difference-edited-MRS (JDE-MRS) for better measurement of hepatic lipid composition and evaluated its effectiveness in detecting lipid profile changes among metabolic disorders.

Approach: Hepatic lipid composition was measured and compared among healthy, NAFLD and T2DM human subjects using JDE-MRS under 3T, as well as among normal, obese and T2DM rat models using conventional MRS under 7T.

Results: The JDE-MRS application in human liver is reliable and the results shows differences between different groups, with similar results in rats.

Impact: This study demonstrates the feasibility of applying JDE-MRS in human liver, which can be used to quantify hepatic unsaturated lipid profile and can provide a reliable biomarker for clinical investigations of lipid metabolism in hepatic diseases.

0850 Pitch: 8:15 Poster: 9:15 Screen 36



Developing a body composition protocol on a commercial 0.55T MRI system

Rebecca E Thornley[1,2], Zihan Ning[1,3], Brandon Whitcher[4], Philippa Bridgen[1,2,3], Jimmy D Bell[4], E Louise Thomas[4], Sharon L Giles[1,2], Claire J Steves[2,5], Sebastien Ourselin[1], Joseph V Hajnal[1,3], and Anthony N Price[1,2,3]

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Keywords: Screening, Low-Field MRI, Body Composition

Motivation: Body composition MRI is well established at 1.5T. However there is limited work at low-field where there is growing interest, particularly with increased accessibility of ultra-wide bore systems.

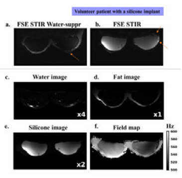
Goal(s): Demonstrate the feasibility of body composition MRI on a 0.55T (80cm) system, and present optimised sequence parameters suitable for large-scale studies.

Approach: Dixon and liver T1 and T2*/PDFF scans were optimised iteratively by scanning subjects with a range of BMIs at 0.55T using ultra-flexible receive-array coils.

Results: Body composition MRI has been demonstrated on a commercial 0.55T system. Image quality was sufficient for utilisation of an analysis pipeline established for higher field.

Impact: Body composition MRI is feasible on a commercial 0.55T system, providing motivation for further protocol development. This generation of scanner presents an opportunity for more affordable and accessible MRI, with a wide bore suitable for imaging larger patients and participants.

0851 Pitch: 8:15 Poster: 9:15 Screen 37



T2-weighted imaging and water-fat-silicone separation in breast MRI.

Aizada Nurdinova[1], Philip K. Lee[1], Xuetong Zhou[1,2], Catherine J. Moran[1], Bruce L. Daniel[1,2], and Brian A. Hargreaves[1,2,3]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Bioengineering, Stanford University, Stanford, CA, United States, [3]Electrical Engineering, Stanford University, Stanford, CA, United States

Keywords: Breast, Breast

Motivation: Breast MRI is increasingly used for diagnosis and high-risk screening in patients with silicone breast implants, a common aesthetic procedure, but silicone-specific sequences lengthen and complicate protocols.

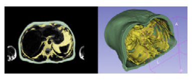
Goal(s): We aim to demonstrate simultaneous water-fat-silicone separation with T2-weighting, and improved contrast between fat and silicone.

Approach: We propose Dual-Interval Echo-Time (DIET) preparation to provide T2-weighting with reduced fat signal, and multi-point species separation with 5 gradient echoes at each spin-echo.

Results: We demonstrate robust water-fat-silicone separation (WFSS) and improved control of T2-weighting in water, and the contrast between fat and silicone.

Impact: We have combined DIET Fast Spin Echo with multi-echo water-fat-silicone separation to enable T2-weighted imaging for subjects with silicone breast implants. This may allow improved evaluation of breast tissue, as well as assessment of complications with implants.

0852 Pitch: 8:15 Poster: 9:15 Screen 38



Automated 3D Volume Segmentation of Subcutaneous and Visceral Abdominal Fat Using Fat-Water Imaging

Sai K Merugumala[1], Shalender Bhasin[2,3], and Alexander P Lin[1,2]

[1]*Department of Radiology, Mass General Brigham, Boston, MA, United States,* [2]*Harvard Medical School, Boston, MA, United States,* [3]*Research Program in Men's Health: Aging and Metabolism, Mass General Brigham, Boston, MA, United States*

Keywords: Endocrine, Body, Fat Water Imaging

Motivation: The study is driven by the need to accurately quantify abdominal fat, particularly visceral fat, to better understand its link with metabolic diseases

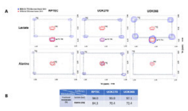
Goal(s): This research aims to develop a robust, automated 3D segmentation method for distinguishing and quantifying Subcutaneous and Visceral Fat from volumetric fat-water MRI images.

Approach: Utilizing Fat-Water Imaging combined with 3D whole volume segmentation and morphology provides improved quantification.

Results: The new method yielded more reliable and consistent fat compartment segmentation across subjects, outperforming the prior 2D segmentation techniques and showing promise for aiding the study of metabolic disorders.

Impact: The study's automated 3D Fat-Water image segmentation technique aids the assessment of abdominal fat, enabling clinicians and researchers to efficiently study and evaluate metabolic disease risk and progression.

0853 Pitch: 8:15 Poster: 9:15 Screen 39



Investigation of Metabolic Heterogeneity in von Hippel Lindau (VHL) Patient Derived Renal Tumor cells using NMR Stable Isotope Tracing

Gitanjali R. Asampille[1], Daniel R. Crooks[1], Youfeng Yang[1], and William Marston Linehan[1]

[1]*Urologic Oncology Branch, NCI, National Institutes of Health, Bethesda, MD, United States*

Keywords: Cancer, Cancer, Clear Cell Renal Cell Carcinoma

Motivation: To develop targeted therapies for Clear Cell Renal Cell Carcinoma (ccRCC).

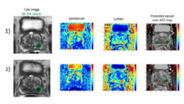
Goal(s): Investigation of metabolic activity in von Hippel-Lindau (VHL) patient derived renal tumor cells using NMR based stable isotope tracing to develop targeted tumor therapies.

Approach: Cultured VHL patient derived renal tumor cells (UOK270 and UOK 366) were harvested and extracted upon 24 h of [U-^{13}C] Glucose tracing and analyzed using NMR based stable isotope Resolved Metabolomics (SIRM).

Results: After 24 h of [U-^{13}C] Glucose tracing, we determined the relative levels of ^{13}C incorporation in Glycolysis and (Tri Carboxylic Acid) TCA cycle intermediates in UOK 270 and UOK366 using NMR based SIRM.

Impact: This is the first-time investigation of metabolic activity in VHL patient derived renal tumor cells generated in house (UOK270 and UOK366) impacting on ccRCC treatment development.

0854 Pitch: 8:15 Poster: 9:15 Screen 40



Hybrid Multidimensional MRI: Demonstrating Repeatability in Non-Invasive Prostate Cancer Tissue Characterization

Abel Lorente Campos[1], Aritrick Chatterjee[1], Ambereen Yousuf[1], Tatjana Antic[2], Aytekin Oto[1], and Gregory Karczmar[1]

[1]*Radiology, University of Chicago, Chicago, IL, United States,* [2]*Pathology, University of Chicago, Chicago, IL, United States*

Keywords: Prostate, Prostate

Motivation: Validate the consistency and reliability of Hybrid Multidimensional MRI (HM-MRI) through repeatability assessments.

Goal(s): Evaluate the repeatability of HM-MRI in prostate tissue characterization and its diagnostic accuracy for prostate cancer.

Approach: Our approach consists on performing dual HM-MRI scans with a one-week interval to assess measurement consistency and diagnostic accuracy of HM-MRI biomarkers.

Results: The results indicate high reproducibility of HM-MRI metrics, evidenced by strong inter-class correlation coefficients, with consistent tissue composition measurements across initial and repeat scans, and robust diagnostic performance of HM-MRI parameters in prostate cancer detection.

Impact: The findings of this study highlights the potential of HM-MRI as a reliable tool for prostate cancer diagnosis, paving the way for non-invasive clinical applications and inspiring further research into its utility in other diagnostic imaging techniques.

Power Pitch

Pitch: AI-Powered Analysis for Cancer Diagnosis & Prognosis

Power Pitch Theatre 3

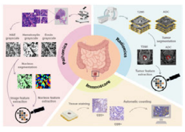
Wednesday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Peter LaViolette & Esin Ozturk Isik

(no CME credit)

0855

Pitch: 8:15
Poster: 9:15
Screen 41



Integrating radiomics, pathomics, and biopsy-adapted immunoscore for predicting distant metastasis in locally advanced rectal cancer

Rui Zhao[1], Wenjuan Shen[1], Sicong Wang[2], Shuangmei Zou[1], and Hongmei Zhang[1]

[1]*Cancer Hospital of Chinese Academy of Medical Sciences, Beijing, China,* [2]*GE Healthcare China, Beijing, China*

Keywords: Diagnosis/Prediction, Radiomics, Rectal cancer; Neoadjuvant chemoradiotherapy; Distant metastasis; Pathomics; Immunosocre

Motivation: Identifying high-risk patients for distant metastasis (DM) before treatment can facilitate the development of personalized neoadjuvant treatment and improve the prognosis of patients with locally advanced rectal cancer (LARC).

Goal(s): This study aimed to construct a predictive model that integrates radiological information at the macroscale and pathological information at the microscale to estimate the probability of DM in LARC patients after neoadjuvant chemoradiotherapy, using radiomics, pathomics, and biopsy-adapted immunoscore.

Approach: Feature selection and signature construction were performed using the least absolute shrinkage and selection operator (LASSO)-Cox analysis.

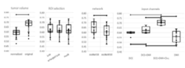
Results: The results demonstrated the effectiveness of the nomogram in identifying high-risk DM patients.

Impact: Incorporating multiscale information, including radiomics, pathomics, and the immune microenvironment, enhances the characterization of tumors and provides a robust model for identifying high-risk DM patients in LARC. This approach aids in the development of personalized neoadjuvant treatment strategies.

0856

MERIT AWARD MAGNA CUM LAUDE

Pitch: 8:15
Poster: 9:15
Screen 42



Deep learning models for predicting responses to neoadjuvant systemic therapy in triple-negative breast cancer using pre-treatment MRI

Zhan Xu[1], Jong Bum Son[1], Beatriz E. Adrada[2], Tanya W. Moseley[2], Rosalind P. Candelaria[2], Mary S. Guirguis[2], Miral M Patel[2], Gary J Whitman[2], Jessica W. T. Leung[2], Huong T. C. Le-Petross[2], Rania M Mohamed[2], Sanaz Pashapoor[2], Bikash Panthi[1], Deanna L Lane[2], Frances Perez[2], Huiqin Chen[3], Jia Sun[3], Peng Wei[3], Debu Tripathy[4], Wei Yang[2], Clinton Yam[4], Gaiane M. Rauch[2], and Jingfei Ma[1]

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[2]*Department of Breast Imaging, The University of Texas MD Anderson Cancer Center, Houston, TX, United States,*
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Keywords: Diagnosis/Prediction, Cancer

Motivation: Neoadjuvant systemic therapy (NAST) followed by surgery is the standard of care for triple-negative breast cancer (TNBC) patients. However, only approximately half of these patients achieve pathological complete response (pCR).

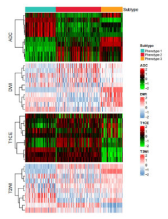
Goal(s): To build a prediction model to identify non-pCR patients before the initiation of NAST.

Approach: We evaluated multiple prediction models using pretreatment multi-parametric MRI from a cohort of 282 TNBC patients.

Results: Our findings revealed that combined with clinical information, the best-performing model achieved an AUC of 0.74 on an independent testing set. We further observed that the performance of our models is not sensitive to the voxel selections in tumor segmentation.

Impact: Deep learning models for predicting pathological complete response to neoadjuvant systemic therapy of triple-negative breast cancer were developed using baseline multi-parametric MRI data and clinical information and achieved an AUC of 0.74 on the independent testing dataset.

0857 Pitch: 8:15 Poster: 9:15 Screen 43



[Identification of intrinsic imaging phenotype for endometrial carcinoma based on multi-modality MRI using multi-Omics clustering algorithm]

Xiaoting Jiang[1], Shaofeng Duan[2], Jiacheng Song[1], Xisheng Liu[1], and Ting Chen[1]

[1]Jiangsu Province Hospital, the First Affiliated Hospital With Nanjing Medical University, Nanjing, China, [2]Central Research Institute, UIH Group, Shanghai, China

Keywords: Diagnosis/Prediction, Pelvis, Imaging phenotype

Motivation: Heterogeneity of endometrial carcinoma (EC) leads to differences in prognosis among different patients. The method of unsupervised machine learning can classify tumors into different subtypes by identifying heterogeneity and similarity in radiomics features, which may have the ability of preoperative risk stratification.

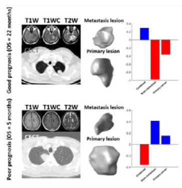
Goal(s): To identify the intrinsic imaging phenotype for EC using multi-modality MR-based radiomics features.

Approach: Ten multi-omics clustering methods were used for imaging phenotypes identification and reached a consensus.

Results: Among the three identified imaging phenotypes, multiple pathological features and disease-free survival time showed significant differences.

Impact: Based on multi-modality MRI using an unsupervised machine learning approach to classify EC into different imaging phenotypes, which were associated with clinicopathological features and prognosis, and can be used for preoperative risk stratification.

0858 Pitch: 8:15 Poster: 9:15 Screen 44



[Enhancing Prognosis Prediction for Lung Cancer Patients with Brain Metastasis by Combining Brain MR and Lung CT Radiomic Features]

Jyun-Ru Chen[1], Cheng-Chia Lee[2,3], Huai-Che Yang[2,3], Wen-Yuh Chung[4], Hsiu-Mei Wu[3,5], Wan-You Guo[3,5], and Chia-Feng Lu[1]

[1]Department of Biomedical Imaging and Radiological Sciences, National Yang Ming Chiao Tung University, Taipei, Taiwan, [2]Department of Neurosurgery, Neurological Institute, Taipei Veterans General Hospital, Taipei, Taiwan, [3]School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan, [4]Department of Neurosurgery, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan, [5]Department of Radiology, Taipei Veterans General Hospital, Taipei, Taiwan

Keywords: Diagnosis/Prediction, Radiomics, Brain metastasis

Motivation: Control of metastatic and primary tumors has been identified as prognostic factors for lung cancer patients with brain metastasis. However, prognosis prediction by combining imaging features of metastatic and primary tumors was less explored.

Goal(s): This study investigated the prediction efficacy based on image traits of brain metastasis and primary lung cancer.

Approach: The radiomic features separately extracted from brain MRI and chest CT images were merged to build the survival prediction models.

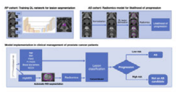
Results: The proposed prediction model showed superior performance compared to the models based on a single modality in lung cancer with brain metastasis.

Impact: This study suggested that survival prediction can be enhanced by combining features of brain metastasis MRI and lung cancer CT. Imaging characteristics of both primary and secondary (metastatic) tumors are valuable for prognostic prediction in lung cancer with brain metastasis.

0859 Pitch: 8:15

Poster: 9:15

Screen 45



Multiparametric MRI Radiomic Features Improve Patient Selection for Active Surveillance in Prostate Cancer

Veronica Wallaengen[1], Evangelia I Zacharaki[1], Mohammed Alhusseini[1], Isabella M Kimbel[1], Nachiketh Soodana Prakash[2], Ahmad Algohary[1], Adrian L Breto[1], Sandra M Gaston[1], Rosa P Castillo Acosta[3], Oleksandr N Kryvenko[4], Bruno Nahar[2], Dipen J Parekh[2], Alan Pollack[1], Sanoj Punnen[2], and Radka Stoyanova[1]

[1]Department of Radiation Oncology, University of Miami Miller School of Medicine, Miami, FL, United States, [2]Department of Urology, University of Miami Miller School of Medicine, Miami, FL, United States, [3]Department of Radiology, University of Miami Miller School of Medicine, Miami, FL, United States, [4]Department of Pathology, University of Miami Miller School of Medicine, Miami, FL, United States

Keywords: Diagnosis/Prediction, Cancer

Motivation: Accurate selection of prostate cancer patients to undergo active surveillance (AS) is crucial to ensure suitable treatment.

Goal(s): To develop an automated framework for mpMRI analysis to assist clinical decision making about whether a patient should remain on AS.

Approach: We developed a progression risk stratification model using mpMRI data from an AS trial, and incorporating clinical biomarkers and radiomic features from lesions identified by a deep neural network.

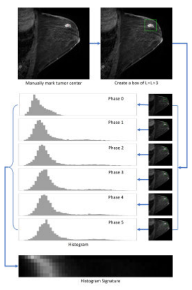
Results: The lesion segmentation network achieved a median DSC of 60.7%, and the progression prediction model an AUC of 81.1% in determining likelihood of progression within 12 months.

Impact: We present a fully automated methodology to assess prostate cancer progression risk for AS patients within the timeframe between their follow-up visits, thereby providing essential data for clinicians that can prospectively improve AS patient selection.

0860 Pitch: 8:15

Poster: 9:15

Screen 46



Prediction of pathological complete response in breast cancer by histogram signatures from multi-phase contrast enhanced MRI

Hai-Tao Zhu[1], Yu-Hong Qu[2], Kun Cao[1], Xiao-Ting Li[1], and Ying-Shi Sun[1]

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Keywords: Diagnosis/Prediction, Cancer

Motivation: Accurate prediction of pathological complete response (pCR) after neoadjuvant chemotherapy enables individualized treatment options to avoid unnecessary breast excision and improve patients' life quality.

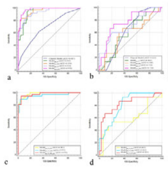
Goal(s): To improve the prediction accuracy by simultaneously extracting temporal and spatial features of MRI signal during contrast enhancement.

Approach: A histogram signature is designed by concatenating histograms at different enhancing phases into a 2D picture and classified by convolutional neural network into pCR or non-pCR.

Results: The AUC, sensitivity, specificity of the histogram signature for pCR prediction is 0.833 in the test group (n=132). The model combining histogram signature with ER and HER2 increases AUC to 0.842.

Impact: Histogram signatures from multi-phase MRI can be used as a new marker to measure tumor heterogeneity, estimate drug uptake, evaluate treatment response and predict prognosis for breast cancer or other cancers.

0861 Pitch: 8:15 Poster: 9:15 Screen 47



Prediction of lymph node metastasis after neoadjuvant chemoradiotherapy in rectal cancer with multiparametric MRI-based radiomics

Weicui Chen[1], Qiurong Wei[1], Ling Chen[1], Kan Deng[2], Xiaoyan Hou[1], Yunying Lin[1], Renlong Xie[1], Xiayu Yu[3], Hanliang Zhang[1], and Yuankui Wu[4]

[1]Department of Radiology, The Second Affiliated Hospital of Guangzhou University of Chinese Medicine, Guangzhou, China, [2]Philips Healthcare, Guangzhou, China, [3]The Second Affiliated Hospital of Guangzhou University of Chinese Medicine, Guangzhou, China, [4]Department of Medical Imaging, Nanfang Hospital, Guangzhou, China

Keywords: Diagnosis/Prediction, Radiomics

Motivation: A precise assessment of LN restaging following nCRT is important to guide therapeutic decision and predict prognosis for LARC patients.

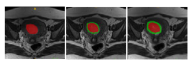
Goal(s): To develop and validate a predictive radiomics model for assessing LNM status after nCRT in LARC.

Approach: This study enrolled 150 LARC patients from two centers and constructed several radiomics models based on T2WI and DWI before or/and after nCRT to assess LNM after nCRT.

Results: The multiparametric model incorporating MR radiomics features prior to and after nCRT was superior to the clinical model, model$_{pre_T2_DWI}$ and the single-sequence models (external validation cohort AUC 0.831).

Impact: Radiomics analysis of pre- and post-nCRT multiparameter MR images could predict LNM after nCRT in patients with LARC, and might help guide therapies and predict prognosis for LARC patients.

0862 Pitch: 8:15 Poster: 9:15 Screen 48



Prediction of Lymphovascular Space Invasion in endometrial cancer using MRI-based radiomics models

Lu Chen[1], Xiao-li Huang[1], Lan-hui Qin[1], Chong-ze Yang[1], Kan Deng[2], and Jin-yuan Liao[1]

[1]The First Affiliated Hospital of Guangxi Medical University, Nanning, China, [2]Philips Healthcare, Guangzhou, China

Keywords: Diagnosis/Prediction, Radiomics

Motivation: Predicting LVSI before surgery remains a critical challenge.

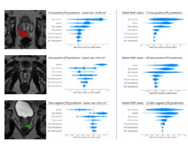
Goal(s): To predict preoperative LVSI in patients with endometrial cancer in a noninvasive way.

Approach: We developed and validated MRI radiomics and clinical-radiomics models based on the features extracted from tumor and peritumoral regions.

Results: The clinical-radiomics model based on the features extracted from the tumors with 3mm peritumoral region exhibited the hightest predictive performance in the training cohort and testing cohort with an AUC of 0.86 and 0.86, respectively. The model also displayed clinical validity as depicted in the DCA curve.

Impact: Incorporating the radiomics features extracted from tumor with 3mm peritumoral region and clinical significance factors can improve the predictive efficacy of the model for predicting LVSI and increase its applicability in clinical practice.

0863 Pitch: 8:15 Poster: 9:15 Screen 49



Explaining MRI radiomics-based detection of prostate cancer using clinical concepts

Rebecca Segre[1], Gabriel Addio Nketiah[1,2], Axel Nael[1], Mohammed Rasem Sadeq Sunoqrot[1,2], Tone Frost Bathen[1,2], and Mattijs Elschot[1,2]

[1]Department of Circulation and Medical Imaging, NTNU, Norwegian University of Science and Technology, Trondheim, Norway, [2]Department of Radiology and Nuclear Medicine, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway

Keywords: Diagnosis/Prediction, Radiomics, Explainability, Analysis/Processing, Cancer, Diagnosis/Prediction, Machine Learning/Artificial Intelligence, Prostate, Software Tools

Motivation: Clinical use of computer-aided diagnosis systems for prostate cancer is currently hindered by their internal complexity. Explainability tools can give insight into the functioning of these machine learning (ML) models.

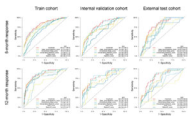
Goal(s): Our goal was to supplement the predictions of an MRI radiomics-based ML model for prostate cancer detection with explanations based on clinical concepts currently used in radiological assessment.

Approach: We clustered correlating MRI radiomics features into groups representing clinical concepts underlying the PI-RADS system. We used SHAP analysis to explain the importance of these concepts in each predicted lesion.

Results: Explainability based on clinical concepts gives insight into ML model predictions.

Impact: Our machine learning pipeline combines accurate prostate cancer detection on MRI with intrinsic explainability, potentially resulting in an easier integration into clinical use.

0864 Pitch: 8:15 Poster: 9:15 Screen 50



An MRI-based nomogram predicts brain metastasis response to targeted therapy in lung cancer patients: A multi-center study

Junwei Chen[1], Jiaji Mao[1], Junhao Li[1], Baoxun Li[1], Haojiang Li[2], Daiying Lin[3], Xuewen Fang[4], Fang Xiao[5], Zehe Huang[6], Wensheng Wang[7], Shaoxian Chen[3], Zonghuan Cai[3], Manqiu Liang[4], Shengzhang Pan[6], Dabiao Deng[7], Zhiyuan Wu[8], and Jun Shen[1]

[1]Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou, China, [2]Sun Yat-sen University Cancer Center, Guangzhou, China, [3]Shantou Central Hospital, Shantou, China, [4]The Tenth Affiliated Hospital of Southern Medical University, Dongguan People's Hospital, Dongguan, China, [5]The First Affiliated Hospital of USTC, University of Science and Technology of China, Hefei, China, [6]Qinzhou First People's Hospital, Qinzhou, China, [7]Guangdong 999 Brain Hospital, Guangzhou, China, [8]Capital Medical University, Beijing, China

Keywords: Diagnosis/Prediction, Machine Learning/Artificial Intelligence, lung cancer patients with brain metastasis

Motivation: To determine an effective individualized treatment decision for lung cancer patients with brain metastasis (BrM) to receive targeted therapy.

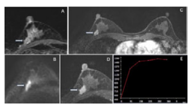
Goal(s): we developed an MRI-based nomogram that can predict the response of lung cancer BrM to targeted therapy using multi-center data.

Approach: Clinical predictors, radiomics and deep learning features extracted from BrM baseline MR images were incorporated to establish the nomogram using the LASSO logistics coefficients.

Results: The nomogram can accurately predict the 6-month and 12-month responses of BrM to targeted therapy across the training cohort, internal validation cohort, and external test set, outperforming all other models.

Impact: The MRI-based nomogram can be used as a pretreatment and personalized tool to predict response to targeted therapy in lung cancer patients with BrMs and thus assist in optimizing treatment for lung cancer patients who suffer from BrMs.

0865 Pitch: 8:15 Poster: 9:15 Screen 51



Preoperative Prediction of Her2-zero, -low and -overexpression Breast Cancers Using Multiparametric MRI and Machine Learning Modeling

Jiejie Zhou[1,2], Yang Zhang[1], Jinhao Wang[3], Yezhi Lin[4], Ga Young Yoon[2,5], Yan-lin Liu[2], Jeon-Hor Chen[2], Hailing Wang[3], Meihao Wang[1], and Min-ying Su[2]

[1]First affiliated hospital of Wenzhou Medical University, Wenzhou, China, [2]University of California, Irvine, Irvine, CA, United States, [3]Guangxi Normal University, Guilin, China, [4]Wenzhou Medical University, Wenzhou, China, [5]University of Ulsan College of Medicine, Gangneung Asan Hospital Gangwondo, Gangneung, Korea, Republic of

Keywords: Diagnosis/Prediction, Breast

Motivation: Her2-low breast cancers could benefit from new anti-HER2 therapies.

Goal(s): To construct a preoperative prediction model of HER2 expression levels using multiparametric MRI and machine learning (ML) algorithms.

Approach: 621 patients were investigated. Four ML methods were used to build models based on MRI features to predict HER2 expression levels.

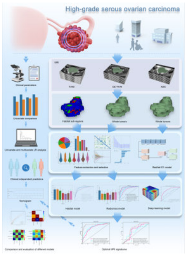
Results: MRI features of multiple lesions, spiculated margin, peritumoral edema and largest diameter were selected to build the models. ML models performed better for predicting HER2-zero vs. HER2-low/-overexpression than HER2-low vs. HER2-overexpression. The best model was KNN of AUC 0.86, sensitivity of 76%, specificity of 73%, and accuracy of 75%.

Impact: MRI features of breast cancer are associated with different HER2 expression levels. MRI-based ML models have the potential to preoperatively predict the HER2 expression status.

0866 Pitch: 8:15 Poster: 9:15 Screen 52

[MRI-Based Habitat, Radiomics, and Deep Learning for Assessing Response of Platinum-Based Chemotherapy in HGSOC Patients]

Qiu Bi[1], Jinwei Qiang[2], Yang Song[3], and Yunzhu Wu[3]



[1]the First People's Hospital of Yunnan Province, Kunming, China, [2]Jinshan Hospital, Fudan University, Shanghai, China, [3]MR Research Collaboration Team, Siemens Healthineers Ltd., Shanghai, China

Keywords: Diagnosis/Prediction, Pelvis

Motivation: High-grade serous ovarian carcinoma (HGSOC) poses a significant challenge due to platinum resistance and the inherent difficulty in its prediction.

Goal(s): We aimed to explore MRI-based habitat model for predicting response of platinum-based chemotherapy in HGSOC patients, and compared with radiomics and deep learning models.

Approach: We leveraged the K-means algorithm for clustering on multiparameter MRI data. Then the radiomics, habitat, and deep learning models were constructed.

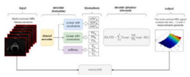
Results: Habitat model had the potential to predict platinum resistence, with a superior performance to radiomics and deep learning models. The nomogram integrating habitat with neoadjuvant chemotherapy yielded a better performance compared to others.

Impact: This study holds substantial clinical significance as it establishes a foundational framework for the customization of treatment strategies for patients afflicted with HGSOC.

0867 Pitch: 8:15 Poster: 9:15 Screen 53

[Pathology Without a Knife: MRI-based Non-invasive Determination of Prostate Cancer Grade with Physics-Informed Deep Learning]

Batuhan Gundogdu[1], Aritrick Chatterjee[1], Senthooran Kalidoss[1], Gregory S Karczmar[1], and Aytekin Oto[1]



[1]University of Chicago, Chicago, IL, United States

Keywords: Diagnosis/Prediction, Cancer

Motivation: Millions of prostate biopsies are being ordered each year, a great majority of which yield negative results. A reliable and non-invasive method for detecting prostate cancer grade is critical.

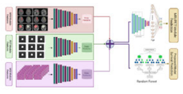
Goal(s): To develop a robust and efficient MRI-based non-invasive model to detect the Gleason score of the lesions without the need for a biopsy.

Approach: We propose a physics-informed autoencoder that integrates the strengths of model-based and deep learning-based methods, while overcoming their respective weaknesses.

Results: Physically-interpretable biomarkers that our model yields correlate strongly with Gleason score, providing important new diagnostic markers, and laying the groundwork for a potential new quantitative MRI method.

Impact: The proposed model offers for many potential usages in diagnostic radiology, by presenting a non-invasive method for diagnosing and staging prostate cancer, potentially affecting about a million patients annually by reducing unnecessary biopsies and saving millions in healthcare costs.

0868 Pitch: 8:15 Poster: 9:15 Screen 54



[Deep Learning Based Multi-Scale Approach for Precision Medicine and Quantitative Imaging in Glioblastoma]

Anum Masood[1], Usman Naseem[2], Junaid Rashid[3], Euijoon Ahn[2], Mehmood Nawaz[4], and Mehwish Nasim[5]

[1]Radiology, Harvard Medical School, Boston Children's Hospital, Boston, MA, United States, [2]James Cook University, James Cook University, Townsville, Australia, [3]Department of Data Science, Sejong University, Seoul, Korea, Republic of, [4]Department of Biomedical Engineering, The Chinese University of Hong Kong, Hong Kong, Hong Kong, [5]School of Physics, Mathematics and Computing, The University of Western Australia, Perth, Australia

Keywords: Diagnosis/Prediction, PET/MR, Glioblastoma, WSI

Motivation: Glioblastoma (GBM) is a fast-growing invasive brain tumor that presents unique treatment challenges. Early diagnosis requires manual segmentation using MRI and histopathological image analysis.

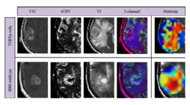
Goal(s): Our proposed model can facilitate medical personnel in an efficient and accurate diagnosis of glioblastoma.

Approach: We present a multiscale multilevel approach based on deep learning for precision medicine and quantitative imaging in GBM capturing image feature and providing wide-ranging contextual information.

Results: Our method predicted the overall survival of GMB patients with an average accuracy of 88.63% and 91.7% DSC (Unet: 84% DSC; Swin Transformer: 87% DSC) on BraTS 2020.

Impact: Our model surpasses state-of-the-art methods in Glioblastoma (GBM) segmentation and predicts patient survival with 88.63% accuracy. This research work assists in precise and efficient diagnoses of GBM, potentially contributing to early disease detection and treatment strategies.

0869 Pitch: 8:15 Poster: 9:15 Screen 55



[Attention-Boosted CNN for Improving the Classification of IDH and TERTp Mutation Status in Gliomas Based on Dynamic Susceptibility Contrast MRI]

Buse Buz-Yalug[1], Gulce Turhan[1], Ayse Irem Cetin[1], Ayca Ersen Danyeli[2,3], Cengiz Yakicier[3,4], M. Necmettin Pamir[3,5], Koray Ozduman[3,5], Alp Dincer[3,6], and Esin Ozturk-Isik[1]

[1]Institute of Biomedical Imaging, Bogazici University, Istanbul, Turkey, [2]Department of Medical Pathology, Acibadem University, Istanbul, Turkey, [3]Brain Tumor Research Group, Acibadem University, Istanbul, Turkey, [4]Department of Molecular Biology and Genetics, Acibadem University, Istanbul, Turkey, [5]Department of Neurosurgery, Acibadem University, Istanbul, Turkey, [6]Department of Radiology, Acibadem University, Istanbul, Turkey

Keywords: Diagnosis/Prediction, Data Processing

Motivation: Molecular markers, such as IDH and TERTp, have been reported as significant prognostic factors in gliomas.

Goal(s): The aim of this study is to predict IDH and TERTp mutational subtypes in gliomas non-invasively using deep-learning applied to rCBV images derived from DSC-MRI.

Approach: We proposed a deep-learning approach with attention gates to classify IDH- and TERTp-mutation subgroups of gliomas using rCBV images along with anatomical-MRI. Additionally, Grad-CAM approach was employed to provide an explanation of which image sections played a role in decision-making.

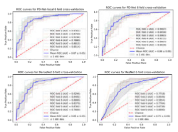
Results: Attention-boosted deep learning-based classification model yielded high accuracy rates. GradCAM approach also highlighted the significance of different tumor components.

Impact: The proposed attention-boosted deep learning based method might have the potential to assist clinicians in the noninvasive identification of IDH and TERTp mutations at the pre-surgery point and potentially enhance treatment strategies and patient outcomes.

0870 Pitch: 8:15

Poster: 9:15

Screen 56



An artificial intelligence decision tree diagnostic platform helps neuroradiologists reclassify adult-type diffuse gliomas

Liqiang Zhang[1], Xinyi Xu[1], Hongyu Pan[2], Jueni Gao[3], Linling Wang[1], Zhi Liu[4], Xu Cao[5], and Yongmei Li[1]

[1]The First Affiliated Hospital of Chongqing Medical University, Chongqing, China, [2]Southwest University, Chongqing, Chongqing, China, [3]Shanxi Provincial People's Hospital, Shanxi, Shanxi, China, [4]Chongqing Hospital of Traditional Chinese Medicine, Chongqing, China, [5]School of Medical and Life Sciences Chengdu University of Traditional Chinese Medicine, Chengdu, China

Keywords: Diagnosis/Prediction, Brain

Motivation: Deep learning networks offers an opportunity for diffuse gliomas classification, which may be help for therapeutic decision making and selection of patient groups suitable for targeted genetic analysis.

Goal(s): The purpose of this study is to develop an artificial intelligence method to reclassify adult-type diffuse gliomas based on the new WHO CNS tumor classification.

Approach: An artificial intelligence decision tree diagnostic platform(DTDP) based on MRI and deep learning networks was developed by combined 6 individualized CNNs models in series and parallel

Results: The DTDP performed well with accuracy of 86.67%.

Impact: The DTDP achieved automatic classification and comprehensive diagnosis of adult-type diffuse gliomas by combining genetic biomarkers and histological grading, and effectively helped neuroradiologists to reclassify adult-type diffuse gliomas.

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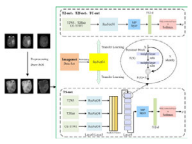
Screen 57



Using Multi-sequence MRI-based Convolutional Neural Network to Predict the Methylation Status of MGMT Promoter in Glioma

Xiaohua Chen[1,2], Zhiqiang Chen[3], Ruodi Zhang[1], Yunshu Zhou[1], Shili Liu[1], and Yuhui Xiong[4]

[1]Clinical medicine school of Ningxia Medical University, Yinchuan, China, [2]Medical Imaging Center of Ningxia Hui Autonomous Region People's Hospital, Yinchuan, China, [3]Department of Radiology ,the First Hospital Affiliated to Hainan Medical College, Haikou, China, [4]GE Healthcare MR Research, Beijing, China

Keywords: Diagnosis/Prediction, Radiomics, Gliomas

Motivation: The MGMT promoter is closely associated with the survival period of glioma patients and their response to chemotherapy drug temozolomide. Predicting the promoter status of MGMT accurately pre-operator is crucial for making personalized treatment decisions for glioma patients.

Goal(s): To propose models based on CNNs to predict the MGMT methylation status of gliomas using conventional pre-operative MR images.

Approach: Building three CNNs models based on T2WI, T2-FLAIR, CE-T1WI images, respectively. Fusing features to build the fourth model to predict the MGMT methylation status.

Results: All models can predict the MGMT status effectively and accurately, the fused-feature model has the best diagnostic performance.

Impact: Models based on conventional MRI sequences and VASARI features provide the clinical value for evaluation of molecular typing in gliomas. It is expected to become a practical tool for the non-invasive characterization of gliomas to help the individualized treatment planning.

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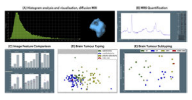


MIROR: The Clinical Decision Support System with Functional Imaging and Machine Learning

Dadi Zhao[1,2], Sara Burling[2], Lesley MacPherson[3], Lara Worthington[1,2,4], Theodoros N Arvanitis[1,2,5], John R Apps[1,2], and Andrew C Peet[1,2]

[1]Cancer and Genomic Sciences, University of Birmingham, Birmingham, United Kingdom, [2]Oncology, Birmingham Children's Hospital, Birmingham, United Kingdom, [3]Radiology, Birmingham Children's Hospital, Birmingham, United Kingdom, [4]RRPPS, University Hospital Birmingham NHS Foundation Trust, Birmingham, United Kingdom, [5]Engineering, University of Birmingham, Birmingham, United Kingdom

Keywords: Diagnosis/Prediction, Radiomics

Motivation: Radiomics has potential to bring added values to cancer diagnosis and prognosis, whilst a practical tool that is accessible for clinicians and radiologists has not been available.

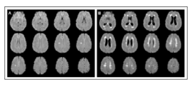
Goal(s): To design MIROR, a clinical decision support system, that can aid tumour diagnosis with real-time image and spectroscopy analysis.

Approach: The project keeps collecting childhood brain tumour proton MR images and spectroscopy in England and has built a multi-centre database that includes 377 cases.

Results: MIROR supports key features including visualisation, image analysis, feature extraction, spectroscopy quantification, and tumour type and subtype prediction through machine learning.

Impact: A practical solution that translates radiomics and machine learning into clinical scenarios can aid tumour diagnosis and treatment planning, bring benefits to patient healthcare, and improve clinical outcomes.

0873 Pitch: 8:15 Poster: 9:15 Screen 59



Self-supervised representational learning for automated risk assessment in longitudinal imaging

Lavanya Umapathy[1,2], Radhika Tibrewala[1,2], Li Feng[1,2], Hersh Chandarana[1,2], and Daniel K Sodickson[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Diagnosis/Prediction, Machine Learning/Artificial Intelligence, Longitudinal health monitoring

Motivation: Techniques that allow automated evaluation of the evolution of disease risk over time can be of great value for active surveillance and other imaging-based monitoring.

Goal(s): We introduce a novel self-supervised framework to learn representations that can identify increases in risk over time.

Approach: We propose a contrastive learning model to first learn subject-specific representations from low-slice-resolution images followed by learning a risk axis in the representational space to provide information on global changes in risk over time.

Results: The developed framework was used to assess risk of new metastases in a cohort of subjects from the NYU-Mets longitudinal imaging dataset.

Impact: A key question when moving to lower field strengths in MRI is if we can get comparable information from lower-quality images as we can from the current standard of high-quality, high-resolution images. Self-supervised contrastive learning approaches can hold the key.

Member-Initiated Session

Wild Wild West: MR Physics in Clinical Practice

Room 325-326 Wednesday 8:15 - 10:15 *Moderators:* Pim Pullens

(no CME credit)

8:15 Role of MR Physicist: EU Perspective

Cormac McGrath

Forster Green Hospital, Belfast, Ireland

8:28 The Delivery of Safe, High Quality MRI Services Requires Close Cooperation Between a Multi-Disciplinary Team

Mahadevappa Mahesh

Johns Hopkins University School of Medicine, Baltimore, MD, United States

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8:41 Standards in MRI: How Can the MR Physicist Contribute?

James Pipe

University of Wisconsin, Madison, WI, United States

8:54 MR Physics Workforce Planning: A UK Survey
Matthew Grech-Sollars
National Hospital for Neurology & Neurosurgery, London, United Kingdom

9:07 Resource Planning: Tender, Commissioning
Nikki Shelton
Austin Health, Melbourne, Australia

9:20 Teamwork: Radiologist/Radiographer/Physicist
Glenn Cahoon
Olivia Newton-John Cancer & Wellness Centre, Heidelberg, Australia

9:33 Lessons from Radiation Therapy
Petra van Houdt
Netherlands Cancer Institute, Almere, Netherlands

9:46 Case: Implementation of Advanced Acceleration Techniques
Steven Jackson
The Christie NHS Foundation Trust, Manchester, United Kingdom

9:59 Panel Discussion

Study Group Business Meeting
Molecular & Cellular Imaging Business Meeting

Room 303-304 Wednesday 9:15 - 10:15

(no CME credit)

Study Group Business Meeting
Quantitative MR Business Meeting

Room 324 Wednesday 9:15 - 10:15

(no CME credit)

Plenary Session
Wednesday Plenary

Organizers: Seena Dehkharghani, Ramesh Venkatesan

Plenary Hall (Hall 603-604) Wednesday 10:30 - 12:00 *Moderators:* Seena Dehkharghani & Ramesh Venkatesan

10:30 Ernst Lecture
Sean Deoni[1]

[1]*Brown University, United States*

11:00 From Innerspace to Outer Space: Why? A Preamble
Leon Axel[1]

[1]*New York University, School of Medicine, United States*

11:20 From Innerspace to Outer Space: How? A Point-Counterpoint Exchange & Discussion
Urvashi Rau[1]

[1]*National Radio Astronomy Observatory, Socorro, United States*

11:40 Open forum panel discussion and audience questions

Other

Gold Corporate Symposium GE Healthcare

Plenary Hall (Hall 603-604) Wednesday 12:15 - 13:15

(no CME credit)

Study Group Business Meeting
MR Safety Business Meeting

Room 303-304 Wednesday 13:30 - 14:30

(no CME credit)

Study Group Business Meeting
Chemical Exchange Saturation Transfer Business Meeting

Room 324 Wednesday 13:30 - 14:30

(no CME credit)

Weekday Course
Physics for Clinicians & Data Scientists

Organizers: Najat Salameh, Andrew Webb

Summit 1 Wednesday 13:30 - 15:10 *Moderators:* Patricia Figueiredo & Cristina Granziera

13:30 Basic MRI

Hongxia LEI[1,2]

[1]Wuhan United-Imaging Life Science Instrument Co., Ltd, Wuhan, China, [2]Shanghai United-Imaging Healthcare Co., Ltd, Shanghai, China

Keywords: Education Committee: Clinical MRI

This session introduces some of MRI essentials, including MRI instruments, nuclear spin, Lamar frequency-resonance, magnetization/precession/rotating frame and T_1/T_2 relaxation etc. Conventional spatial encoding based on gradients and geometrical method for MRI are briefly covered. In summary, MRI requires a strong magnet, some nuclear spins and RF transmit and receive. With an RF applied on resonance, we can manipulate the magnetization vector. The resulting MR signal has two characteristic relaxation times – T_1 and T_2. With numerous spatial encoding methods, MRI can be obtained.

13:50 Contrast Mechanisms

Daniel Cornfeld[1]

[1]Matai Medical Research Institute, New Zealand

14:10 k-Space & Data Processing

Joseba Alonso[1]

[1]Spanish National Research Council (CSIC, Q2818002D), Spain

Keywords: Physics & Engineering: Physics, Image acquisition: Reconstruction

These slides are for an introductory course to k-space and data sampling. This teaching material has been designed for non-experts, and we have strived to keep mathematical formalisms to the bare minimum.

14:30 Basic Sequences & Acceleration Strategies

Reina Ayde[1]

[1]Center for Adaptable MRI Technology (AMT Center), Aberdeen, United Kingdom

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14:50 Identifying & Correcting for Artifacts

Michael L Lipton[1]

[1]Columbia University Irving Medical Center, United States

Keywords: Image acquisition: Artefacts

Common MRI artifacts will be reviewed to clarify their mechanisms and leverage this knowledge to identify and implement solutions to reduce artifacts that lessen image quality. Common artifacts will be classified based on the way in which they impact image quality.

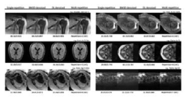
Oral

AI-Empowered Image Enhancement, Segmentation & Synthesis

Hall 606 | Wednesday 13:30 - 15:30 | *Moderators:* Simon Warfield & Weitian Chen

0874 13:30

MERIT AWARD MAGNA CUM LAUDE



Deep learning enabled MRI general denoising at 0.55T

Zheren Zhu[1], Azaan Rehman[2], Michael Ohliger[1], Yoo Jin Lee[1], Hui Xue[2,3], and Yang Yang[1]

[1]*Radiology and Biomedical Imaging, University of California, San Francisco, CA, United States,* [2]*National Institutes of Health, Bethesda, MD, United States,* [3]*National Heart Lung and Blood Institute, Bethesda, MD, United States*

Keywords: AI/ML Image Reconstruction, Visualization, Mid-Field MRI, Denoising

Motivation: Recent advancements in 0.55T MRI systems present promising opportunities for affordable and accessible MRI. Enhancing SNR to mitigate the inherent limitations of mid field strength is a crucial step in advancing this technology.

Goal(s): In this study, we aim to advance 0.55T MRI for speed and quality through a deep-learning-driven general denoise method processing low-SNR scans of various body parts and sequences.

Approach: We constructed a model with a spatial-temporal attention mechanism and employed massive complex image data for training.

Results: The proposed method significantly improves low SNR single-repetition images at 0.55T, making the results comparable or superior to the averages of multi-repetitions.

Impact: With robust denoising on mid-field systems, enhanced image quality and quicker scans can be expected for more accurate diagnoses and improved patient experience. New sequences can be developed and paired to further advance the system.

0875 13:42

MERIT AWARD SUMMA CUM LAUDE

Accelerating Low-Field Prostate DWI: Self-Supervised Denoising for Rapid Scan Acquisition

Laura Pfaff[1,2], Omar Darwish[2], Cornelius Eichner[2], Fabian Wagner[1], Mareike Thies[1], Nastassia Vysotskaya[1], Elisabeth Weiland[2], Thomas Benkert[2], Marcel Dominik Nickel[2], Tobias Wuerfl[2], and Andreas Maier[1]

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Keywords: Analysis/Processing, Low-Field MRI, Diffusion-Weighted Imaging

Motivation: Diffusion-weighted imaging (DWI) is crucial for lesion detection but suffers from inherently low signal-to-noise ratio (SNR), especially in low-field settings.

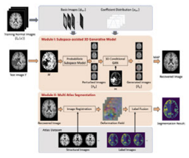
Goal(s): The goal of this work is to accelerate low-field prostate DWI, reducing the number of image repetitions and scan time while maintaining image quality.

Approach: We present a self-supervised denoising method employing Stein's unbiased risk estimator (SURE) and a physics-based noise model and evaluate the denoising results without relying on ground-truth data.

Results: Our method excels in preserving image content, outperforming other denoising techniques. This allows a substantial reduction in scan time, making it a promising advancement in low-field DWI.

Impact: Our proposed denoising approach accelerates low-field prostate DWI via self-supervised denoising, improving scan efficiency without compromising image quality. We further demonstrate how to employ a physics-based noise model to evaluate denoising performance in the absence of noise-free ground-truth data.

0876 13:54



Multi-Atlas Segmentation of MR Brain Images with Lesions Using Subspace-Assisted-GAN Based Image Recovery

Yi Ding[1], Huixiang Zhuang[1], Yue Guan[1], Yunpeng Zhang[1], Ziyu Meng[1], Zhi-Pei Liang[2,3], and Yao Li[1]

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Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence, Multi-Atlas Segmentation

Motivation: Multi-atlas segmentation (MAS) of MR brain images with lesions is of great clinical significance but remains challenging due to registration inaccuracy caused by pathologies.

Goal(s): Our goal was to improve the MAS performance of pathological brain images by restoring more accurate normal images form lesion data.

Approach: We integrate a novel subspace-assisted generative model into the MAS framework for estimation of subject-specific posterior normative distribution, which can effectively extract a “hypothetical” normal image from the lesion data, thus enhancing the accuracy of lesion segmentation.

Results: Our method produced significantly improved results in normal recovery and MAS compared to the state-of-the-art methods.

Impact: The proposed method significantly improves the performance of segmentation of MR brain images with lesions, which may provide a useful tool for tissue segmentation in pathological brain images.

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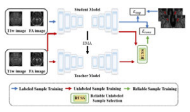

LESEN: Label-Efficient Self-Ensembling Network for Multi-Parametric MRI-based Visual Pathway Identification

Alou Diakite[1,2], Cheng Li[1], Lei Xie[3], Yuanjing Feng[3], Hua Han[1], Hairong Zheng[1], and Shanshan Wang[1,4,5]

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Keywords: Analysis/Processing, Brain, Semi-supervised learning

Motivation: Obtaining labeled data for visual pathway (VP) segmentation can be laborious and time-consuming. Therefore, it is crucial to develop algorithms with good performance in situations with limited labeled samples.

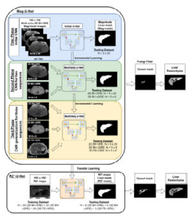
Goal(s): The goal is to propose a label-efficient self-ensembling network (LESEN) for VP segmentation.

Approach: We first introduce the LESEN model which consists of a student model and a teacher model that learn from each other using supervised and unsupervised losses. Additionally, a novel reliable unlabeled sample selection (RUSS) method is introduced to enhance the effectiveness of the LESEN model.

Results: The LESEN model surpasses existing techniques on the human connectome project (HCP) dataset.

Impact: The proposed LESEN model can improve visual pathway segmentation accuracy and reliability with limited labeled data, advancing multi-parametric MRI analysis in clinical and research settings.

0878 14:18



Single Generalized Convolutional Neural Network for Automatic Liver Extraction and R2* Estimation for Iron Overload Assessment

Utsav Shrestha[1,2], Cara Morin[3], Zachary R. Abramson[2], and Aaryani Tipirneni-Sajja[1,2]

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Keywords: Analysis/Processing, Quantitative Imaging, Deep Learning, Generalized CNN, R2*, HIC

Motivation: Although R2*-MRI is extensively validated to assess hepatic iron content(HIC), different MRI sequences are used, hence multiple sequence-specific convolutional neural networks(CNNs) have been proposed for automated liver segmentation and HIC estimation.

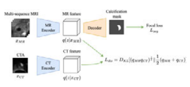
Goal(s): Assess feasibility of generalized CNN with limited training datasets to automate liver segmentation across various MRI sequences used to quantify HIC in clinical practice.

Approach: Data of twenty-nine patients scanned using multi-echo 2D/3D breath-hold and free-breathing Cartesian and radial GRE sequences were used to train U-Net CNN using incremental learning.

Results: Excellent agreement was obtained between manual and single generalized U-Net for liver segmentation and R2* estimation across multiple MRI sequences.

Impact: Generalized CNN using incremental learning minimizes the need for extensive training datasets to segment liver across multiple MRI sequences. With additional fine-tuning and validation, this approach can be widely applicable for sequence-independent liver segmentation and assessment of hepatic iron content.

0879 14:30



A deep multimodal fusion framework for MRI-based segmentation of intracranial arterial calcification

Xin Wang[1,2], Gador Canton[2], Yin Guo[2,3], Kaiyu Zhang[2,3], Thomas S. Hatsukami[2,4], Jin Zhang[5], Beibei Sun[5], Huilin Zhao[5], Yan Zhou[5], Mahmud Mossa-Basha[2], Chun Yuan[2,6], and Niranjan Balu[2]

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Keywords: Analysis/Processing, Segmentation, Vessel wall imaging, intracranial calcification, multimodal fusion

Motivation: Recently, MRI-based intracranial arterial calcification segmentation has got increasing interest due to its clinical value, but current approaches to this challenging problem suffer from poor performance.

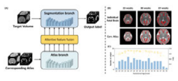
Goal(s): To develop a deep learning model for enhancing calcification segmentation on MRI by using CT as additional training resource.

Approach: A dissimilarity loss is proposed to align the latent features learned from MRI and CT of the same subject, thus making MR feature simpler and it easier for segmentation.

Results: Compared with several commonly used segmentation networks, our model demonstrates superior performance in calcification segmentation. The ablation study further shows the effectiveness of the dissimilarity loss.

Impact: The proposed model could be applied in clinical scenarios to automatically segment calcification on cerebral MR scans and it does not require CT imaging. Radiologists could leverage the segmentation result in the analysis of various vessel plaque components.

0880 14:42 [AtlasSeg: Atlas Prior Guided Dual-UNet for Cortical Segmentation in Fetal Brain MRI]



Haoan Xu[1], Tianshu Zheng[1], Xinyi Xu[1], Yao Shen[1], Jiwei Sun[1], Cong Sun[2], Guangbin Wang[3], and Dan Wu[1]

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Keywords: Analysis/Processing, Segmentation, Fetal Brain MRI; Artificial Intelligence

Motivation: Automatic segmentation of fetal brain remains challenging partially due to the dynamically changing anatomical structures during fetal brain development.

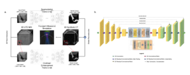
Goal(s): To enhance segmentation accuracy through incorporating gestational age-specific information as a guidance, we introduce AtlasSeg, a dual-U-shape network with dense attentive interactions.

Approach: By providing atlas volume and segmentation label at the corresponding gestational age, AtlasSeg effectively extracts the contextual features of age-specific patterns and structures that assist segmentations.

Results: AtlasSeg demonstrated superior performance against six other segmentation networks in both standard and out-of-distribution experiments, in two fetal MRI datasets. Ablation tests further demonstrated the role of atlas guidance.

Impact: Through gestational age-specific atlas-guided information, AtlasSeg can serve as an accurate and robust automatic segmentation tool for its superior performance in both in-distribution and out-of-distribution tests, which is useful for quantitative analysis in large-scale fetal brain studies.

0881 14:54 [Enhancing transcranial focused ultrasound treatment planning with synthetic ct from ultra-short echo time (UTE) MRI: a deep learning approach]



Dong Liu[1], Zhuoyao Xin[2], Robin Ji[3], Fotis Tsitsos[3], Sergio Jiménez-Gambín[3], Vincent P Ferrera[3], Elisa E. Konofagou[3], and Jia Guo[3]

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Keywords: Analysis/Processing, Focused Ultrasound, UTE MRI, image guided therapy

Motivation: There's a clinical interest in exploring an alternative option using ultrashort-time-echo MRI to replace CT imaging for accurate transcranial FUS treatment planning.

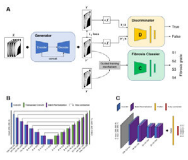
Goal(s): To employ a deep learning approach to generate synthetic CT images from a limited UTE-MRI dataset.

Approach: A deep learning framework based on 3D Transformer U-net is applied to the paired UTE-CT dataset and acoustic simulation is performed to validate the results.

Results: Utilizing UTE MRI can offer synthetic CT as an alternative to traditional CT imaging. The simulations showed a minimal maximum acoustic pressure difference of less than8% and a focus shift of less than1.5mm compared to CT-based simulations.

Impact: This study introduces a novel multi-task deep learning approach that enables accurate synthetic CT generation from limited UTE-MRI data. This innovation provides a cost-effective and radiation-free alternative to traditional CT imaging, significantly enhancing transcranial focused ultrasound treatment planning.

0882 15:06



[Hepatobiliary Phase Synthesis Using Multi-Task Learning GAN: Application to Liver Fibrosis Classification]

Rencheng Zheng[1], Nannan Shi[2], Yuxin Shi[2], Zidong Yang[3], Xueqin Xia[1], Hing-Chiu Chang[4], Weibo Chen[5], Ying-Hua Chu[6], Chengyan Wang[7], and He Wang[1]

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Keywords: AI/ML Image Reconstruction, Liver

Motivation: Hepatobiliary phase (HBP) has important clinical diagnostic value for liver diseases, but its long acquisition time can pose issues with scanning resources and patient cooperation.

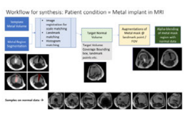
Goal(s): Our goal was to design a generative model for HBP synthesis based on early phases in hepatobiliary-specific contrast-enhanced MRI.

Approach: We proposed a multi-task learning deep learning model and evaluated its performance on a multi-center dataset.

Results: The proposed model exhibited superior HBP synthesis performance compared to the classic Pix2Pix model. The synthetic HBP was comparable to the real HBP, and significantly outperformed early phases in subsequent liver fibrosis grading tasks.

Impact: The proposed approach has the potential to accurately synthesize HBP, which is expected to be extended to clinical practice for rapid acquisition of HBP in hepatobiliary-specific contrast-enhanced MRI, thereby significantly reducing scanning time and alleviating clinical stress.

0883 15:18



[Metal artifact synthesis: Enabling inclusive Deep learning for patients with implants]

Vanika Singhal[1], Deepa Anand[1], Florintina C[1], Harshit Dubey[1], RAdhika Madhavan[2], Chitresh Bhushan[2], and Dattesh Shanbhag[1]

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Keywords: Analysis/Processing, Artifacts, Metal implants, simulation, augmentation

Motivation: AI medical imaging solutions are impacted by the presence metal implants and a design of appropriate synthesis method can improve robustness of DL models.

Goal(s): Simulation of patient medical condition like metal artifacts in MRI medical images.

Approach: The proposed method blends regions from template images containing metal artifacts into target images by using metal segmentation mask for selection, blending this region into a chosen target image RoI .

Results: Improvement in knee classification accuracy of 8% and decrease in spine plane distance error by 25-40% and plane angle error by 4-30% using the proposed approach.

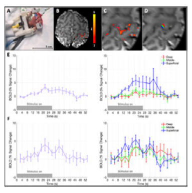
Impact: A data adaptive metal simulation method in semantically relevant regions in anatomy ensures robust of DL models in patients with metal implants who hitherto would not have benefitted from AI driven tasks .

Oral

Mesoscale fMRI

Nicoll 1 Wednesday 13:30 - 15:30 *Moderators:* Renzo Huber & Pinar Özbay

0884 13:30



Characterisation of cortical depth dependent hemodynamics in early human development using high-resolution BOLD fMRI at 7 Tesla.

Jucha Willers Moore[1,2,3], Elisabeth Pickles[4,5], Philippa Bridgen[4,5], Alena Uus[1,6], Ines Tomazinho[1,4], Beya Bonse[1,4], Maria Deprez[1,6], Sharon Giles[1,4,5], A. David Edwards[1,2,4], Jo V Hajnal[1,6], Shaihan J Malik[1,5,6], Tomoki Arichi[1,2,4], and Jonathan R Polimeni[3,7,8]

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Keywords: fMRI Analysis, High-Field MRI, Brain, Neuro

Motivation: Hemodynamic responses in adults vary across cortical depths, partly due to specific differences in vascular anatomy and physiology. It is unknown how these differences relate to the responses seen in neonates, when the cortex and neurovasculature are rapidly maturing.

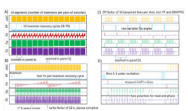
Goal(s): To characterize the amplitude and timing of the hemodynamic response across cortical depths during the neonatal period.

Approach: Cortical depth-dependent hemodynamic responses to sensorimotor stimulation were delineated using GRE-BOLD fMRI in term-aged neonates.

Results: A cortical depth-specific profile of key hemodynamic response parameters, including onset and undershoot, was observed in the neonatal cortex that differs from those seen in the adult.

Impact: We demonstrate for the first time how developing vascular network may alter hemodynamic response across cortical depths. It illuminates what underlying neurobiology may generate the neonatal specific BOLD signal profile and what components are altered relative to the adult response.

0885 13:42



T1234: A distortion-matched structural scan solution to misregistration of high resolution fMRI data

Chung (Kenny) Kan[1], Rüdiger Stirnberg[2], Marcela Montequin[1], Omer Faruk Gulban[3], A Tyler Morgan[1], Sean Marrett[1], Peter A Bandettini[1], and Renzo Huber[1]

[1]NIH, Bethesda, MD, United States, [2]German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany, [3]Maastricht University, Maastricht, The Netherlands, & Brain Innovation, Maastricht, The Netherlands, Maastricht, Netherlands

Keywords: fMRI Acquisition, fMRI, layer-fMRI, Ultra High Field, Structural scan

Motivation: High-resolution fMRI at 7T is limited by misregistration of functional data with structural scans.

Goal(s): We aim to provide a fast acquisition method that provides *distortion matched*, artifact mitigated structural reference data.

Approach: T1234: **T1**-weighted **2**-inversion **3**D-EPI with **4** directions for high-resolution fMRI. A forward Bloch model is implemented for T1 quantification and protocol optimization.

Results: Our protocol is fast (3:40 min) and provides whole-brain segmentations in EPI-space. It is robust across sessions, participants, and scanners.

Impact: This structural mapping approach allows precise registration with fMRI data. T1234 is implemented, validated, and tested to serve users of our sequence (locally and 43 centers worldwide).

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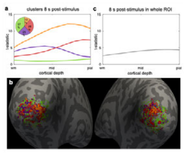

[Characterizing spatial heterogeneity of BOLD fMRI cortical-depth profiles of activation: the average profile may not be typical]

Anna I Blazejewska[1,2], Daniel Gomez[1,2], and Jonathan R Polimeni[1,2,3]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: fMRI Analysis, fMRI, fMRI Analysis, fMRI (task based), Brain, Gray Matter, Neuroscience, Blood, Data Analysis

Motivation: Laminar-fMRI analysis routinely averages cortical-depth profiles within an ROI to estimate a typical laminar activation profile and increase SNR. Previous studies suggested heterogeneity of cortical-depth profiles measured with GE-BOLD-fMRI, therefore the assumption that profiles inside ROI are similar may not hold.

Goal(s): To test whether the average cortical-depth profile is typical for the whole ROI.

Approach: We applied k-means clustering to identify cortical locations within an ROI with similar BOLD-fMRI cortical-depth profiles.

Results: Cortical-depth profiles vary substantially across the activated region and therefore the average response profile inside the ROI may not be resemble that of any particular activated location.

Impact: In laminar-fMRI analysis, due to heterogeneity of neuronal responses and/or vascular architecture the average cortical-depth profile within an ROI may not match the profile at any one location, suggesting that averaging may lose meaningful layer-specific information within the activated region.

0887 14:06

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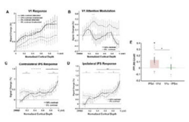

[300 µm multi-echo bSSFP fMRI at 7 Tesla revealed the IPS-V1 feedback circuit of spatial attention in the human brain]

Yifei Wang[1,2], Fanhua Guo[1,2], Huilou Liang[1,2], Jing An[3], Rong Xue[1,2], Chencan Qian[1,2], and Peng Zhang[1,2]

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Keywords: Task/Intervention Based fMRI, fMRI (task based)

Motivation: Layer-specific response in frontoparietal areas and their connectivity with the visual cortex are important to understand the neural circuitry of attention.

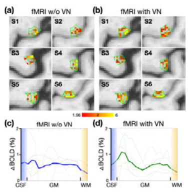
Goal(s): Investigate the neural circuitry of attention in IPS and V1 with laminar fMRI.

Approach: Using ultra-high resolution multi-echo bSSFP fMRI at 7 Tesla, layer-specific functional activity in IPS and V1 were simultaneously recorded in a spatial attention task.

Results: Attention demanding task induced significant activations in both superficial and deep layers of IPS, enhanced activity in the deep layers of V1, and increased feedback connectivity from the deep layers of IPS to the deep layers of V1.

Impact: This study demonstrates the feasibility of using ultra-high resolution multi-echo bSSFP fMRI at 7 Tesla to simultaneously image multiple brain regions to investigate the neural circuitry of high-level cognition.

0888 14:18 [Enabling brain-wide mapping of directed functional connectivity at 3T via layer-dependent fMRI with draining-vein suppression]



Wei-Tang Chang[1], Weili Lin[1], and Kelly Sullivan Giovanello[2]

[1]*Radiology, UNC at Chapel Hill, Chapel Hill, NC, United States,* [2]*Psychology, UNIV OF NORTH CAROLINA AT CHAPEL HILL, Chapel Hill, NC, United States*

Keywords: fMRI Acquisition, fMRI, Layer-dependent fMRI

Motivation: Mapping brain-wide directed functional connectivity demands techniques with high spatiotemporal resolution yet current methods fall short.

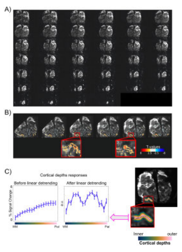
Goal(s): To improve spatial specificity of GE-BOLD EPI by reducing draining-vein contamination without compromising speed.

Approach: Incorporating velocity-nulling (VN) gradients into a GE-BOLD fMRI sequence at 3T. We also integrated NORDIC denoising to enhance signal sensitivity.

Results: The VN fMRI method demonstrated decent spatial specificity, evidenced by identifying double-peak activation patterns within the M1 area during a finger-tapping task. This technique showed enhanced robustness across participants compared to conventional fMRI. Our findings on directed functional connectivity reveal layer-specific relationships that closely align with the existing literature.

Impact: Leveraging its comprehensive brain coverage and efficient scan time, VN fMRI has yielded promising results in directed FC studies. Given the widespread accessibility of 3T scanners, we anticipate this development will have a significant impact across multiple neuroscience research domains.

0889 14:30 [Human fMRI at 10.5T: new regimes of high resolutions]



Luca Vizioli[1], Logan T Dowdle[1], Steen Moeller[1], Andrea Grant[1], Essa Yacoub[1], and Kamil Ugurbil[1]

[1]*CMRR, University of Minnesota, Minneapolis, MN, United States*

Keywords: Task/Intervention Based fMRI, fMRI (task based), Neuroscience

Motivation: Submillimeter fMRI allows imaging the human brain noninvasively at the mesoscopic scale, targeting layers and columns. Standard submillimeter resolution however may be inadequate to fully capture these ensembles. Consequently, the Brain Initiative challenged the MR community to achieve 0.1µL, and subsequently, 0.01µL voxel resolution

Goal(s): Achieve and surpass the goal of human functional mapping at 0.1µL, towards the goal of 0.01µL using a 10.5T scanner.

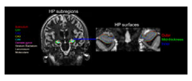
Approach: We recorded human functional BOLD responses at 10.5T, during visual experiments, at different spatial resolutions.

Results: Using 10.5T and NORDIC denoising we demonstrate functional imaging the human brain with <0.1µL resolution.

-

Impact: We demonstrate functional mapping at 10.5 T with unprecedented spatial resolutions, moving towards the 0.01µL voxel volume goal (Brain Initiative 2.0). At these resolutions single voxels contain a few thousand neurons, heralding major new opportunities in human neuroscience.

0890 14:42



Laminar profile of hippocampal subregions during spatial navigation

Khazar Ahmadi[1], David Stawarczyk[1], Viktor Pfaffenrot[2], Carlos A. Gomez[1], Zita Patai[1], David G. Norris[3], and Nikolai Axmacher[1]

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Keywords: Task/Intervention Based fMRI, High-Field MRI, Hippocampus, navigation

Motivation: Despite substantial progress in understanding the role of the hippocampus in spatial navigation, the layer-specific microcircuits underlying distinct navigation processes are yet to be determined.

Goal(s): We aimed to investigate the laminar organization of hippocampal subregions during spatial navigation including its relationship to specific strategies.

Approach: Leveraging submillimeter-resolution fMRI at 7T, we quantified BOLD signal changes across hippocampal depths and applied mixed-effect models to probe the relationship between subregional laminar activity and specific strategies reflected by straight paths and deviation towards environmental boundaries.

Results: We show that laminar profiles in hippocampal subregions are differentially associated with navigation strategies.

Impact: Our results demonstrate the promise of laminar fMRI for mapping complex cognitive functions in the hippocampus at mesoscale. Given the vulnerability of this region to Alzheimer's disease pathology, these findings may have clinical implications for early diagnosis.

0891 14:54

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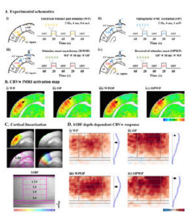

Laminar specific fMRI response is mainly regulated by first synaptic input-driven or more synchronous activity

Won Beom Jung[1,2], Geun Ho Im[1], Haiyan Jiang[1,2], and Seong-Gi Kim[1,3]

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Keywords: Task/Intervention Based fMRI, fMRI (task based)

Motivation: While responses to feedforward inputs have been well-observed in layer-specific fMRI studies, our understanding of responses to feedback projections within the ongoing functional processing remains limited.

Goal(s): Our study aimed to investigate how synaptic onset and strength contribute to specificity of laminar fMRI responses.

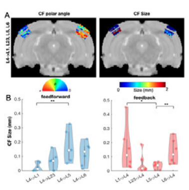
Approach: We performed the ultrahigh resolution CBV-weighted laminar fMRI by modulating thalamocortical and corticocortical projections with stimulus onset asynchrony in mice.

Results: We observed that the laminar response is highly sensitive to the strength of synaptic inputs, shifting from early to later input sites with increased strength.

Impact: Laminar CBV responses are highly regulated by micro-vessels coupled with earlier synaptic input activity, but potentially driven by the most synchronous activity within neural circuits.

0892 15:06

MERIT AWARD
SUMMA CUM LAUDE



Decoding directionality of information in cortical networks using layer-based connective field model

Joana Carvalho[1], Francisca Fernandes[1], Koen Haak[2], and Noam Shemesh[1]

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Keywords: Functional Connectivity, Brain Connectivity, BOLD, difusion fMRI, visual system, connective field model

Motivation: To disentangle feedback and feedforward signals in cortical circuits.

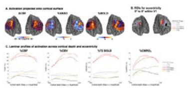
Goal(s): To unravel the intricate neural connections within cortical layers.

Approach: We implemented a layer connective field (lCF) model and applied it to ultrafast RS data and RS dfMRI data.

Results: 1.Intracortical lCF shows two lCF size profiles: **feedforward** with inverse U shape with the larger lCF sizes at layer 5 and **feedback** with U shape and larger CF sizes at superficial and deeper layers. 2.In the absence of visual input the functional connectivity reflects visuotopic organization. 3.lCF estimates obtained from dfMRI(ADC) are more layer specific than the ones estimated from BOLD.

Impact: This study showcases the ability of high spatio-temporal resolution MRI techniques (ultrafast BOLD and dfMRI) when coupled with biologically grounded connectivity models (lCF) to unveil the intricacies of information directionality within topographically organized cortices.

0893 15:18 Distinct laminar neurovascular and metabolism responses across eccentricity revealed by multi-contrast visual fMRI at 7T



Xingfeng Shao[1], Fanhua Guo[1], Jung Hwan Kim[2], David Ress[3], Chenyang Zhao[1], Qinyang Shou[1], Kay Jann[1], and Danny J.J. Wang[1]

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Keywords: Task/Intervention Based fMRI, High-Field MRI, Arterial spin labeling, cortical layers, calibrated fMRI, CMRO2, negative BOLD

Motivation: To better understand the complex interplay between neurovascular responses and metabolism.

Goal(s): The goal was to develop a multi-contrast laminar fMRI tool to concurrently measure CBF, CBV, BOLD, and $CMRO_2$ signals.

Approach: We employed a novel pulse sequence to simultaneously acquire ASL CBF, VASO CBV, and T2-BOLD signals at a high spatial resolution of 7T. We also incorporated a calibrated fMRI approach (Davis model) to calculate $CMRO_2$, using parameters estimated from breath-hold induced hypercapnia.

Results: We found distinct neurovascular and metabolic responses across cortical layers and eccentricities in response to a ring-shaped visual stimulus.

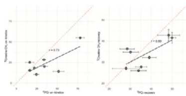
Impact: Multi-contrast laminar fMRI significantly impacts neuroscientific research by providing a more comprehensive understanding of neurovascular (CBF, CBV, BOLD) and metabolic ($CMRO_2$) interactions across cortical layers. It opens doors for exploring complex brain functions and disorders.

Oral

Muscle Up: Structural & Functional Muscle Imaging

Nicoll 2 | Wednesday 13:30 - 15:30 | *Moderators:* Donnie Cameron & Valentina Mazzoli

0894 13:30 Creatine CH2 and PCr dynamics closely correlate in dynamic interleaved MRS of exercising muscle



Radka Klepochova[1,2], Fabian Niess[2], Siegfried Trattnig[2,3,4,5], Alexandra Kautzky-Willer[1], Martin Krššák[1,2], and Martin Meyerspeer[6]

[1]Division of Endocrinology and Metabolism, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria, [2]High-Field MR Center, Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [3]CD Laboratory for MR Imaging Biomarkers (BIOMAK), Vienna, Austria, [4]Austrian Cluster for Tissue Regeneration, Ludwig Boltzmann Institute for Experimental and Clinical Traumatology, Vienna, Austria, [5]Institute for Clinical Molecular MRI in the Musculoskeletal System, Karl Landsteiner Society, Vienna, Austria, [6]High-Field MR Center, Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria

Keywords: Muscle, Spectroscopy

Motivation: To explore quantification of skeletal muscle oxidative metabolism by ^{1}H MRS.

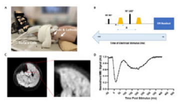
Goal(s): We used the increased accuracy of 7T MRS with a dedicated RF-coil, interleaved acquisition and localization of ^{31}P information to compare Creatine-CH_2 and Phosphocreatine time courses during exercise and recovery.

Approach: Eight volunteers were measured on a 7T MR system with RF-coil and ergometer dedicated for exercise. ^{1}H and ^{31}P MR spectra were acquired interleaved during exercise and recovery.

Results: Exercise led to disappearance of the Creatine-CH_2 resonance, while the CH_3 resonance remained stable during exercise. The recovery time constants were similar (τ_{PCr}=37±9s and τ_{Cr}=34±6s) and positively correlated.

Impact: The time course of the Creatine-CH_2 resonance in skeletal muscle can be accessed via dynamic ^{1}H MRS. If accurately reflecting oxidative metabolism, this technique has the potential to render non-invasive metabolic studies broadly accessible, without needing multi-nuclear MRI capabilities.

0895 13:42



Motor unit magnetic resonance imaging to assess muscle twitch dynamics in mitochondrial disease after an exercise programme.

Matthew Birkbeck[1,2], Mathew Elameer[1,3], Linda Heskamp[1], Jane Newman[1,4,5,6], Renae Stefanetti[1,4,5,6], Isabel Barrow[1,4,5,6], Gráinne Gorman[1,4,5,6], Ian Schofield[1], Julie Hall[3], Andrew Blamire[1], and Roger Whittaker[1]

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Keywords: Functional/Dynamic, Muscle, Genetic Diseases

Motivation: Changes to muscle twitch dynamics are overlooked in trials assessing resistance exercise in primary mitochondrial myopathies (PMM).

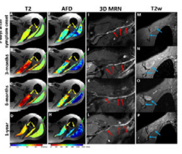
Goal(s): Motor unit MRI to measure twitch dynamics in PMM participants before and after a 12-week exercise programme.

Approach: Voxel-wise measurements of rise time (T_{rise}), contraction time ($T_{contract}$) and half-relaxation time ($T_{half\text{-}relax}$) in the tibialis anterior in 10 controls and 9 PMM participants. PMM participants scanned twice, before and after a 12-week exercise programme.

Results: $T_{contract}$ of the tibialis anterior was significantly longer in PMM participants post exercise; $T_{rise,}$ $T_{half\text{-}relax}$ demonstrated no change. In participants who had the highest adherence to exercise $T_{contract}$ increased the most.

Impact: Motor unit MRI (MUMRI) detected slower muscle contraction times in primary mitochondrial myopathies post resistance exercise programme. This may evidence increased numbers of type-I fibres post-exercise. MUMRI could be used to measure changes in muscle twitch dynamics in neuromuscular diseases.

0896 13:54



Longitudinal Assessment of Denervated Muscles in Parsonage-Turner Syndrome with Quantitative MRI

Gracyn J Campbell[1], Tim Y Li[2], Ranqing Lan[1], Ek T Tan[1], and Darryl B Sneag[1]

[1]Radiology and Imaging, Hospital for Special Surgery, New York, NY, United States, [2]Weill Cornell Medical College, New York, NY, United States

Keywords: Muscle, Quantitative Imaging

Motivation: Parsonage-Turner syndrome (PTS) is a spontaneous peripheral neuropathy affecting upper extremity nerves and leading to severe muscle denervation. Quantitative MRI (qMRI) can objectively evaluate the degree of denervation and muscle recovery from PTS over time.

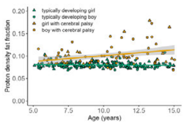
Goal(s): To characterize PTS-related muscle denervation using qMRI biomarkers and to assess longitudinal changes.

Approach: In 21 PTS subjects at up to four timepoints, the associations of T2, apartment fiber diameter (AFD), fat fraction (FF), and muscle volume with electromyography and muscle function were analyzed.

Results: Associations between qMRI biomarkers reflect severity of muscle denervation in PTS. Recovery, involving reduced edema and increased atrophy, may follow non-linear patterns.

Impact: Quantitative MRI biomarkers including T2 mapping, apparent fiber diameter, fat fraction, and muscle volumetry correlate with electrodiagnostic and functional assessments of denervation and muscle function impairment in Parsonage-Turner syndrome (PTS), and they can longitudinally characterize PTS-related changes.

0897 14:06



Muscle-specific fat fractions during childhood development in typically developing children and children with cerebral palsy

Bart Bolsterlee[1,2], Brian Chow[1,3], Caroline Rae[1,4], Suzanne Davies[1], Catherine Morgan[5], Iain Ball[6], Ann Lancaster[1], Rodrigo Rizzo[1,3], Claudia Rizzo[1], Maria Kyriagis[7], Iona Novak[5,8], and Robert D Herbert[1,3]

[1]Neuroscience Research Australia (NeuRA), Sydney, Australia, [2]Graduate School of Biomedical Engineering, University of New South Wales, Sydney, Australia, [3]School of Biomedical Sciences, University of New South Wales, Sydney, Australia, [4]School of Psychology, University of New South Wales, Sydney, Australia, [5]Cerebral Palsy Alliance Research Institute, The University of Sydney, Sydney, Australia, [6]Philips Australia & New Zealand, Sydney, Australia, [7]Rehab2Kids, Sydney Children's Hospital, Sydney, Australia, [8]Faculty of Medicine and Health, The University of Sydney, Sydney, Australia

Keywords: Muscle, Fat, cerebral palsy

Motivation: Little is known about the fat content of the skeletal muscles of typically developing children or children with cerebral palsy.

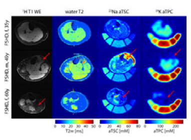
Goal(s): To describe and compare muscle-specific intramuscular fat fractions in typically developing children and children with cerebral palsy.

Approach: Proton density fat fractions were calculated for 11 lower leg muscles using mDixon MRI scans of 280 children (5 to 15 years), including 79 with cerebral palsy.

Results: Age and sex did not affect mean fat fractions in typically developing children. Fat fractions varied across muscles. Fat fractions were larger, more variable, and increased with age in children with cerebral palsy.

Impact: The comprehensive dataset and automation measurement techniques for measurement of muscle-specific fat fractions in typically developing children and children with cerebral palsy may be used to monitor muscle-specific disease progression or measure the effect of interventions.

0898 14:18



Potassium (39K) & Sodium (23Na) MRI of dystrophic skeletal muscle tissue at 7T: impact of fatty infiltration on measured tissue ion concentrations

Lena V. Gast[1], Teresa Gerhalter[1], Matthias Türk[2], Alper Sapli[1], Rafael Heiss[1], Claudius S. Mathy[1], Pierre-Yves Baudin[3], Benjamin Marty[3], Michael Uder[1], and Armin M. Nagel[1,4]

[1]Institute of Radiology,University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany, [2]Department of Neurology, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Erlangen, Germany, [3]NMR Laboratory, Neuromuscular Investigation Center, Institute of Myology, Paris, France, [4]Division of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

Keywords: Muscle, Muscle

Motivation: Combined ^{23}Na/^{39}K MRI at 7T can highlight ion disturbances related to patho-physiological processes within dystrophic muscle tissue. However, quantification of the apparent tissue potassium concentration (aTPC) using ^{39}K MRI is challenging due to low signal-to-noise and rapid signal decay.

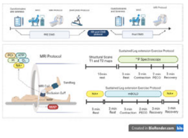
Goal(s): Here, we investigated the feasibility of quantitative ^{39}K MRI in dystrophic muscle tissue.

Approach: The lower leg of 14 FSHD patients and 11 healthy controls was examined using ^{39}K/^{23}Na and ^{1}H MRI at 7T.

Results: We found a strongly reduced aTPC in fat infiltrated muscles. After correction for reduced potassium concentration in fat, aTPC values in dystrophic muscles were similar to healthy muscles.

Impact: Potassium concentration in fatty tissue is strongly reduced compared to healthy skeletal muscle tissue. This has to be considered when investigating and interpreting aTPC values measured with ^{39}K MRI in fat-replaced skeletal muscle tissue.

0899 14:30 [Unlocking Muscle Fatigue: Insights from Multi-Parametric 1H, 23Na & 31P MRI in Exercise-Induced Muscle Damage and Inflammation]



Fabio Zambolin[1], Susan Pinner[1], James McStravick[1], Aneurin James Kennerley[1], and Jamie Stewart McPhee[1]

[1]Sport and Exercise Sciences, Manchester Metropolitan University, Manchester, United Kingdom

Keywords: Muscle, Spectroscopy, Muscle Inflammation, Integrative Physiology

Motivation: Exercise Induced Muscle Damage (EIMD) presents as a viable model to study the muscle inflammation and fatigue which may present across various age-related pathologies.

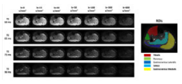
Goal(s): Our model presents as a useful tool to test therapies aimed at improved patient rehabilitation.

Approach: Here we use multi-parametric ^{31}P, ^{23}Na and ^{1}H based MRI to show EMID is charactered by reduced muscle oxygenation with an increase in phosphate metabolism, sodium perturbation and overall perception of effort. Interestingly the cardiovascular response to exercise remained unchanged.

Results: Our results suggest a discrepancy between cardiovascular and muscle metabolic demand leads to altered oxygen delivery during exercise and increased fatigability.

Impact: This study highlights the importance of an integrative multi-parametric MRI approach to study the physiological consequences underlying muscle inflammation. This is crucial for advance our understanding on the abnormal responses present in age-related/health conditions characterised by muscle weakness and fatigue.

0900 14:42 [Combined Diffusion-Relaxation MRI to Assess Muscle Microstructure and Composition]



Matteo Figini[1], Paddy J Slator[2,3], Giovanna Rizzo[4], and Alfonso Matropietro[4]

[1]Centre for Medical Image Computing, University College London, London, United Kingdom, [2]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff, United Kingdom, [3]School of Computer Science and Informatics, Cardiff University, Cardiff, United Kingdom, [4]Istituto di Sistemi e Tecnologie Industriali Intelligenti per il Manifatturiero Avanzato, Consiglio Nazionale delle Ricerche, Milano, Italy

Keywords: Muscle, Diffusion/other diffusion imaging techniques, diffusion-relaxation

Motivation: Quantifying muscle tissue properties is crucial for understanding physio-pathological changes occurring in skeletal muscle (SM). However, current methods measure T2 and diffusion separately, and hence conflate them.

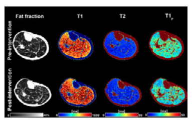
Goal(s): Demonstrate a combined diffusion-relaxation MRI approach for disentangling T2 and diffusivity properties in SM.

Approach: We devise and implement a combined T2-diffusion sequence in the leg muscles in five healthy volunteers after exercise. DTI and an advanced diffusion model were implemented and compared.

Results: We calculated disentangled T2 and diffusion-related parameter maps. Our maps capture muscle tissue differences in specific muscle groups highlighting differences related to muscle involvement during exercise.

Impact: Combined diffusion-relaxation MRI can provide detailed non-invasive estimation of muscle tissue properties by mitigating T2 effects on diffusion parameters. These approaches could reduce the need for invasive biopsies for evaluating muscle changes related to neuromuscular diseases, exercise, and rehabilitation.

0901 14:54



[Automatic estimation of T1, T2, T1ρ and fat fraction in calf muscles for patients with diabetic peripheral neuropathy]

Radhika Tibrewala[1,2,3], Azadeh Sharafi[4], Jill T Shah[1], Smita Rao[5], Ravinder R Regatte[1,2,3], and Ryan Brown[1,2,3]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Vilcek Institute of Graduate Biomedical Sciences, New York University Grossman School of Medicine, New York, NY, United States, [4]Medical College of Wisconsin, Milwaukee, WI, United States, [5]Department of Physical Therapy, New York University, New York, NY, United States

Keywords: Muscle, Diabetes

Motivation: Quantitative MRI is used for muscle parameter mapping, but single-parameter techniques and manual muscle segmentations take long.

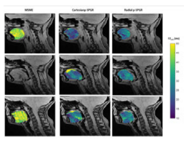
Goal(s): Develop an automatic processing pipeline to generate parameter maps from 3D MRF and fat fraction images to extract quantitative biomarkers.

Approach: 3D MRF and fat fraction images were acquired on patients with diabetic peripheral neuropathy, deep-learning methods and post-processing were used to generate muscle masks and parameter maps before and after exercise intervention.

Results: Automatic muscle segmentation and 3D MRF are able to generate quantitative fat fraction, T_1, T_2, $T_{1\rho}$ volumetric maps within muscle ROIs for tracking changes in patients before and after exercise intervention.

Impact: Both the 3D MRF sequence and automatic muscle extraction help reduce acquisition and post-processing time, allowing faster assessment of treatment response in diabetic patients.

0902 15:06



[Quantitative assessment of tongue tissue structure with 3D partially spoiled gradient echo]

Eléonore VERMEULEN[1], Pierre-Yves Baudin[1], Marc Lapert[2], and Benjamin Marty[1]

[1]NMR Laboratory, Neuromuscular Investigation Center, Institute of Myology, Paris, France, [2]Siemens Healthcare SAS, Saint-Denis, France

Keywords: Muscle, MSK

Motivation: Fat fraction and water T2 have been identified as biomarkers of muscle tissue alterations in neuromuscular diseases. Tongue muscles are involved in several muscular disorder, but due to swallowing motion, quantitative MRI is almost never applied at this level.

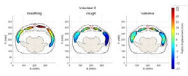
Goal(s): Assess the feasibility of a water T2 mapping in the tongue.

Approach: In this feasibility study, we proposed an RF phase-modulated gradient-echo acquisition with 3D radial encoding to obtain FF and water T2 maps of the tongue.

Results: The proposed method enables 3D mapping. The values found in the tongue are consistent with those found with the same methods in the leg muscles.

Impact: Performing quantitative imaging in the tongue is challenging due to swallowing motion. Applying a 3D radial sequence appears the appropriate strategy for water T2 imaging.

0903 15:18 [Dynamic MRI in vivo investigation of abdominal hernia repair during standardized exercises]



Victoria Joppin[1], Thierry Bège[1,2], Catherine Masson[1], and David Bendahan[3]

[1]Laboratoire de Biomécanique Appliquée - UMRT24 Université Gustave Eiffel - Aix Marseille Université, Marseille, France, [2]Department of General Surgery, Aix Marseille Univ, North Hospital, APHM, Marseille, France, [3]CRMBM - UMR 7339 CNRS - Aix Marseille Université, Marseille Cedex 05, France

Keywords: Data Processing, Segmentation

Motivation: The incidence of abdominal hernia recurrence is reaching up to 45%; so the integration of biomechanical concepts into management could be helpful.

Goal(s): Few tools are currently available to assess the behaviour of the abdominal wall in vivo under physiological conditions.

Approach: Dynamic MRI was employed to obtain motion of the abdominal wall of patients before and after hernia surgery during a range of exercises. The areas of interest were segmented.

Results: Quantification of displacements and deformations in the abdominal muscles, hernia sac area, and inter-muscular distance demonstrate anatomical and functional changes in the abdominal wall post-hernia surgery.

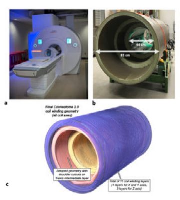
Impact: A better understanding of the biomechanical behaviour of pathologic abdominal wall could be helpful to understand the mechanisms involved in the appearance and recurrence of hernias, thereby opening the way to more effective interventions for hernia patients.

Oral

System Engineering: Gradients, Magnets, & Shims

Nicoll 3 | Wednesday 13:30 - 15:30 | *Moderators:* Feng Liu

0904 13:30 [Connectome 2.0: Performance evaluation and initial in vivo human brain diffusion MRI results]



Gabriel Ramos-Llordén[1], Peter Dietz[2], Mathias Davids[1], Hong-Hsi Lee[1], Yixin Ma[1], Mirsad Mahmutovic[3], Alina Scholz[3], Hansol Lee[1], Chiara Maffei[1], Anastasia Yendiki[1], Berkin Bilgic[1], John E. Kirsch[1], Daniel J. Park[1], Bryan Clifford[4], Wei-Ching Lo[4], Stefan Stocker[2], Jasmine Fischer[2], Elmar Rummert[2], Andreas Krug[2], Andreas Potthast[2], Thomas Benner[2], Rebecca Ramb[2], Peter J. Basser[5], Thomas Witzel[6], Lawrence L. Wald[1], Bruce R. Rosen[1], Boris Keil[3,7], and Susie Y. Huang[1]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States, [2]Siemens Healthineers, Erlangen, Germany, [3]Institute of Medical Physics and Radiation Protection, Mittelhessen University of Applied Sciences, Giessen, Germany, [4]Siemens Medical Solutions USA, Boston, MA, United States, [5]Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, United States, [6]Q Bio Inc, San Carlos, CA, United States, [7]Department of Diagnostic and Interventional Radiology, University Hospital Marburg, Philipps University of Marburg, Marburg, Germany

Keywords: Gradients, Gradients, Diffusion Acquisition, Neuro

Motivation: Current human MR scanners cannot resolve the full range of length scales needed to study the brain's microscopic and mesoscopic structure.

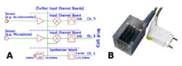
Goal(s): To construct and validate the next-generation human connectomics and microstructure MRI scanner known as Connectome 2.0.

Approach: The 3T Connectome 2.0 scanner incorporates a peripheral nerve stimulation-optimized asymmetric head gradient driven by dual gradient power amplifiers. Custom-built high-sensitivity 72-channel (in vivo imaging) and 64-channel (ex vivo imaging) receive coils were integrated.

Results: The Connectome 2.0 scanner achieves G_{max}=500 mT/m and SR_{max}=600 T/m/s, demonstrates 2x improved SNR for diffusion MRI over Connectome 1.0, and enables high-resolution tractography.

Impact: The Connectome 2.0 scanner will allow the exploration of new microstructure properties and connectional anatomy in the living human brain with unprecedented spatial and diffusion resolution.

0905 13:42



[A Versatile Setup for Measuring Complex Gradient-to-Acoustic-Noise or Gradient-to-Vibration Transfer Functions via the Scanner's ADC]

Roland Müller[1], Toralf Mildner[1], Niklas Wallstein[1], and Harald E. Möller[1,2]

[1]NMR Methods & Development Group, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]Felix Bloch Institute for Solid State Physics, Leipzig University, Leipzig, Germany

Keywords: Gradients, New Devices, Acoustic, Vibration, Microphone, Accelerometer, Transfer Function, Sound Level, Safety

Motivation: Knowledge of gradient transfer functions *in situ* would allow predictions about the auditory spectrum of arbitrary MRI sequences during execution, to achieve individualized assessments of potentially harmful sound levels or damaging vibrations of the gradient coil.

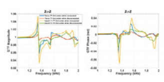
Goal(s): Our goal was to enable the integration of appropriate sound or vibration measurements into the routine operation of a scanner.

Approach: A modulator box was developed that emulates a receiver coil and permits the simultaneous digitization of variable sensor signals (e.g., microphones and accelerometers) by the scanner's ADC.

Results: Realistic gradient-to-acoustic-noise and gradient-to-vibration transfer functions were determined without the need of synchronizing external devices.

Impact: A versatile hardware concept has been developed that allows integration into a clinical scanner and prediction of the sound level inside the bore from the frequency spectrum of the input signal defined by the pulse sequence during scanning.

0906 13:54



[Impact of third order shim coils on gradient-magnet interactions and gradient waveform fidelity]

Nicolas Boulant[1], Caroline Le Ster[1], Alexis Amadon[1], Guy Aubert[2], Alexander Beckett[3,4], Jean Belorgey[2], Cédric Bonnelye[1], Dario Bosch[5,6], David Otto Brunner[7], Guillaume Dilasser[2], Olivier Dubois[2], Philipp Ehses[8], David Feinberg[3,9], Sajjad Feizollah[10], Vincent Gras[1], Simon Gross[7], Quentin Guihard[2], Hervé Lannou[2], Denis Le Bihan[1], Franck Mauconduit[1], Frédéric Molinié[2], François Nunio[2], Klaas Pruessmann[11,12], Lionel Quettier[2], Klaus Scheffler[5,13], Tony Stöcker[8], Christine Tardif[10], Kamil Ugurbil[14], Alexandre Vignaud[1], An Vu[15,16], and Xiaoping Wu[14]

[1]NeuroSpin, CEA, Gif sur Yvette, France, [2]Irfu, CEA, Gif sur Yvette, France, [3]Advanced MRI technologies, Sebastopol, CA, United States, [4]Helen Wills Neuroscience institute, University of California, Berkeley, CA, United States, [5]Department for biomedical Magnetic Resonance, University of Tübingen, Tuebingen, Germany, [6]High-field MR center, Max Planck Institute for biological cybernetics, Tuebingen, Germany, [7]Skope MRT, Zürich, Switzerland, [8]DZNE, Bonn, Germany, [9]Helen Wills Neuroscience institute, Universiy of California, Berkeley, CA, United States, [10]Montreal Neurological Institute-Hospital, McGill University, Montreal, QC, Canada, [11]ETH Zürich, Zürich, Switzerland, [12]University of Zürich, Zürich, Switzerland, [13]High field MR center, Max Planck Institute for biological cybernetics, Tuebingen, Germany, [14]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [15]University of California, San Francisco, CA, United States, [16]San Francisco VA Health Care System, San Francisco, CA, United States

Keywords: Gradients, Gradients

Motivation: Third order shim coils can impact gradient-magnet interactions with consequences on image quality and magnet safety.

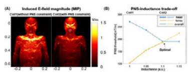
Goal(s): To demonstrate the influence of third order shim coils on the SC72 gradient coil using field and vibration measurements.

Approach: The gradient transfer function was measured at 11.7T (Iseult) and at 7T (Terra) with and without connection of the 3rd order shim coils. Vibration measurements were carried out on Iseult from 0 to 11.7T in the two configurations as well.

Results: The data demonstrate a drastic influence of the 3rd order shim coils and their circuits.

Impact: The work suggests caution when using third order shim coils at 7T and above. It also paves the way for further investigations to improve gradient waveform fidelity.

0907 14:06



[A Magnetic Vector Potential-Based Linear Predictor to Increase Peripheral Nerve Stimulation Thresholds in Gradient Coil Design]

Liyi Kang[1,2], Ling Xia[1], Qian Liu[3], Qinwei Zhang[4], Jianmin Yuan[3], and Dan Wu[1,2]

[1]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Center for Intelligent Biomedical Instrumentation, Zhejiang University Binjiang Research Institute, Hangzhou, China, [3]United Imaging Healthcare Co., Ltd, Shanghai, China, [4]Beijing United Imaging Research Institute of Intelligent Imaging, Beijing, China

Keywords: Gradients, Gradients, Gradient coil design, peripheral nerve stimulation, MRI safety

Motivation: The linear predictor incorporating a coupled electromagnetic-neurodynamic model shows reliable estimation of Peripheral Nerve Stimulation (PNS) thresholds, which is important for gradient coil design. However, the computational complexity and long computation time within the coupled model leads to difficulties in application.

Goal(s): We proposed a simplified predictor based on the spatial distribution of magnetic fields, circumventing complexity of the coupled model.

Approach: The magnetic vector potential was employed to form a simplified predictor, serving as a constraint for PNS-optimized gradient coil design.

Results: With the simplified predictor, the optimized coil achieved an 84% increase in PNS threshold at a 10% inductance penalty.

Impact: Based on the magnetic vector potential, the proposed predictor enabled the simplified evaluation of PNS thresholds through magnetic field spatial distribution. In addition, the proposed method facilitated PNS optimization in gradient coil design.

0908 14:18

MERIT AWARD
MAGNA CUM LAUDE

[Concept 0.13 T bedside MRI for early brain imaging in the neonatal intensive care unit.]

Aaron R. Purchase[1,2,3], Monika Sliwiak[1], Sara V. Bates[3,4], Jason P. Stockmann[1,3], Martin D. Hurlimann[1,3], Lawrence L. Wald[1,3,5], and Clarissa Z. Cooley[1,3]

[1]A.A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Radiology, Massachusetts General Hospital, Boston, MA, United States, [3]Harvard Medical School, Boston, MA, United States, [4]Pediatrics-Neonatology, Massachusetts General Hospital, Boston, MA, United States, [5]Harvard-MIT Division of Health Sciences and Technology, Cambridge, MA, United States

Keywords: Magnets (B0), Magnets (B0)

Motivation: Despite the high diagnostic value of MRI, safety concerns and logistical burdens often prohibit the transport of neonatal intensive care unit (NICU) patients to standard MRI scanners.

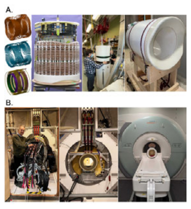
Goal(s): In response, we aim to design a specialized NICU bedside MRI scanner that prioritizes minimal disruption to care and provides a higher field strength (and signal-to-noise) than currently available portable scanners.

Approach: Using realistic finite element modeling and genetic algorithm optimization, we demonstrate a 131mT Halbach magnet design with a peak-to-peak homogeneity of 421ppm over a 14cm diameter spherical volume.

Results: We present the computer-aided-design prototype of the full portable NICU MRI system.

Impact: The bedside MRI scanner capable of diffusion contrast neuroimaging of neonates could bring a new early evaluation tool for brain conditions such as hypoxic ischemic encephalopathy (HIE).

0909 14:30



Design, construction and first experimental results of the high performance LH7 insertable head gradient set at 10.5T

Brian Rutt[1], Alexander Bratch[2], Andrew Alejski[3], Trevor Wade[3], Matthew Bester[3], Koray Ertan[4], Peter Roemer[5], Edward Auerbach[2], Gregor Adriany[2], and Kamil Ugurbil[2]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]CMRR, University of Minnesota, Minneapolis, MN, United States, [3]Robarts Research Institute, University of Western Ontario, London, ON, Canada, [4]Stanford University, Stanford, CA, United States, [5]Roemer Consulting, Lutz, FL, United States

Keywords: Gradients, Gradients, ultra high field, insertable head gradient, PNS

Motivation: Increased gradient performance can address several of technical and physics challenges of UHF MRI.

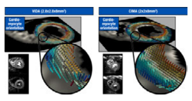
Goal(s): To develop a head gradient coil (known as LH7) for insertion into the body gradient coil of a 10.5T MRI system.

Approach: Design innovations include: symmetric folded geometry with variable end-flange angle optimized for shoulder geometry; double Z-primary layer.

Results: With 650A, 2000V gradient drivers, the hardware limits of LH7 are G_{max} 117mT/m and S_{max} 900T/m/s. Thermal results demonstrate cooling capacity >45kW. Compared to body gradients, PNS thresholds are 2-3 fold higher. After interfacing LH7 to the CMRR 10.5T, promising experimental characterizations and imaging results have been obtained.

Impact: LH7 provides an order-of-magnitude increase in head gradient performance (Gmax*Smax) over body gradients, which, combined with 10.5T B0, should provide major sensitivity and resolution increases for brain mapping by dMRI or fMRI. Experimental results to date are confirming these expectations.

0910 14:42



Leveraging unprecedented ultra-high strength gradients in commercially available MRI for in-vivo diffusion tensor CMR

Andrew D Scott[1,2], Karl P Kunze[3], Pedro F Ferreira[1,2], Peter Speier[4], Christian Geppert[4], Dudley J Pennell[1,2], and Sonia Nielles-Vallespin[1,2]

[1]CMR Unit, The Royal Brompton Hospital, London, United Kingdom, [2]National Heart and Lung Institute, Imperial College London, London, United Kingdom, [3]MR Research Collaborations, Siemens Healthcare Limited, Camberley, United Kingdom, [4]Cardiovascular MR Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany

Keywords: Gradients, Diffusion Tensor Imaging, ultra high gradient strength; motion compensated spin echo;

Motivation: Spin echo diffusion tensor cardiovascular magnetic resonance (DT-CMR) suffers from low SNR and resolution due to the time-consuming motion-compensated encoding gradients required.

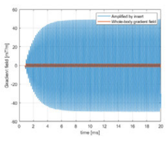
Goal(s): Shorten TEs for motion compensated spin echo (MCSE) DT-CMR techniques to improve SNR and allow higher spatial resolution using ultra-high strength whole body gradients (200mT/m) newly available in commercially available scanners.

Approach: We implemented second order MCSE and acquired data in healthy subjects at peak systole and end diastole with maximum gradient strength of 146mT/m.

Results: We demonstrate high quality MCSE DT-CMR data with reduced TEs and higher spatial resolution than on previously available scanners using similar protocols.

Impact: Increases in imaging efficiency in DT-CMR enabled by the use of ultra-high strength gradients on commercial MRI systems will deliver shorter scans and improvements in spatial resolution which are vital steps on the road to clinical translation of DT-CMR.

0911 14:54



Accelerating MRI with a Wireless Insert Gradient Coil

Rik Weersink[1,2,3], Edwin Versteeg[1], Sven Nouwens[3], Thomas Roos[1], Jeroen Siero[1], and Dennis Klomp[1]

[1]Department of Radiology, UMC Utrecht, Utrecht, Netherlands, [2]Department of Biomedical Engineering, Technical University Eindhoven, Eindhoven, Netherlands, [3]Department of Mechanical Engineering, Technical University of Eindhoven, Utrecht, Netherlands

Keywords: Gradients, Gradients

Motivation: High performance gradients enable fast and high-resolution imaging but are costly and cumbersome to install in an existing MRI-system

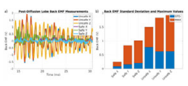
Goal(s): Present a wireless (resonant) gradient coil setup that yields additional gradient performance without needing a dedicated amplifier

Approach: The increased gradient performance was measured using field camera measurements and acceleration performance was assessed retrospectively using phantom experiments

Results: The wireless gradient yielded a factor 23 improvement in slew rate (from 125 T/m/s to 2900 T/m/s) and 28-fold retrospective acceleration resulted in aliasing free images.

Impact: A wireless insert gradient coil enables 28-fold accelerated scanning without a supplementary gradient amplifier. This provides a cost-effective pathway for improving gradient performance with minimal system modifications.

0912 15:06



Safe Diffusion Lobes for Diminished Gradient Vibration

Matthew A. McCready[1], John Pauly[1], and Adam B Kerr[1,2]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Center for Cognitive and Neurobiological Imaging, Stanford University, Stanford, CA, United States

Keywords: Pulse Sequence Design, Pulse Sequence Design

Motivation: Gradient coil vibrations are a source of loud acoustics, persistent field distortions, potential system damage, and in some cases signal dropout in diffusion MRI. Vibrations are particularly strong at mechanical resonant frequencies.

Goal(s): To design “safe” time-optimal diffusion gradients which avoid mechanical resonant frequencies.

Approach: A convex optimization problem is formed which seeks to maximize b-value for a given duration while constraining the discrete cosine transform of the diffusion lobe. A bisection search is applied to duration to find the shortest feasible solution with the target b-value.

Results: Safe diffusion lobes greatly diminished coil vibration and minimized oscillations in the gradient fields.

Impact: Safe diffusion lobes were shown to avoid specified gradient mechanical resonant frequencies reducing vibrations and persistent k-space oscillations. These waveforms have clinical and research potential to improve auditory comfort, prevent DWI signal dropout and image artifacts, and prevent system damage.

15:18

Discussion

Feng Liu

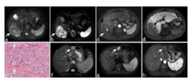
University of Queensland, Australia

Oral

Shining a Light on Liver Cancer

Room 331-332 | Wednesday 13:30 - 15:30 | *Moderators:* Scott Reeder & Shintaro Ichikawa

0913 13:30



Predictive Model for Proliferative HCC Using LI-RADS v2018: Assessing Therapeutic Outcomes in Hepatectomy and Systemic Therapy

Mengtian Lu[1], Xueqin Zhang[1], Tao Zhang[1], Qi Qu[1], Zuyi Yan[1], and Xiance Zhao[2]

[1]Nantong Third People's Hospital, Nantong, China, [2]Philips Healthcare, Nantong, China

Keywords: Liver, Data Analysis

Motivation: Hepatocellular carcinoma (HCC) can be categorized into proliferative and non-proliferative classes, with proliferative HCC exhibiting aggressive characteristics and a poor prognosis.

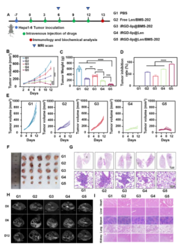
Goal(s): To develop a predictive model for proliferative HCC using Liver Imaging Reporting and Data System (LI-RADS) and to investigate its prognostic value for HCC.

Approach: A logistic regression nomogram was constructed based on LI-RADS features to identify proliferative HCC. The implication of model-predicted proliferative HCC for different therapeutic outcomes in HCC was investigated.

Results: The predictive model for proliferative HCC performed well and is a risk factor for postoperative recurrence in HCC, associated with favorable outcomes in systemic therapy.

Impact: The MR-based model, utilizing LI-RADS v2018, could predict proliferative HCC before treatment. Patients with model-predicted proliferative HCC had more post-hepatectomy recurrences but better responses to systemic therapy, which may facilitate clinical decision-making for more precise and rational therapeutic strategies.

0914 13:42



Improved Hepatocellular Carcinoma Targeted Combination Immunotherapy Using a Nanocarrier: Monitoring Tumor Response via Functional MRI

Jiamin Li[1], Ruili Wei[1], Ruimeng Yang[1], Xinqing Jiang[1], and Yongzhou Xu[2]

[1]Department of Radiology, The Second Affiliated Hospital, School of Medicine, South China University of Technology, Guangzhou, China, [2]Philips Healthcare, Guangzhou, China

Keywords: Liver, fMRI, Hepatocellular Carcinoma； Immunotherapy； Nanocarrier; IVIM-MRI; Tumor Microenvironment

Motivation: To enhance the efficacy of hepatocellular carcinoma immunotherapy using a nanocarrier and to explore IVIM-MRI for monitoring the tumor immune microenvironment.

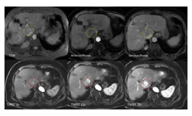
Goal(s): To synthesize iRGD-targeted liposomes to enhance the treatment efficacy of hepatocellular carcinoma and to develop effective biomarkers for the tumor microenvironment.

Approach: We synthesized iRGD-modified liposomal co-encapsulating Lenvatinib and BMS-202. IVIM-MRI was performed before and at 6 and 12 days after treatments, followed by pathological examination after the final scan.

Results: iRGD-lip@Len/BMS-202 promotes tumor vascular normalization and effectively activates an anti-tumor immune response. Importantly, the derived parameters D* and f are significantly correlated with tumor vascular normalization and immune activation.

Impact: The iRGD-targeted dual-drug liposomal nanoparticles exhibited potent synergistic anti-tumor effects. Additionally, IVIM-MRI facilitated the monitoring of changes in the tumor microenvironment, with the D* and f parameters serving as valuable indicators for evaluating tumor vascular network and immune microenvironment modulation.

0915 13:54



[Enhancing Hepatocellular Carcinoma (HCC) Diagnosis Through TWIST MRI Sequence]

Mohamed Elboraey[1] and Jordon D. LeGout[1]

[1]*Radiology, Mayo Clinic, Jacksonville, FL, United States*

Keywords: Liver, Tumor, Hepatocellular carcinoma

Motivation: Our report targets precise timing in hepatocellular carcinoma (HCC) diagnosis via MRI. Timely recognition of the late hepatic arterial phase is crucial to avoid unnecessary invasive biopsies and minimize patient risks.

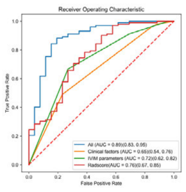
Goal(s): Our report evaluates the TWIST technique's effectiveness in HCC diagnosis, aiming to reduce the need for percutaneous biopsies.

Approach: We integrated TWIST into our liver MRI protocols, capturing images at preset intervals, enhancing temporal resolution for HCC diagnosis.

Results: Our report successfully employs the TWIST technique to diagnose HCC by capturing arterial hyperenhancement. This innovation improves diagnostic accuracy and diminishes the necessity for invasive procedures, benefiting patients.

Impact: The implementation of the TWIST technique promises safer and more accurate hepatocellular carcinoma (HCC) diagnosis. This technique minimizes invasive biopsies, reshaping clinical practice and offering a new perspective on non-invasive diagnostic techniques.

0916 14:06



[Intravoxel incoherent motion model for prediction of tertiary lymphoid structures in HCC.]

Lidi Ma[1], Xiaolan Zhang[2], Fan Zhou[1], Zhijun Geng[1], and Chuanmiao Xie[1]

[1]*Department of radiology, Sun Yat-sen University Cancer Center, Guangzhou, China,* [2]*Shukun Technology Co., Ltd, Beijing, China*

Keywords: Liver, Radiomics, Magnetic resonance imaging, IVIM, Hepatocellular carcinoma, tertiary lymphoid structures

Motivation: Intra-tumoral tertiary lymphoid structures (TLSs) are associated with a favorable prognosis for patients with hepatocellular carcinoma (HCC). Intravoxel incoherent motion (IVIM) sequences describe heterogeneity of tumor components.

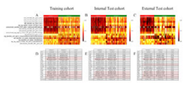
Goal(s): We aimed to explore the value of intravoxel incoherent motion (IVIM) sequences in predicting TLSs.

Approach: IVIM quantitative parameters and radiomics features were obtained. A fusion model based on the above and clinical characteristics was constructed. Receiver operating characteristic curve analysis was performed to assess the diagnostic performance of different models for TLSs prediction.

Results: Radiomics features based on IVIM-DWI can be better conducive to preoperative prediction of TLSs in patients than IVIM parameter maps.

Impact: TLSs exhibit considerable promise in prognostic prediction and the identification of appropriate candidates for immunotherapy. The fusion model based on the IVIM-DWI showed great performance in predicting TLSs, assisting the selection of clinical immunotherapy patients.

0917 14:18



Intertumoral Heterogeneity based on MRI Radiomics Features Predicts prognosis in HCC patients before Hepatectomy

Mengshi Dong[1], Yuanqiang Xiao[1], Chao Li[1], Lina Zhang[1], Tianhui Zhang[2], Jinhui Zhou[1], Linqi Zhang[3], Xin Jin[1], Zebin Fang[1], Mengsi Li[1], Yu Han[1], and Jin Wang[1]

[1]radiology, Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, China, [2]radiology, Meizhou People's Hospital, Meizhou, China, [3]radiology, Third affliated hospital of San Yet-Sun university, Guangzhou, China

Keywords: Liver, Liver, hepatocellular carcinoma

Motivation: Hepatocellular carcinoma (HCC) exhibits significant intertumoral heterogeneity, which contributes significantly to treatment resistance and failure. Noninvasive imaging and radiomics for preoperative decoding of the subtypes and prognosis may be valuable in clinical management.

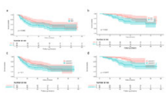
Goal(s): To preoperatively develop and validate clustering analysis of HCC based on MRI radiomics features for identifying subtypes with discrete prognosis.

Approach: We performed clustering analysis of HCC based on MRI radiomics features to detect distinct subtypes, and subsequently clinicopathological parameters and prognosis were compared and evaluated between different subtypes.

Results: Based on the radiomics features of MRI, clustering analysis identified two distinct subtypes with discrete prognosis in HCC patients.

Impact: Clustering analysis based on the radiomics features of multiparametric MRI is a potential noninvasive decision-making method for the management of patients with HCC in clinical practice.

0918 14:30



MR radiomics to predict microvascular invasion status and biological processes in combined hepatocellular carcinoma-cholangiocarcinoma

Yuyao Xiao[1]

[1]radiology, Zhongshan Hospital Fudan University, Shanghai, China

Keywords: Liver, Liver

Motivation: Prognostic value of microvascular invasion (MVI) in combined hepatocellular carcinoma-cholangiocarcinoma (cHCC-CCA) was verified, and an effective prediction model is warranted to facilitate risk stratification and individual management.

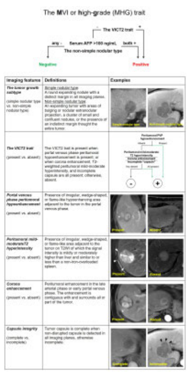
Goal(s): To establish an MRI-based radiomics model for predicting MVI status of cHCC-CCA, and to investigate biological processes underlying the radiomics model.

Approach: Clinical data, conventional MR features, MR-based radiomics features and RNA sequencing data were collected and analyzed.

Results: A robust MRI-based radiomics model was established for predicting MVI status in cHCC-CCA, in which potential prognostic value and underlying biological processes that regulate immune response were demonstrated.

Impact: MVI is a significant manifestation of tumor invasiveness,and the MR-based radiomics model established in our study will facilitate risk stratification. Furthermore, underlying biological processes demonstrated in radiomics model will offer valuable insights for guiding immunotherapy strategies.

0919 14:42



MRI-based prediction of microvascular invasion or high tumor grade and adjuvant therapy benefit for solitary HCC ≤5 cm

Hanyu Jiang[1], Binrong Li[2], Tianying Zheng[3], Yun Qin[3], Zhenru Wu[3], Maxime Ronot[4], Victoria Chernyak[5], Kathryn J. Fowler[6], Mustafa R. Bashir[7], Weixia Chen[3], Yuan-Cheng Wang[2], Shenhong Ju[2], and Bin Song[3,8]

[1]Radiology, West China Hospital, Sichuan University, Chengdu, China, [2]Zhongda Hospital, Southeast University, Nanjing, China, [3]West China Hospital, Sichuan University, Chengdu, China, [4]Hôpital Beaujon, Clichy, France, [5]Memorial Sloan Kettering Cancer Center, New York, NY, United States, [6]University of California San Diego, San Diego, CA, United States, [7]Duke University Medical Center, Durham, NC, United States, [8]Sanya People's Hospital, Sanya, China

Keywords: Liver, Liver

Motivation: Noninvasive assessment of high-risk histopathology (microvascular invasion or Edmondson-Steiner G3/4) for early HCC is critical but challenging.

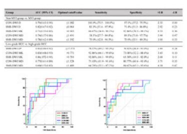
Goal(s): To develop an MRI-based diagnostic model for high-risk histopathology.

Approach: This dual-center retrospective study included consecutive patients who underwent contrast-enhanced MRI and subsequent curative resection or RFA for solitary BCLC 0/A HCC≤5 cm. A diagnostic model was developed against pathology based on resection-treated patients.

Results: 554 patients were included. Serum α-fetoprotein, non-simple nodular growth subtype, and the VICT2 trait constituted the model (testing center AUC, 0.828). Adjuvant therapies were associated with improved RFS (resection, *P*=.009; RFA, *P*=.009) for the model-positive patients.

Impact: This dual-center study developed and externally validated a diagnostic model which could effectively predict high-risk histopathology and adjuvant therapy benefit for patients receiving curative resection or radiofrequency ablation for solitary BCLC 0 or A HCCs ≤5 cm.

0920 14:54



Simultaneous Multi-Slice Imaging in DKI and IVIM for Hepatocellular Carcinoma: Correlation with Microvascular Invasion and Histologic Grade

Yingyi Wu[1], Zheng Ye[1], and Bin Song[1,2]

[1]West China Hospital, Sichuan University, Chengdu, China, [2]Radiology Department, Sanya People's Hospital, Sanya, China

Keywords: Liver, Quantitative Imaging, Hepatocellular carcinoma (HCC); apparent diffusion coefficient (ADC); diffusion kurtosis imaging (DKI); Intravoxel incoherent motion diffusion-weighted imaging (IVIM); histologic grade; microvascular invasion (MVI)

Motivation: IVIM and DKI, effective in HCC malignancy prediction, face limitations due to lengthy scan times. The Simultaneous Multi-Slice (SMS) technology has successfully reduced scan times for ADC studies, but its application in IVIM and DKI remains underexplored.

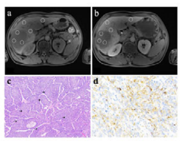
Goal(s): To evaluate SMS-accelerated IVIM and DKI's efficacy in predicting HCC microvascular invasion (MVI) and tumor grading compared to conventional methods.

Approach: The study enrolled 42 HCC patients, conducting MRI with both conventional and SMS-accelerated DWI, DKI, and IVIM.

Results: SMS significantly reduced MRI scan times while maintaining reliable diffusion metrics, proving more effective than ADC in predicting MVI and tumor grades in HCC.

Impact: Integrating SMS into IVIM and DKI protocols can notably shorten scan times while preserving diagnostic accuracy in MVI and tumor grading, potentially improving clinical efficiency and patient management.

0921 15:06



[Quantitative parameters obtained from gadobenate dimeglumine-enhanced MRI can predict proliferative subtype of hepatocellular carcinoma.]

Feier Ding[1], Chao Zhang[1], Xu Qi[1], Lianbang Wang[1], Changhu Liang[1], and Xinya Zhao[1]

[1]*Shandong Provincial Hospital, Jinan, China*

Keywords: Liver, Cancer

Motivation: Hepatocellular carcinoma (HCC) is the most common type of primary liver cancer and the third leading cause of cancer-related death.

Goal(s): This study investigated the value of gadobenate dimeglumine-enhanced quantitative parameters for predicting the proliferative subtype of HCC and patients' prognosis.

Approach: All HCC lesions were resected and pathologically confirmed. The lesion-to-liver contrast enhancement ratio (LLCER) was measured in the hepatobiliary phase.

Results: LLCER was identified as an independent predictor of proliferative HCC. Patients with LLCER < -4.59% had a significantly higher incidence of proliferative HCC. In addition, patients with LLCER < -4.61% showed poorer overall survival than those with LLCER ≥ -4.61%.

Impact: Quantitative information from gadobenate dimeglumine–enhanced MRI can provide crucial information on hepatocellular carcinoma subtypes. It might be valuable to design novel therapeutic strategies, such as tar□geted therapies or immunotherapy.

15:18 Discussion

Scott Reeder

University of Wisconsin, United States

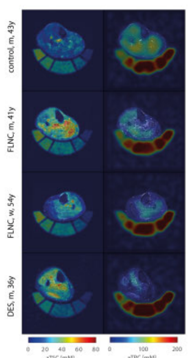
Oral

(23)Na(31)P Time

Room 334-336 | Wednesday 13:30 - 15:30 | *Moderators:* Erin MacMillan & Bhavana Solanky

0922 13:30

MERIT AWARD SUMMA CUM LAUDE



[39K/23Na-MRI at 7T for assessment of ionic balance combined with fat quantification at 3T in myofibrillar myopathies]

Claudius Sebastian Mathy[1,2], Lena Vanessa Gast[1], Christian Holtzhausen[3], Teresa Gerhalter[1], Matthias Türk[4,5], Rafael Heiß[1], Arnd Dörfler[6], Michael Uder[1], Armin Michael Nagel[1,7], and Rolf Schröder[3]

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Keywords: Muscle, Rare disease, Potassium, Sodium

Motivation: Recent advances have enabled the application of ^{39}K-MRI in skeletal muscle in vivo. Moreover, information on disease progression/pathogenesis from non-invasive ^{1}H-MRI is still limited.

Goal(s): Determination of apparent tissue potassium and tissue sodium concentrations (aTPC/aTSC) in myofibrillar myopathies.

Approach: Less severe effected lower legs of 10 patients with filaminopathy-, desminopathy- and zaspopathy-causing mutations measured by ^{39}K/^{23}Na-MRI at 7T and Dixon-type-sequence at 3T.

Results: Fat-corrected ion concentrations were significantly altered in calf muscles of all patients with myofibrillar myopathies in comparison to healthy control subjects. Despite incoherencies with respect to disease progression and etiology fat-corrected aTSC were in- and aTPC were decreased.

Impact: Combined ^{39}K/^{23}Na-MRI detects changes in ionic balance beyond fatty replacement of muscle in a diverse cohort of myofibrillar myopathies. Further studies are needed to investigate whether different genotypes or whether disease progression can be detected in early stages by ^{39}K/^{23}Na-MRI.

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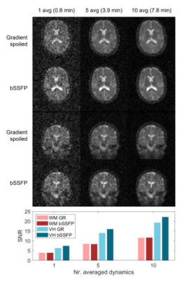

[3D Seiffert spiral k-space trajectories for a functional sodium (23Na) MRI protocol at 3T]

Samuel Rot[1,2], Matthew Clemence[3], Bhavana S Solanky[1,4], and Claudia A. M. Gandini Wheeler-Kingshott[1,5,6]

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Keywords: Non-Proton, Non-Proton

Motivation: With advancing hardware, scan durations of ^{23}Na-MRI have decreased, enabling novel applications that probe dynamic or functional processes; existing sequences, though, may not fully exploit the possible acceleration.

Goal(s): Implement and demonstrate a highly efficient ultrashort echo time non-Cartesian sequence based on 3D Seiffert spirals, for temporally-resolved applications of ^{23}Na-MRI.

Approach: A possible acquisition protocol for functional brain ^{23}Na-MRI at a temporal resolution of 47s was tested on a healthy volunteer at rest, at 3T.

Results: Image quality and SNR are high considering the temporal resolution, with compressed sensing successfully reducing noise. Further work will optimise the sequence analytically, ensuring homogeneous k-space sampling.

Impact: Dynamic ^{23}Na-MRI at 3T is possible at sub-minute temporal resolution with a 3D Seiffert spiral k-space trajectory. Unlike for other sequences, efficient k-space coverage is achieved without downsides of unpleasant acoustic noise, or exciting mechanical resonances of scanner hardware.

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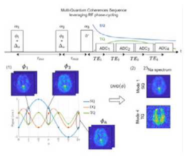

[Dynamic Mode Decomposition reveals 23Na Multi-Quantum Coherences and allows incomplete RF Phase-Cycling]

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Keywords: Non-Proton, Non-Proton, Dynamic Mode Decomposition, Signal separation

Motivation: Sodium (^{23}Na) Multi-Quantum Coherences (MQC) MRI potentially provides richer tissue information. However, separation of the single (SQ) and triple (TQ) quantum coherences is challenging and is done by computing the Fourier transform (FT). Unfortunately, the FT is susceptible to noise and phase-cycle imperfections.

Goal(s): To enable reliable frequency separation of the superimposed ^{23}Na MQC signal even with undersampling phase-cycling.

Approach: Dynamic Mode Decomposition (DMD) was used to separate the signal components and was tested on numerical simulations, phantom and in vivo brain data acquired at 3T.

Results: DMD reliably separated SQ and TQ signal components from ^{23}Na MQC MRI despite missing phase-cycling steps.

Impact: DMD reliably separates SQ and TQ signal components and has the potential to enable phase-cycle undersampling below the TQ Nyquist limit to accelerate ^{23}Na MQC MRI. Despite ^{23}Na MQC MRI, every MRI experiment involving phase-cycling could benefit from this approach.

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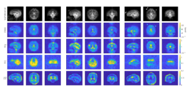

Low-rank reconstruction for simultaneous Double-Half-Echo 23Na and undersampled 23Na Multi-Quantum Coherences MRI

Christian Licht[1,2], Simon Reichert[1,2], Mark Bydder[3], Jascha Zapp[1,2], Shirley Corella[3,4], Maxime Guye[3,4], Lothar R Schad[1,2], and Stanislas Rapacchi[3,4]

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Keywords: Non-Proton, Non-Proton, low-rank matrix completion, sequence optimization

Motivation: Sodium (^{23}Na) Multi-Quantum Coherences (MQC) MRI potentially provides richer tissue information. However, 3D ^{23}Na multi-quantum coherences imaging lacks conventional ^{23}Na MRI resolution and requires multiple radiofrequency phase-cycling limiting spatial resolution.

Goal(s): We propose an efficient sequence to simultaneously acquire Cartesian double-half echo (DHE) ^{23}Na and accelerated ^{23}Na MQC MRI.

Approach: Leveraging advanced low-rank matrix completion frameworks to enable simultaneous DHE ^{23}Na and ^{23}Na MQC MRI were tested on numerical simulations, retro- and prospectively undersampled phantom and in vivo brain data acquired at 7T.

Results: Simultaneous Cartesian ^{23}Na and higher resolution 3-fold prospectively undersampled ^{23}Na MQC brain MRI of 4 volunteers were obtained.

Impact: The new sequence, in combination with the low-rank reconstruction frameworks, enables efficient ^{23}Na and higher resolution ^{23}Na MQC MRI while supporting conventional ^{1}H-based acceleration techniques and offers, therefore, a convenient sequence for the sodium MRI community.

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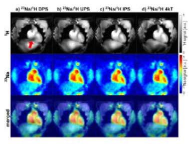

Interleaved 23Na/1H (pTx) MRI of the human heart at 7 Tesla

Laurent Ruck[1], Nico Egger[1], Sophia Nagelstraßer[1], Tobias Wilferth[1], Jürgen Herrler[2], Christoph Kopp[3], Saskia Wildenberg[1,4], Andreas K. Bitz[4], Michael Uder[1], and Armin M. Nagel[1,5]

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Keywords: Non-Proton, Non-Proton, Sodium MRI, 23Na MRI, interleaved 23Na/1H MRI, High-Field MRI

Motivation: Interleaved dual-nuclear acquisition enables time-efficient ^{23}Na and ^{1}H cardiac MRI within one measurement. However, at 7T the reduced excitation wavelengths can lead to flip angle (FA) inhomogeneities in ^{23}Na MRI and even to signal dropouts in ^{1}H MRI. Both effects impair a reproducible quantitative evaluation of the myocardial ^{23}Na signal.

Goal(s): To reduce FA inhomogeneities for interleaved ^{23}Na/^{1}H MRI.

Approach: We included three different pTx pulses in ^{1}H MRI of the interleaved sequence and introduced a fast ^{23}Na FA mapping.

Results: All three pTx pulses improved the ^{1}H FA homogeneity and ^{23}Na images showed better signal homogeneity after FA correction.

Impact: Interleaved ^{23}Na/^{1}H (pTx) MRI in combination with additional fast ^{23}Na FA mapping is less prone to FA inhomogeneities and by that should enable reliable quantification of myocardial ^{23}Na signal within clinically feasible acquisition times.

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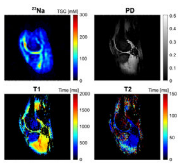

Simultaneous 1H MRF / 23Na MRI in knee cartilage at 7 T

Anne Adlung[1,2], Zoe Pursel[1,3], Baptiste Busi[1,2], Gonzalo Gabriel Rodriguez[1,4], and Guillaume Madelin[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Pelham Memorial High School, Pelham, NY, United States, [4]NMR Signal Enhancement, Max Planck for Multidisciplinary Sciences, Göttingen, Germany

Keywords: Non-Proton, Non-Proton

Motivation: Sodium MRI can provide tissue sodium concentration (TSC) and enable assessment of knee cartilage degradation.

Goal(s): We aim to quantify TSC, proton density (PD) and ^{1}H T1 and T2 in the knee from multinuclear simultaneous acquisition.

Approach: We acquired ^{23}Na-only FLORET and simultaneous ^{1}H MRF/^{23}Na MRI data in the knee of four healthy volunteers. We calculated TSC maps from both ^{23}Na acquisitions for comparison, and PD, T1 and T2 maps from ^{1}H MRF.

Results: Mean TSC in patellar and femorotibial cartilage, and gastrocnemius muscle showed no significant differences between both sodium acquisitions. Mean TSC, PD, T1 and T2 values were within previously-reported range.

Impact: We showed that a 3D simultaneous ^{1}H MRF/^{23}Na MRI acquisition at 7 T can provide reliable quantitative maps of TSC, PD, and ^{1}H T1 and T2 relaxation times in cartilage.

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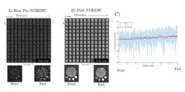

Using NORDIC with 23Na MRI to study dynamic changes in tissue sodium concentration

Ben Prestwich[1], Susan Francis[1,2], Rosemary Nicholas[1], and Daniel Marsh[1]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Biomedical Research Centre, Nottingham Univ. Hospital NHS Trust and Univ. Nottingham, Nottingham, United Kingdom

Keywords: Non-Proton, Non-Proton

Motivation: To perform ^{23}Na MRI to study dynamic studies of changes in tissue sodium concentration in-vivo.

Goal(s): To demonstrate the application of NOise Reduction with DIstribution Corrected (NORDIC) PCA denoising to ^{23}Na MRI data.

Approach: Dynamic timeseries of ^{23}Na GRE data and NORDIC denoising to validate measurement of a known change in sodium concentration in a phantom, and dynamic changes in calf muscle in response to exercise.

Results: NORDIC PCA denoising allows detection of the temporal change in sodium in a phantom with good spatial resolution. This is applied to study the dynamics of sodium changes in muscle in response to exercise.

Impact: NOise Reduction with DIstribution Corrected (NORDIC) PCA denoising provides the potential to improve low SNR ^{23}Na MRI measures to study dynamic changes in sodium on a spatially resolved level. Here, applied to study ^{23}Na changes in calf muscle on exercise.

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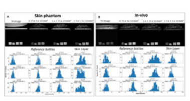

Validation of High Spatial Resolution 23Na Imaging of the Skin

Theodora Slater[1], Ben L Prestwich[1], and Susan T Francis[1]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom

Keywords: Non-Proton, Non-Proton, skin

Motivation: The storage of sodium in the skin is thought to be a physiologically important regulatory mechanism for blood pressure, volume regulation, and to change with age, hypertension and disease such as renal and cardiovascular disease.

Goal(s): To image the skin at higher spatial resolution for improved estimation of skin sodium quantification.

Approach: To develop a dual-tuned ^{23}Na/^{1}H skin coil to image a skin 'phantom' and the skin in-vivo. To apply a B_1-mapping correction and use the skin 'phantom' to validate methods, and study the effects of spatial resolution on skin sodium measures.

Results: High resolution skin sodium imaging was achieved, improving ^{23}Na quantification.

Impact: Improved spatial resolution of sodium imaging measures of the skin will provide improved assessment of quantification of skin sodium to study the effects of age, ethnicity and disease.

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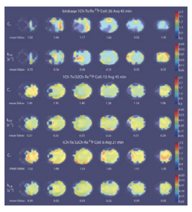

[3D whole brain mapping of creatine kinase metabolic rate using 31P-MR fingerprinting.]

Mark Stephan Widmaier[1,2], Antonia Kaiser[1], Ying Xiao[1,3], Zhiwei Huang[1,4], Yun Jiang[5], Song-I Lim[6], Daniel Wenz[6], and Lijing Xin[6]

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Keywords: MR Fingerprinting, MR Fingerprinting, 31P, MRF, creatine kinase rate, kCK, MRSI, 7T

Motivation: Using ^{31}P MRS combined with magnetization transfer (MT) experiments including saturation transfer or inversion transfer to assess chemical exchange rate of creatine kinase (k_{CK}) in the human brain are time-consuming and limited to 1D-acquisitions.

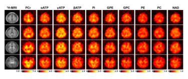
Goal(s): Acquiring a 3D whole brain k_{CK} map.

Approach: In this abstract, we introduce an advanced, fast 3D-^{31}P-MRF sequence for the human brain at 7T.

Results: The novel 3D-^{31}P-MRF approach is feasible for whole brain mapping of k_{CK}, enabling the investigation of region-specific energy metabolism under various pathological conditions.

Impact: Using the novel 3D-^{31}P-MR Fingerprinting approach for whole brain mapping of k_{CK} enables us to investigate region-specific energy metabolism under various pathological conditions and may enhance our understanding of the underlying molecular and metabolic processes.

0931 15:18



[Fast Volumetric Mapping of Brain NAD Levels Using 7T 31P-MRSI and Learned Probabilistic Subspaces]

Rong Guo[1,2], Shaolin Yang[3], Hannes M Wiesner[4], Yudu Li[2], Yibo Zhao[2,5], Zhi-Pei Liang[2,5], Wei Chen[4], and Xiao-Hong Zhu[4]

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Keywords: Non-Proton, Non-Proton

Motivation: Measuring brain intracellular NAD levels has long been of interest, but the current ^{31}P-MRSI methods would take prohibitively long scan times for mapping NAD.

Goal(s): To present a method for fast volumetric NAD mapping of the entire human brain.

Approach: *In vivo* ^{31}P-MRSI scans were performed at 7T with a nominal resolution of 1.0 cc within 20 minutes. A probabilistic subspace-based method integrating spectral prior, spatial constraint, and statistical distributions was applied for denoising.

Results: The proposed method successfully provided high-resolution brain NAD mapping within 20-minute scans. The results also showed promises in revealing metabolic tissue heterogeneity and age correlation of NAD.

Impact: This work demonstrates the feasibility of volumetric brain NAD mapping with a nominal resolution of 1.0 cc within 20 minutes. It may provide a powerful metabolic imaging tool for many applications.

Oral
Diffusion in Gray Matter

Summit 2 | Wednesday 13:30 - 15:30 | *Moderators:* Jennifer McNab & Kevin Harkins

13:30 Introduction

Jennifer McNab
Stanford University, Stanford, CA, United States

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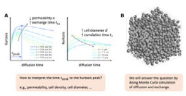

[Revealing membrane integrity and cell size from diffusion kurtosis time-dependence]

Hong-Hsi Lee[1], Dmitry S Novikov[2], Els Fieremans[2], and Susie Y Huang[1]

[1]*Radiology, Massachusetts General Hospital, Charlestown, MA, United States,* [2]*New York University School of Medicine, New York, NY, United States*

Keywords: Simulation/Validation, Microstructure, simulations, validation

Motivation: The non-monotonic dependence of the diffusion kurtosis on diffusion time has been observed in tissue, yet its relation to membrane integrity and tissue geometry remains unknown.

Goal(s): We investigate the relation between the characteristic time t_{peak} and the tissue parameters, such as cell size, volume fraction and permeability.

Approach: We perform Monte Carlo simulations of diffusion and exchange in randomly, densely packed spheres with varying permeability, cell fractions and sizes, and identify the value of t_{peak}.

Results: We obtain an empirical, albeit highly accurate relation of t_{peak} to tissue parameters in a broad parameter range.

Impact: Diffusion-kurtosis time-dependence is sensitive to pathological changes in membrane integrity and cellular structure in diseases, such as ischemic stroke and tumors. Numerical simulations suggest an empirical interpretation of kurtosis time-dependence, offering a novel biomarker for in vivo evaluation of pathology.

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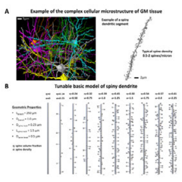

[Towards quantifying Gray Matter "micro-connectivity": the measurable impact of dendritic spines on metabolite diffusion]

Kadir Şimşek[1,2] and Marco Palombo[1,2]

[1]*Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom,* [2]*School of Computer Science and Informatics, Cardiff University, Cardiff, United Kingdom*

Keywords: Microstructure, Microstructure, brain, diffusion, microstructure, metabolites, DW-MRS, spines, gray matter, simulation

Motivation: Dendritic spines are fine microstructures increase the complexity of brain cells. Spines are characteristic morphological feature of neurons and their density can change with pathological conditions.

Goal(s): Quantification of dendritic spines in gray matter in human brain using diffusion-weighted MR spectroscopy

Approach: Using Monte-Carlo diffusion simulations for metabolites, to investigate how a dMRS signal is sensitive to the dendritic spines.

Results: Our findings suggests potential biomarkers for characterizing dendritic spines in human brain gray matter using diffusion-weighted MR spectroscopy

Impact: This work establishes a benchmark for spine sensitivity and quantification. Also it offers potential dMRS acquisition parameters for spine detection in human brain.

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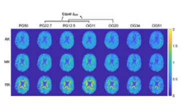

[Investigation of the time- and frequency-dependence of diffusion kurtosis in the human brain with pulsed and oscillating gradient experiments]

Runpu Hao[1], Eric S. Michael[1], Franciszek Hennel[1], and Klaas P. Pruessmann[1]

[1]*Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland*

Keywords: DWI/DTI/DKI, Microstructure, Kurtosis, OGSE, PGSE, Frequency dependence, Time dependence, Human brain

Motivation: Investigation of the time- and frequency-dependence of diffusion kurtosis, a valuable probe of microstructure and exchange, is becoming feasible in humans due to advances of gradient hardware.

Goal(s): To provide more data regarding time- and frequency-dependent diffusion kurtosis in the human brain.

Approach: Diffusion MRI with pulsed and oscillating gradients (PGSE/OGSE) at different but partially overlapping diffusion times using a head gradient insert and spiral readouts.

Results: Biphasic kurtosis behavior (i.e., increase with time in the short-time range and decrease with time in the long-time range covered by OGSE/PGSE, respectively) was observed, with an explainable mismatch between both sequences in the overlapping range.

Impact: Studying the time- and frequency-dependence of diffusion kurtosis using both PGSE and OGSE experiments over a range of diffusion times and length scales can provide valuable information about brain tissue complexity, heterogeneity, and inter-compartmental water exchange.

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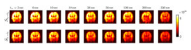

[Quantification of exchange in the mouse brain using double diffusion encodings with fixed total diffusion-weighting]

Teddy Xuke Cai[1,2], Nathan Hu Williamson[2,3], Peter Joel Basser[2], Mohamed Tachrount[1], and Karla Loreen Miller[1]

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Keywords: Diffusion Acquisition, Diffusion/other diffusion imaging techniques, Exchange

Motivation: Exchange is an important effect in diffusion MR of the brain but remains difficult to quantify using conventional methods and signal models due to parameter degeneracy.

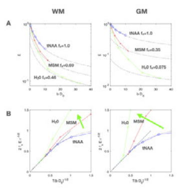
Goal(s): To develop and demonstrate robust measurement of exchange in the mouse brain.

Approach: A method based on double diffusion encoding was previously developed to probe exchange isolated from other effects, yielding robust exchange time measurements. We apply this method *in vivo* for the first time.

Results: We report a fast *in vivo* exchange time of approximately 38 ms as compared to 146 ms in a fixed sample, obtained by averaging through a slice.

Impact: Cellular water exchange reflects not only structural characteristics but has also been linked to metabolism. Quantifying exchange may yield rich information, yet methods to do so are not mature. Here, we demonstrate a unique, isolated measurement of exchange *in vivo*.

0936 14:30



[A new handle on extracellular diffusion and exchange? Single and double diffusion encoded MRS in humans after MSM ingestion]

Henrik Lundell[1,2], Samira Bouyagoub[3], André Döring[4,5], Nick G Dowell[3], Roland Kreis[6,7], and Itamar Ronen[3]

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Keywords: Microstructure, Microstructure

Motivation: The investigation of extracellular spaces with diffusion weighted MRI andMRS is limited by the ubiquitous distribution and fast exchange of water, while endogenous metabolites are mostly intracellular.

Goal(s): Investigate the diffusion characteristics of ingested MSM compared to water and endogenous metabolites.

Approach: Multi b-valued single and double diffusion encoded MRS in humans at 3T.

Results: MSM diffuses anisotropically, but considerably faster than intracellular metabolites, and exhibits a substantially different behavior compared to both water and metabolites.

Impact: MSM provides a novel probe of extracellular spaces similar to water but with differences that could be rotted in different transmembrane exchange properties.

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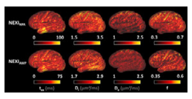

[NEXI for the quantification of human gray matter microstructure on a clinical MRI scanner]

Quentin Uhl[1,2], Tommaso Pavan[1,2], Thorsten Feiweier[3], Gian Franco Piredda[4,5], Sune N. Jespersen[6], and Ileana Jelescu[1,2]

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Keywords: Microstructure, Diffusion/other diffusion imaging techniques, Diffusion modeling, Quantitative imaging, Tissue characterization

Motivation: This study assesses the Neurite Exchange Imaging (NEXI) microstructure model in human cortex using clinical MRI data, addressing the model's clinical applicability.

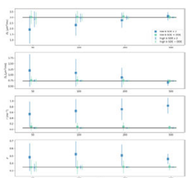
Goal(s): How meaningful, robust, and reproducible are microstructural properties in the human cortex estimated using the NEXI diffusion model on clinical data?

Approach: Scan-rescan clinical data from six volunteers were collected and processed. NEXI was estimated and compared to expected cortical distributions and to the myelin water fraction distribution.

Results: NEXI provided robust, biologically plausible results and maintained inter-subject sensitivity and intra-subject reproducibility. A significant correlation between exchange time and myelin water fraction supports the relationship between membrane permeability and myelination.

Impact: We successfully estimate the Neurite Exchange Imaging (NEXI) model on clinical MRI data and report a strong correlation between the estimated exchange time, a proxy for membrane permeability, and the Myelin Water Fraction in the human cortex.

0938 14:54



[Tensor encoded diffusion weighting improves model parameter estimation of SMEX/NEXI]

Nayereh Ghazi[1], Santiago Coelho[2], Noam Shemesh[3], and Sune Nørhøj Jespersen[1,4]

[1]Center of Functionally Integrative Neuroscience (CFIN) and MINDLab, Department of Clinical Medicine, Aarhus University, Aarhus, Denmark, [2]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University, School of Medicine, New York, NY, United States, [3]Champalimaud Research, Champalimaud Center for the Unknown, Lisbon, Portugal, [4]Department of Physics and Astronomy, Aarhus University, Aarhus, Denmark

Keywords: Microstructure, Microstructure, Gray Matter, Exchange, Double Diffusion Encoding

Motivation: SMEX is a model of diffusion which may enable gray matter (GM) microstructural mapping in-vivo. However, clinical translation necessitates reliable parameter estimation with short scan time and limited gradient strength.

Goal(s): Resolve degeneracies for SMEX parameter estimation and enable more accurate and precise GM microstructural mapping

Approach: We complement the Single Diffusion Encoding measurement with Double Diffusion Encoding. We analyze the signal theoretically for low b-values in terms of the cumulant expansion, and for high b-values with numerical simulations.

Results: Planar diffusion encoding resolves an intrinsic degeneracy in SMEX at low b, and generally provides higher accuracy and precision in model parameter estimation.

Impact: The improvement in parameter estimation afforded by tensor encoded diffusion may enable shorter sequences and lower gradient strengths, thereby facilitating clinical translation of SMEX.

0939 15:06

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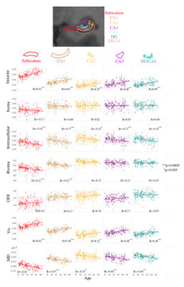


[A deep dive into hippocampus growth: Unveiling neurite and soma development with in vivo diffusion MRI]

Bradley G Karat[1], Sila Genc[2], Erika Raven[3], Marco Palombo[4], Ali R Khan[1,5], and Derek K Jones[4]

[1]Robarts Research Institute, Western University, London, ON, Canada, [2]Department of Neurosurgery, The Royal Children's Hospital, Melbourne, Australia, [3]Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [4]Cardiff University Brain Research Imaging Centre (CUBRIC), Cardiff University, Cardiff, United Kingdom, [5]Department of Medical Biophysics, Western University, London, ON, Canada

Keywords: Microstructure, Aging, Hippocampus; High-field MRI

Motivation: The hippocampus serves multiple cognitive functions, yet little is known about its microstructural development.

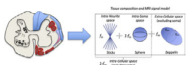
Goal(s): To leverage recent MRI hardware and microstructure modeling advances to capture hippocampal cell-body (soma) and projection (neurite) development during late-childhood and adolescence.

Approach: Diffusion MRI data was acquired in 88 participants aged 8-18 years using a 3T Connectom scanner (with 300mT/m gradients), and analyzed using the Soma and Neurite Density Imaging model.

Results: For the first time, we identified distinct developmental patterns of hippocampal microstructural subcomponents. Specifically, we found an age-related increase in neurite fraction and concurrent decrease in extracellular fraction and soma radius.

Impact: We report, for the first time, distinct neurite and soma developmental profiles in the hippocampus during late childhood/adolescence. This forms a crucial baseline for understanding developmental disorders, and opens new avenues for corroborating *in vivo* diffusion with histology.

0940 15:18



[Characterization of neurite and soma organization in the in vivo spinal cord with diffusion MRI]

Kurt Schilling*[1], Marco Palombo*[2], Kristin O'Grady[1], Marco Pizzolato[3], Bennett A Landman[4], and Seth Smith[1]

[1]Vanderbilt University Medical Center, Nahville, TN, United States, [2]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom, [3]Department of Applied Mathematics and Computer Science, Technical University of Denmark, Lyngby, Denmark, [4]Vanderbilt University, Nashville, TN, United States

Keywords: Microstructure, Spinal Cord, Spinal cord; soma; microstructure; modeling; diffusion

Motivation: Multicompartment models of diffusion MRI have proven valuable in the brain.

Goal(s): However, application of these models in the spinal cord (SC) remains relatively understudied.

Approach: Here, we address challenges related to acquisition and image processing in order to apply the Soma and Neurite Density Imaging (SANDI) model in the human SC in 11 healthy subjects.

Results: We show that SANDI captures differences between white and gray matter tissue types and across the functionally relevant white matter pathways and gray matter architectures and has the potential to act as a biomarker for biomedical applications.

Impact: We show that the Soma and Neurite Density Imaging (SANDI) diffusion model is a feasible method to characterize both white and gray matter tissue microstructure of the in vivo human spinal cord on clinical scanners.

Power Pitch

Pitch: Advances in Data Acquisition

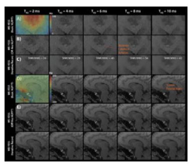
Power Pitch Theatre 1

Wednesday
Pitches: 13:30 - 14:30
Posters: 14:30 - 15:30

Moderators: Rui Pedro Azeredo Gomes Teixeira & Sophie Schauman

(no CME credit)

0941 Pitch: 13:30 Poster: 14:30 Screen 1



3D-Yarnball Acquisition and Reconstruction Advancement Yields High Resolution T1-Weighted Whole Brain Images in Just Over 1 Minute

Rob Stobbe[1], Corey Baron[2], and Christian Beaulieu[1]

[1]University of Alberta, Edmonton, AB, Canada, [2]Western University, London, ON, Canada

Keywords: Data Acquisition, Data Acquisition

Motivation: This study is motivated by the creation of high-resolution T1-weighting whole brain images in considerably less time (1 minute) than currently required for standard MP-RAGE (~4 minutes).

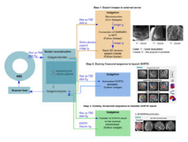
Goal(s): The sampling efficient 3D-Yarnball trajectory offers a potential imaging solution, but trajectory/sequence design and reconstruction aspects remain to be explored.

Approach: Variably under-sampled Yarnball trajectories with 2-10 ms duration were compared in healthy brain, along with different methods of steady-state sequence excitation. Iterative, off-resonance correcting, wavelet-regularized reconstruction was applied to Yarnball for the first time.

Results: Yarnball sequence and reconstruction consideration enabled high-quality 0.77 mm isotropic whole brain images in 1 minute

Impact: The image acquisition, sequence, and reconstruction investigation of this work enabled robust, high-quality 0.77 mm isotropic T1-weighted whole brain images in just over 1 minute. The goal of this work is to facilitate considerably shorter MRI protocols.

0942 Pitch: 13:30 Poster: 14:30 Screen 2



Towards Integrating 3D Fetal Brain Slice-to-Volume Reconstruction in a 0.55T Scanner Environment with Gadgetron

Sara Neves Silva[1,2], Alena Uus[1,2], Jordina Aviles Verdera[1,2], Kelly Payette[1,2], Megan Hall[1,3], Kathleen Colford[1,2], Sarah McElroy[1,2,4], Raphael Tomi-Tricot[1,2,4], Maria Deprez[1,2], Joseph V Hajnal[1,2], Mary Rutherford[1,2], Lisa Story[1,3], and Jana Hutter[1,2]

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Keywords: Data Acquisition, Data Acquisition, Fetal

Motivation: Fetal MRI is an important tool for antenatal diagnosis, allowing to assess appropriate growth with T2-weighted TSE sequences. Involuntary fetal motion is frozen in-plane with single-shot sequences, but 3D inconsistencies remain and are currently mostly addressed with offline slice-to-volume reconstruction.

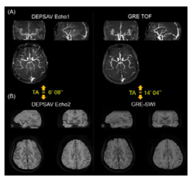
Goal(s): The goal of this work is to integrate slice-to-volume reconstruction into a clinical fetal low-field scan.

Approach: A Gadgetron-based real-time pipeline including quality control, decision support, 3D reconstruction and transfer back to the scanner was implemented.

Results: The steps of the pipeline were successfully tested in-vivo in low-field fetal MRI.

Impact: The complete integration of Slice-to-Volume reconstruction into the normal clinical workflow and the resulting availability of high resolution 3D volumes during the scan overcomes challenges and current barriers of fetal MRI.

0943 Pitch: 13:30 Poster: 14:30 Screen 3



Echo-planar Imaging-based Rapid Simultaneous MR Angiography and Venography with Dedicated Flow-related Ghosting Suppression

Yue Wu[1,2,3], Yan Yang[1,2,3], Dehe Weng[4], Jing An[4], Yan Zhuo[1,2,3], Rong Xue[1,2,3], and Zihao Zhang[1,2,5]

[1]Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, [2]The Innovation Center of Excellence on Brain Science, Chinese Academy of Sciences, Beijing, China, [3]University of Chinese Academy of Sciences, Beijing, China, [4]Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China, [5]Institute of Artificial Intelligence, Hefei Comprehensive National Science Center, Hefei, China

Keywords: Data Acquisition, Vessels, Ghosting suppression, Sequence design, Low-rank reconstruction

Motivation: Ghost artifact of large vessels impede the use of echo-planar imaging(EPI) for accelerated MR Angiography(MRA) or MR Venography(MRV) acquisitions.

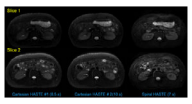
Goal(s): To analyze the physical principles of flow-related ghost, and develop targeted technical approaches to suppress the artifact, enabling EPI-based rapid and high-fidelity simultaneous MRAV.

Approach: By employing techniques including point-spread function modeling, alternating flow-compensation scheme, flow-related phase-based reconstruction, and automatic detection and correction algorithms, rapid *in-vivo* vascular imaging were achieved.

Results: DEPSAV-II achieved cerebral MRAV with suppressed ghost artifacts and comparable vascular depiction with GRE-based methods in 6 minutes, thereby improving the accessibility of comprehensive vascular examination in routine clinical practices.

Impact: Developed a suite of techniques to overcome flow-related ghosting of large vessels which tackling EPI-based rapid arteriovenous-imaging methods.
DEPSAV-II's simultaneous MRAV and significant time-reduction may benefit clinical studies and practices like small vessel diseases requiring comprehensive arterial and venous examination.

0944 Pitch: 13:30 Poster: 14:30 Screen 4



Spiral HASTE using variable-flip-angle single-shot spiral-ring TSE for rapid T2-weighted abdominal imaging

Zhixing Wang[1], Xiaodong Zhong[2], Yang Yang[3], John Mugler[4], An Liu[1], Craig Meyer[5], and Kun Qing[1]

[1]Radiation Oncology, City of Hope National Medical Center, Duarte, CA, United States, [2]Radiological Sciences, University of California Los Angeles, Los Angeles, CA, United States, [3]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [4]Radiology & Medical Imaging, University of Virginia, Charlottesville, VA, United States, [5]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States

Keywords: Data Acquisition, Data Acquisition, Spiral TSE, HASTE, Abdominal imaging

Motivation: Conventional Cartesian HASTE may be susceptible to image blurring, resolution loss, and artifacts in abdominal imaging.

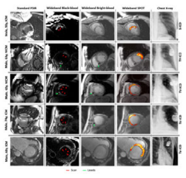
Goal(s): To develop a 2D T_2-weighted abdominal spiral HASTE technique to achieve better image sharpness, reduced scan time, and reduced power deposition compared to Cartesian HASTE.

Approach: A variable-flip-angle refocusing RF series was designed and employed to maintain high signal-intensity at middle- and late-echoes with a smooth signal-evolution compared to a constant-flip-angle scheme. Variable-density spiral-ring trajectories combined with L1-ESPIRiT reconstruction were performed to accelerate the data acquisition.

Results: Whole-abdomen spiral HASTE images were acquired with 1.5×1.5×6 mm^3 spatial-resolution and 25 slices in a 7-second acquisition at 3T.

Impact: This work highlights the utilization of spiral-ring TSE acquisition along with variable-flip-angle RF pulses and L1-ESPIRiT reconstruction for accelerated single-shot abdominal imaging, providing images with improved image sharpness, shorter scan time, and reduced power deposition over conventional Cartesian HASTE.

0945 Pitch: 13:30
Poster: 14:30
Screen 5



[Wideband joint black- and bright-blood late gadolinium enhancement imaging in patients with cardiac implantable devices]

Pauline Gut[1,2], Hubert Cochet[2,3], Guido Caluori[2], Dounia El-Hamrani[2], Marion Constantin[2], Konstantinos Valchos[2], Soumaya Sridi[3], Frederic Sacher[2,4], Pierre Jaïs[2,4], Matthias Stuber[1,2,5], and Aurélien Bustin[1,2,3]

[1]Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland, [2]IHU LIRYC, Electrophysiology and Heart Modeling Institute, Université de Bordeaux – INSERM U1045, Bordeaux, France, [3]Department of Cardiovascular Imaging, Hôpital Cardiologique du Haut-Lévêque, CHU de Bordeaux, Bordeaux, France, [4]Department of Cardiac Pacing and Electrophysiology, Hôpital Cardiologique du Haut-Lévêque, CHU de Bordeaux, Bordeaux, France, [5]CIBM, Center for Biomedical Imaging, Lausanne, Switzerland

Keywords: Pulse Sequence Design, Tissue Characterization

Motivation: Wideband bright-blood late gadolinium enhancement (LGE) enables artifact-free imaging of myocardial scars in patients with implantable cardioverter defibrillators (ICDs). Unfortunately, the poor scar-blood contrast makes it difficult to depict subendocardial scars.

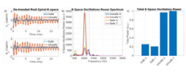
Goal(s): To improve myocardial scar visualization and localization in ICD patients.

Approach: We propose a 2D breath-hold single-shot ECG-triggered gradient echo wideband joint black- and bright-blood (wideband SPOT) LGE sequence to improve scar visualization and localization, while limiting ICD-artifacts. Wideband was implemented in an adiabatic inversion pulse and in an adiabatic T2 preparation.

Results: Wideband SPOT successfully suppressed ICD-artifacts while improving scar detection, and provided same image quality than reference wideband bright-blood.

Impact: This new technology will enable radiologists and cardiologists to detect and localize myocardial scars more accurately in ICD patients by eliminating ICD hyperintensity artifacts and enhancing scar tissue with unprecedented contrast.

0946 Pitch: 13:30
Poster: 14:30
Screen 6



[Safe Spirals for Your Scanner]

Matthew A. McCready[1], Congyu Liao[2], John Pauly[1], and Adam B Kerr[1,3]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Center for Cognitive and Neurobiological Imaging, Stanford University, Stanford, CA, United States

Keywords: Pulse Sequence Design, Pulse Sequence Design

Motivation: Vibration of gradient coils is a source of loud acoustics, signal dropout, field distortion, and potential system damage particularly at mechanical resonant frequencies.

Goal(s): To design safe spiral gradient waveforms which avoid mechanical resonant frequencies and their resulting severe vibrations.

Approach: Instantaneous gradient frequency during spiral readout is estimated as the rotational frequency of a circle at the current k-space radius and gradient amplitude. Amplitude is limited to drop through resonant bands quickly. A convex problem for spiral rewinders is formed minimizing the DFT at resonant frequencies.

Results: Coil vibration was significantly reduced using safe spirals, and gradient field oscillations were minimized.

Impact: Frequency constrained “safe” spiral waveforms were shown to avoid specified frequency bands, reducing gradient vibrations and k-space oscillations without degrading image quality. Such waveforms could potentially prolong gradient coil lifetime, reduce acoustic discomfort, and remove artefacts from persisting k-space oscillations.

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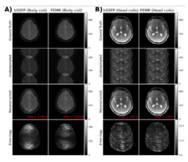
Poster: 14:30
Screen 7



Improved parallel imaging with N-periodic spatial banding patterns in bSSFP

Zimu Huo[1,2], Lorena Garcia-Foncillas[1], Krithika Balaji[1], Michael Mendoza[1], Neal K Bangerter[1], and Peter J Lally[1]

[1]*Imperial College London, London, United Kingdom,* [2]*Univeristy of Cambridge, Cambridge, United Kingdom*

Keywords: Parallel Imaging, Parallel Imaging

Motivation: This research explores the potential for temporally varying N-periodic bSSFP banding artifacts as a new dimension alongside coils for parallel imaging.

Goal(s): Our goal is to leverage the temporally varying spatial modulation of a 2-periodic bSSFP acquisition to improve parallel imaging performance over a straightforward bSSFP approach.

Approach: We optimize imaging parameters using computational simulations and validate our methodology through in-vivo experiments in brain.

Results: Our findings demonstrate that the banding artifacts from 2-periodic bSSFP can serve as additional spatial encoding information in parallel imaging applications to reduce scan time.

Impact: Periodically varying bSSFP banding patterns can be exploited to achieve improved parallel imaging performance, creating opportunities for new experimental designs in accelerated imaging.

0948
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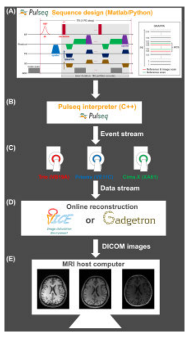
Poster: 14:30
Screen 8



Open-Source, Cross-Platform Workflow for MRI Data Acquisition and Image Reconstruction Based on the Pulseq Framework

Qingping Chen[1], Frank Zijlstra[1,2], Patrick Hucker[1], Sebastian Littin[1], and Maxim Zaitsev[1]

[1]*Division of Medical Physics, Department of Diagnostic and Interventional Radiology, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany,* [2]*Department of Radiology and Nuclear Medicine, St. Olav's University Hospital, Trondheim, Norway*

Keywords: Image Reconstruction, Image Reconstruction, open source vendor-independent sequences

Motivation: To enhance efficiency, transparency, and reproducibility of data acquisition and reconstruction in large-scale MRI studies.

Goal(s): To establish an open-source, cross-platform, easy-to-learn data acquisition and reconstruction workflow.

Approach: The Pulseq framework is extended to integrate Siemens' "Image Calculation Environment" (ICE) and Gadgetron. To validate the workflow, MPRAGE and EPI sequences were developed using the extended Pulseq and executed on three Siemens scanners with comparison to the corresponding product sequences.

Results: The preliminary results show that Gadgetron had comparable reconstruction performance to ICE, and Pulseq sequences generally produced image quality comparable to product sequences. Online Gadgetron and ICE produce images within seconds/minutes after measurements.

Impact: An open-source, cross-platform MRI data acquisition and reconstruction workflow is established by extending the Pulseq framework to link to reconstruction tools. The preliminary results indicate that this workflow has the potential to enable efficient, transparent, reproducible data acquisition and reconstruction.

0949

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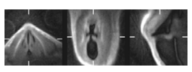
Poster: 14:30
Screen 9



Isotropic 3D Sub-millimeter MRI of the Vocal Fold Oscillation with Sub-millisecond Temporal Resolution

Johannes Fischer[1], Kian Tadjalli Mehr[1], Louisa Traser[2], Bernhard Richter[2], and Michael Bock[1]

[1]*Radiology, Medical Physics, University Medical Center Freiburg, Freiburg, Germany,* [2]*Institute of Musicians' Medicine, University Medical Center Freiburg, Freiburg, Germany*

Keywords: New Trajectories & Spatial Encoding Methods, Data Acquisition

Motivation: Several diseases influence the human vocal fold oscillation which can currently only be studied with superficial stroboscopic imaging.

Goal(s): We aim to develop a technique that allows the full characterization of the vocal fold oscillation with sub-millisecond sub-millimeter resolution.

Approach: ZTE MRI allows to freeze sub-ms dynamic signal changes in k-space. With synchronization data from a microphone, we retrospectively gate ZTE MRI data of the larynx acquired during singing using a total variation constraint in the time domain to reconstruct the vocal fold motion.

Results: 3D vocal fold oscillations can be visualized with ultra-high spatial (0.8mm) and temporal (670µs) resolution.

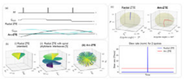
Impact: This work aims to improve the understanding of the VF oscillation under various physiological and pathological conditions, and might have applications in 3D dynamic MRI of other oscillatory body motions.

0950

Pitch: 13:30

Poster: 14:30

Screen 10



Arc-ZTE: Incoherent k-space sampling in time using continuously-slewed gradients for flexible, dynamic, quiet Zero TE MRI

Shreya Ramachandran[1], Tobias C. Wood[2], Gavin Zhang[1], and Michael Lustig[1]

[1]*Electrical Engineering and Computer Sciences, University of California, Berkeley, Berkeley, CA, United States,* [2]*Neuroimaging, King's College London, London, United Kingdom*

Keywords: New Trajectories & Spatial Encoding Methods, New Trajectories & Spatial Encoding Methods, ZTE, Dynamic MRI, Quiet MRI

Motivation: Existing Zero TE methods are constrained due to gradient slew limits between spokes, which hinders their use in dynamic imaging applications.

Goal(s): We aim to improve temporal k-space sampling in time by increasing the possible angular distance between consecutive spokes via continuously-slewed gradients, while still maintaining minimal gradient refocusing and minimal acoustic noise.

Approach: We parameterize the k-space trajectory using sequential rotations of an arc in k-space, then optimize the rotation angles over metrics for sampling uniformity and refocusing.

Results: We demonstrate a proof-of-concept of this trajectory and show improvement over radial ZTE in k-space coverage metrics and reconstructions for various temporal resolutions.

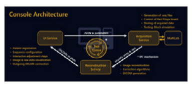
Impact: By improving temporal k-space sampling for Zero-TE MRI, our work enables quiet, dynamic imaging with flexible temporal resolution. Potential applications include quiet DCE or respiratory motion-resolved imaging for neonates and other sound-sensitive populations.

0951

Pitch: 13:30

Poster: 14:30

Screen 11



Open-Source Console Software for the MRI4ALL Hackathon Scanner

Kai Tobias Block[1], Roy Wiggins[1], Amanpreet Singh Saimbhi[1], Tarun Dutt[1], Antonio Verdone Sanchez[1], and Sairam Geethanath[2]

[1]*Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York University, New York, NY, United States, New York City, NY, United States,* [2]*Accessible Magnetic Resonance Laboratory, Biomedical Imaging and Engineering Institute, Department of Diagnostic, Molecular and Interventional Radiology, Icahn School of Medicine at Mt. Sinai, New York, NY, United States, New York City, NY, United States*

Keywords: Software Tools, New Devices, Open-Source

Motivation: Commercial MRI scanners have limited accessibility due to high costs and the proprietary nature of the hardware and software platforms.

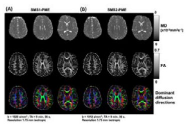
Goal(s): To develop a comprehensive console software for community-built low-field MRI systems that is solely based on open-source components and provides a user interface similar to commercial systems.

Approach: The console software was programmed in the Python programming language. The platform is divided into three decoupled services that 1) provide the interface for scan planning and visualization, 2) run the scanner control, and 3) perform the image reconstruction.

Results: The architecture is described, providing a starting point for utilizing it in other projects.

Impact: The development of open-source MRI software and hardware will help to disseminate fundamental knowledge about the construction of MRI scanners. The software platform described in this work may serve as foundation for future community initiatives on building open-source scanners.

0952 Pitch: 13:30 Poster: 14:30 Screen 12



[Further accelerating spin-echo EPI through combined patterned multislice excitation and SMS acquisition]

Jiazheng Zhou[1], Peter van Gelderen[1], Jacco A. de Zwart[1], Yicun Wang[1], and Jeff H. Duyn[1]

[1]AMRI, LFMI, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States

Keywords: New Signal Preparation Schemes, Pulse Sequence Design, SMS, PME, Diffusion

Motivation: Both the recently introduced patterned multislice excitation (PME) technique and SMS acquisition can be used for faster imaging. Combining these would reduce imaging times further.

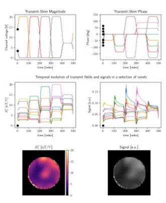
Goal(s): To demonstrate that the PME is compatible with SMS imaging.

Approach: Four RF pulses were combined to achieve acceleration from both SMS and PME. To limit peak RF amplitude, pulse components were time-shifted. The approach was demonstrated using diffusion weighted (DW) imaging at 3T.

Results: Close to fourfold acceleration was successfully implemented by combining twofold SMS and PME and evaluated for DW MRI performance versus twofold acceleration based on PME only.

Impact: Recently introduced PME approach and SMS can be combined to accelerate the acquisition.

0953 Pitch: 13:30 Poster: 14:30 Screen 13



[MR Fingerprinting with Dynamic Transmit Shims]

Felix Horger[1,2], Sarah McElroy[1,2,3], Joseph Hajnal[1,2,4], and Shaihan Malik[1,2,4]

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Keywords: MR Fingerprinting, MR Fingerprinting

Motivation: Transmit-inhomogeneities at ultra-high-field cause realized/effective flip-angles to strongly deviate from the nominal. In quantitative MRI, retrospective correction is possible but leads to spatially varying efficiency for parameter estimation. Parallel-transmit enables spatio-temporal modulation of excitation pulses in MR Fingerprinting (PTX-MRF), potentially improving encoding power by filling in regions of poor precision achieved with a static configuration.

Goal(s): Investigate an MRF prototype sequence with temporal modulation of parallel-transmit shims.

Approach: We sequentially apply different transmit-shims to modulate realized flip-angles and employ temporal low-rank for reconstruction of singular-component-images.

Results: We explored the potential and key requirements for PTX-MRF, showing that parallel-transmit could prove advantageous for MRF.

Impact: This work is an explorative step towards addressing transmit-field inhomogeneities at ultra-high-field. Its impact is mainly indicating new directions worthwhile investigating, supported by evidence from phantom experiments.

0954

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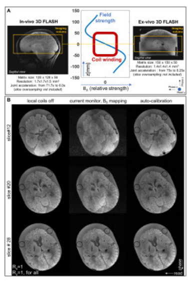
Poster: 14:30

Screen 14



Fast volumetric Cartesian MRI with auto-calibrated local B0 coil array – a reproducing kernel Hilbert space perspective

Rui Tian[1], Martin Uecker[2], Oliver Holder[1], Theodor Steffen[1], and Klaus Scheffler[1,3]

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Keywords: Image Reconstruction, Image Reconstruction, nonlinear gradient

Motivation: The local B_0 coil array has been shown to speed up 2D Cartesian MRI and provides a platform for investigating the most efficient B_0 encoding fields. Nevertheless, optimizing the rapid modulations for accelerating volumetric scans without introducing additional artifacts becomes more challenging.

Goal(s): We explore distinct nonlinear modulation B_0 fields and reconstruct artifact-free accelerated images.

Approach: With a recent RKHS framework, the k-space efficiency maps for various modulation fields are analyzed, and a novel auto-calibration reconstruction method is introduced.

Results: Our k-space analysis provides insights validating optimal modulation fields, and the ex-vivo and in-vivo scans demonstrate the robustness of the proposed reconstruction technique.

Impact: We demonstrate the RKHS formalism as a valuable tool for understanding 3D MRI scans encoded with nonlinear modulation fields. Our auto-calibration reconstruction, analogous to GRAPPA in parallel imaging, offers a promising approach for image acceleration with rapid B_0 modulation.

0955

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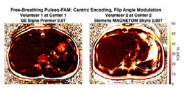
Poster: 14:30

Screen 15



Vendor-Neutral Development and Cross-Center Validation of Flip Angle Modulated 2D Sequential CSE-MRI Technique for Liver Fat Quantification

Jiayi Tang[1,2], Daiki Tamada[2], Xingwang Yong[3,4], Yuting Chen[4,5], Shohei Fujita[4,6], Jitka Starekova[2], Jeff Kammerman[7], Jean H Brittain[7], Alan McMillan[1,2,8,9,10], Jon-Fredrik Nielsen[11], Maxim Zaitsev[12], Scott B Reeder[1,2,8,13,14], Berkin Bilgic[4], and Diego Hernando[1,2]

[1]*Medical Physics, University of Wisconsin-Madison, Madison, WI, United States,* [2]*Radiology, University of Wisconsin-Madison, Madison, WI, United States,* [3]*Key Laboratory for Biomedical Engineering of Ministry of Education, Department of Biomedical Engineering, College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China,* [4]*Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States,* [5]*State Key Laboratory of Extreme Photonics and Instrumentation, College of Optical Science and Engineering, Zhejiang University, Hangzhou, China,* [6]*Radiology, Harvard Medical School, Boston, MA, United States,* [7]*Calimetrix, LLC, Madison, WI, United States,* [8]*Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States,* [9]*Data Science Institute, University of Wisconsin-Madison, Madison, WI, United States,* [10]*Electrical and Computer Engineering, University of Wisconsin-Madison, Madison, WI, United States,* [11]*Radiology, University of Michigan, Ann Arbor, MI, United States,* [12]*Division of Medical Physics, Department of Radiology, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany,* [13]*Medicine, University of Wisconsin-Madison, Madison, WI, United States,* [14]*Emergency Medicine, University of Wisconsin-Madison, Madison, WI, United States*

Keywords: Pulse Sequence Design, Fat, fat/water separation, data acquisition, liver, pulse sequence design, software tools

Motivation: 2D sequential chemical-shift-encoded acquisitions with centric encoding and flip-angle modulation (FAM) enables motion-robust and high-SNR liver fat quantification. Originally developed in a single vendor, the performance and relative simplicity of FAM motivate vendor-neutral implementation and validation.

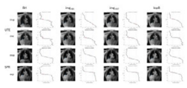
Goal(s): Implement FAM in the vendor-neutral framework Pulseq, and determine its feasibility, bias, and reproducibility in a multi-center, multi-vendor study.

Approach: Pulseq-FAM was applied in two centers with two vendors on a phantom with controlled PDFF/$T1_{water}$ values, and in volunteers during free breathing.

Results: At both centers, Pulseq-FAM shows low bias and good reproducibility in the phantom, and excellent motion robustness and image quality in volunteers.

Impact: A vendor-neutral implementation of motion-robust liver fat quantification, as demonstrated in this study, may enable detection, staging, and treatment monitoring of steatotic liver disease with improved availability and standardization.

0956 Pitch: 13:30 Poster: 14:30 Screen 16



[Self-gated 2D lung imaging using single petal rosette trajectory]

Hanna Frantz[1] and Volker Rasche[1]

[1]Department of Internal Medicine II, Ulm University Medical Center, Ulm, Germany

Keywords: Data Acquisition, New Trajectories & Spatial Encoding Methods

Motivation: Major limitation of lung MRI is respiratory motion which can be overcome by retrospective self-gating approaches.

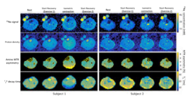
Goal(s): Achieving sufficient SNR values in the parenchyma is crucial for clinical evaluations and the assessment of physiological parameters.

Approach: This abstract presents a single-petal rosette UTE trajectory that is evaluated for k-space-, as well as image-based, retrospective self-gated lung imaging in comparison to the radial UTE trajectory.

Results: Higher SNR values and sharpness are obtained when using the SPR trajectory, compared to radial UTE sampling approaches at constant temporal resolution.

Impact: This abstract presents a single-petal rosette UTE trajectory (SPR) for 2D self-gated lung imaging, yielding higher SNR and sharpness in comparison to radial UTE sampling approaches.

0957 Pitch: 13:30 Poster: 14:30 Screen 17



Dynamic interleaved radial amine CEST and sodium (INTERLACED) at 3T

Alfredo Liubomir Lopez Kolkovsky[1,2,3], Chencai Wang[1,2], Jingwen Yao[1,2,4], and Benjamin M. Ellingson[1,2,5]

[1]Radiological Sciences, UCLA, Brain Tumor Imaging Laboratory, Los Angeles, CA, United States, [2]Radiological Sciences, UCLA, Magnetic Resonance Research Laboratories, Los Angeles, CA, United States, [3]NMR Laboratory, Neuromuscular Investigation Center, Institute of Myology, Paris, France, [4]Bioengineering, UCLA, Los Angeles, CA, United States, [5]Neurosurgery, David Geffen School of Medicine, UCLA, Los Angeles, CA, United States

Keywords: Data Acquisition, Non-Proton

Motivation: Sodium (^{23}Na) and advanced ^{1}H MRI provides valuable metabolic information but are not routinely used because of the required additional scan time.

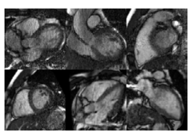
Goal(s): Employ the idle times in ^{23}Na MRI to perform ^{1}H measurements, reducing total scan time.

Approach: An interleaved radial amine CEST and sodium pulse sequence was developed to simultaneously acquire acidity or T_2* maps simultaneously with salinity maps in phantoms and in the lower leg during an exercise paradigm.

Results: A scan reduction of 46% relative to sequential acquisitions. Dynamic T_2*, acidity and sodium changes were successfully tracked and in line with the expected physiological responses.

Impact: The achieved scan time reduction could facilitate the inclusion of sodium and advanced 1H imaging in clinical routine. Furthermore, it could benefit functional studies by providing dynamic multinuclear information simultaneously from the same transient state.

0958 Pitch: 13:30 Poster: 14:30 Screen 18



A preliminary investigation for a Localized Quadratic Encoded 3D bSSFP cardiac cine MRI

Tzu Cheng Chao[1], Dinghui Wang[1], Spencer Waddle[1,2], and Tim Leiner[1]

[1]Department of Radiology, Mayo Clinic, Rochester, MN, United States, [2]MR R&D, Philips Healthcare, Rochester, MN, United States

Keywords: Data Acquisition, Heart, 3D cardiac image, 3D cine image, localized quadratic encoding

Motivation: A gated 3D cardiac cine MRI will be useful to evaluate cardiac structure and function from different viewing angles, unlike conventional 2D scans covering only specific orientations.

Goal(s): To develop a retrospectively cardiac gated 3D imaging sequence for the cine scan with reasonable breath-hold time and reconstruction speed.

Approach: A bSSFP sequence was combined with Localized Quadratic Encoding RF pulses for the cardiac gated 3D imaging.

Results: The 3D cardiac cine imaging requires around 20 breath-holds and each breath-hold takes around 25 seconds. The images feature similar soft tissue contrast to the conventional 2D bSSFP scanning with isotropic resolution along different viewing angles.

Impact: The proposed method enables a 3D cardiac cine scan with reasonable breath-hold duration and much faster reconstruction speed.

0959 Pitch: 13:30 Poster: 14:30 Screen 19

Multi-slab whole-brain in vivo 0.35 mm human brain at 7 T with low undersampling to validate future acceleration & denoising

Omer Faruk Gulban[1,2], Logan T Dowdle[3], Desmond Ho Yan Tse[4], Saskia Bollmann[5], Rainer Goebel[1,2], Benedikt A. Poser[1], and Dimo Ivanov[1]

[1]Department of Cognitive Neuroscience, Maastricht Univesity, Faculty of Psychology and Neuroscience, Maastricht, Netherlands, [2]Brain Innovation, Maastricht, Netherlands, [3]Department of Radiology, Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, Netherlands, [4]Scannexus, Maastricht, Netherlands, [5]School of Electrical Engineering and Computer Science, The University of Queensland, Brisbane, Australia

Keywords: Data Acquisition, Brain, Mesoscopic

Motivation: Our previous work provided 0.35×0.35×0.35 mm^3 voxel resolution T_2^* dataset where the intracortical angioarchitecture details were captured and analyzed (Gulban et al. 2022). However, this work only covered a third of the brain while requiring two scanning sessions.

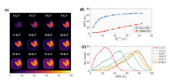
Goal(s): Our aim here is to explore reducing the scanning time while expanding the brain coverage to get similar quality data for vascular analyses.

Approach: Our approach consisted of exploring further acceleration for T_2^* imaging and boosting the SNR of T_1 images though denoising instead of multi-run averaging.

Results: Our results suggest that we can reduce the scanning time five-fold while accomplishing whole brain overage.

Impact: We provide a low undersampling 0.35 mm in vivo human brain dataset and a scanning protocol (including 7 T T2*, T1 contrasts) for cortical angioarchitecture studies while delivering a reference dataset to test further acceleration and denoising.

0960 Pitch: 13:30 Poster: 14:30 Screen 20



Pushing contrast at low field with very high B1

David Leitão[1], Ozlem Ipek[1], Avanya Prathapan[1], Daniel West[1], Jo Hajnal[1,2], Tobias C Wood[3], and Shaihan Malik[1,2]

[1]Biomedical Engineering & Imaging Sciences, King's College London, London, United Kingdom, [2]Centre for the Developing Brain, King's College London, London, United Kingdom, [3]Department of Neuroimaging, King's College London, London, United Kingdom

Keywords: New Signal Preparation Schemes, Low-Field MRI

Motivation: Inherently reduced SAR at low B0 fields opens the possibility for sequences employing high B1 to generate contrasts inaccessible on common systems.

Goal(s): Explore generation of magnetization transfer (MT) and inhomogeneous MT (ihMT) contrast using high B1 sequences on low-field MRI system.

Approach: A tuned resonator was used to enhance B1 fields locally within a 0.55T scanner. Rapid gradient-echo based MT/ihMT sequences were tested on ex-vivo lamb brain sample.

Results: Achieved ~9-fold increase in B1, boosting observed MTR/ihMTR. Unexpectedly, RF pulses failed to function at high B1 due to Bloch-Siegert and spin-locking; new pulse designs for this regime will form future work.

Impact: Using high B1 fields at low B0 enables contrasts that were previously off-limits due to safety constraints at high B0. To exploit these with clinical hardware we demonstrate a passive resonator that increases the B1 by a factor of 9.

Power Pitch

Pitch: Neurodegeneration & White Matter

Power Pitch Theatre 2

Wednesday
Pitches: 13:30 - 14:30
Posters: 14:30 - 15:30

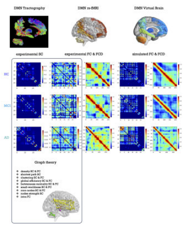
Moderators: Yasutaka Fushimi & Jimmy Lee

(no CME credit)

0961 Pitch: 13:30

Poster: 14:30

Screen 21



Topological network analysis and virtual brain modelling combined to portray subject-specific profiles of dementia stages.

Anita Monteverdi[1], Fulvia Palesi[1,2], Sofia Manzon[2], Francesca Conca[3], Laura Mazzocchi[4], Matteo Cotta Ramusino[5], Eleonora Lupi[2], Marialaura De Grazia[2], Roberta Maria Lorenzi[2], Marta Gaviraghi[2], Lisa Farina[3], Alfredo Costa[2,5], Anna Pichiecchio[2,4], Stefano F. Cappa[3,6], Claudia A.M. Gandini Wheeler-Kingshott[1,2,7], and Egidio D'Angelo[1,2]

[1]Digital Neuroscience Centre, IRCCS Mondino Foundation, Pavia, Italy, [2]Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, [3]IRCCS Mondino Foundation, Pavia, Italy, [4]Advanced Imaging and Artificial Intelligence Center, IRCCS Mondino Foundation, Pavia, Italy, [5]Unit of Behavioral Neurology, IRCCS Mondino Foundation, Pavia, Italy, [6]University Institute of Advanced Studies (IUSS), Pavia, Italy, [7]NMR Research Unit, Queen Square Multiple Sclerosis Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, London, United Kingdom

Keywords: Alzheimer's Disease, Modelling, Virtual Brain modelling, biomarkers, brain dynamics, excitatory/inhibitory balance

Motivation: The high level of heterogeneity typical of mild cognitive impairment (MCI) condition currently hinders the selection of a personalized effective therapy.

Goal(s): Our goal is to obtain a personalized profile exploring not only structural and functional topology but also diving in subject-specific physiological parameters.

Approach: Starting from structural and functional connectomes, we combined graph theoretical analysis with virtual brain models in the default mode network of healthy subjects, MCI and Alzheimer's disease patients.

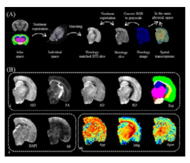
Results: Our results offer a detailed description of alterations at single-subject level, illustrating differences between dementia stages based on topology and subject-specific physiological parameters.

Impact: The personalized profile obtained combining graph theory and virtual brain models portray dementia stages at single-subject level, capturing the wide heterogeneity of mild cognitive impairment and opening new perspectives for personalized effective interventions.

0962 Pitch: 13:30

Poster: 14:30

Screen 22



Spatial Imaging-Transcriptomic analysis reveals the Molecular Basis of diffusion MRI signature in mouse model of Alzheimer’s Disease

Yao Shen[1], Menglei Wang[2], Yiqi Shen[1], Qinfeng Zhu[1], Zhiyong Zhao[1], Zuozhen Cao[1], Guojun Xu[1], Sihui Li[1], and Dan Wu[1]

[1]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Zhejiang University, Hangzhou, China

Keywords: Alzheimer's Disease, Alzheimer's Disease, Transcriptomic, 5xFAD

Motivation: While numerous studies noted the reduction of fractional anisotropy (FA) from diffusion MRI as a sensitive marker in Alzheimer's disease, the underlying biology remained elusive.

Goal(s): We aimed to explore biological basis of DTI metrics by integrating diffusion MRI with spatial transcriptomic data from the same individual.

Approach: We performed voxelwise correlation between the co-registered transcriptomic and MRI data and downstream enrichment analysis.

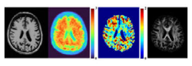
Results: We revealed links to myelin, oligodendrocytes, and Alzheimer's-associated biological processes.These findings enhanced our understanding of changes of diffusion MRI in Alzheimer's disease.

Impact: Spatial imaging-transcriptomic provides a certain level of biological evidence for the molecular processes underlying DTI signatures of Alzheimer’s disease. Similar approach can be applied to other types of MRI markers in different neurodegenerative diseases.

0963 Pitch: 13:30

Poster: 14:30

Screen 23



A Multi-Modal Biomechanical Imaging and Analysis Framework for Co-Correlation of 7T MR Elastography, 7T DTI, and Amyloid Deposition

Em Triolo[1], Mackenzie Langan[2], Oleksandr Khegai[2], Sarah Binder[3], Trey Hedden[4], Priti Balchandani[2], and Mehmet Kurt[1,3]

[1]University of Washington, Seattle, WA, United States, [2]Biomedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai, New York City, NY, United States, [3]Icahn School of Medicine at Mount Sinai, New York City, NY, United States, [4]Department of Neurology, Icahn School of Medicine at Mount Sinai, New York City, NY, United States

Keywords: Alzheimer's Disease, Alzheimer's Disease, DTI, PET

Motivation: There is currently a profound need for non-invasive early detection of mild cognitive impairment (MCI) and Alzheimer’s disease (AD).

Goal(s): The purpose of this study is to determine the relationships between imaging and cognitive testing metrics.

Approach: Subjects underwent multimodal imaging, including 7T DTI, 7T MRE, and amyloid PET, and a PACC test. These metrics were used in Shapley Regressions to determine which metrics were the best predictors of MRE or SUVR.

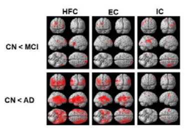
Results: We determined that SUVR was the best predictors of MRE metrics, and that MRE was one of the best predictors of SUVR in subjects with amyloidosis.

Impact: Using multimodal imaging at ultrahigh field (7T) we have observed preliminary relationships between amyloid deposition and biomechanical and microstructural metrics as determined by 7T MR Elastography and DTI in the human brain.

0964 Pitch: 13:30

Poster: 14:30

Screen 24



Increased Extra-neurite Conductivity of Brain in Patients with Alzheimer’s Disease

Geon-Ho Jahng[1], Seowon Hong[1], Yunjeong Choi[2], Mun Bae Lee[3], Hak Young Rhee[4], Soonchan Park[1], Chang-Woo Ryu[1], Wook Jin[1], and Oh In Kwon[3]

[1]Radiology, Kyung Hee University Hospital at Gangdong, Seoul, Korea, Republic of, [2]Biomedical Engineering, Kyung Hee University, Yongin-si, Korea, Republic of, [3]Mathematics, Konkuk University, Seoul, Korea, Republic of, [4]Neurology, Kyung Hee University Hospital at Gangdong, Seoul, Korea, Republic of

Keywords: Alzheimer's Disease, Alzheimer's Disease

Motivation: The decomposed high-frequency conductivity (HFC) into extra-neurite and intra-neurite components to calculate compartmental conductivities has not been applied to any neurological conditions.

Goal(s): To investigate how the separated extra-neurite conductivity (EC) and intra-neurite conductivity (IC) were reflected in Alzheimer’s disease (AD) patients and to evaluate the association between compartmental conductivities and cognitive decline

Approach: A total 66 patients included in 20 AD patients, 25 amnestic MCI patients, and 21 controls were scanned with a multi-echo turbo spin-echo and multi-shell diffusion tensor EPI sequences.

Results: The EC value was higher in patients with AD than others and decreased with increasing K-MMSE scores.

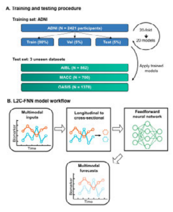
Impact: The EC value might be used as an imaging biomarker for helping to monitor cognitive function.

0965

Pitch: 13:30

Poster: 14:30

Screen 25



L2C-FNN: Longitudinal to Cross-sectional Feedforward Neural Network for generalizable AD-dementia progression prediction

Chen Zhang[1,2,3], Lijun An[1,2,3], Naren Wulan[1,2,3], Kim-Ngan Nguyen[1], Csaba Orban[1,2,3], Pansheng Chen[1,2,3], Christopher Chen[4], Juan Helen Zhou[1,2,5], and B. T. Thomas Yeo[1,2,3,5,6]

[1]Centre for Sleep & Cognition & Centre for Translational Magnetic Resonance Research, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [2]Department of Electrical and Computer Engineering, National University of Singapore, Singapore, Singapore, [3]N.1 Institute for Health & Institute for Digital Medicine, National University of Singapore, Singapore, Singapore, [4]Department of Pharmacology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [5]Integrative Sciences and Engineering Programme (ISEP), National University of Singapore, Singapore, Singapore, [6]Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States

Keywords: Diagnosis/Prediction, Multimodal, Generalization; Generalizable; Longitudinal; Disease progression modeling

Motivation: Current longitudinal AD-dementia progression prediction studies lack cross-cohort evaluation, raising concerns about the clinical applicability of prediction models.

Goal(s): Our goal was to develop a generalizable ML algorithm, L2C-FNN, and assess its generalizability across entirely distinct test cohorts.

Approach: L2C-FNN and baseline models were trained solely on ADNI and subsequently evaluated on AIBL, MACC, and OASIS. Multimodal biomarkers were leveraged for forecasting future clinical diagnosis, cognition, and ventricle volume.

Results: Our algorithm compares favorably against strong baseline models across all test datasets, confirming its superior generalizability.

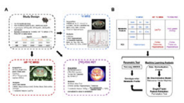
Impact: The demonstrated potential for improved generalizability in L2C-FNN signifies progress toward enhancing AI prediction models for clinical application. This underscores the continued need for cross-cohort evaluation in future AD-dementia progression modeling studies.

0966

Pitch: 13:30

Poster: 14:30

Screen 26



Metabolic neuroimaging of ApoE and APP mutational status in mouse models of Alzheimer's disease

Xiao Gao[1,2,3], Marina Radoul[1,2], Caroline Guglielmetti[1,2], Lydia M. Le Page[1,2], Huihui Li[4], Yoshitaka Sei[4], Yadong Huang[4,5,6,7], Ken Nakamura[4,5,6,7], and Myriam M. Chaumeil[1,2,3]

[1]Department of Physical Therapy and Rehabilitation Science, University of California, San Francisco, San Francisco, CA, United States, [2]Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [3]UCSF/UCB Graduate Program in Bioengineering, University of California, San Francisco, San Francisco, CA, United States, [4]Gladstone Institute of Neurological Disease, Gladstone Institutes, San Francisco, CA, United States, [5]Department of Neurology, University of California, San Francisco, San Francisco, CA, United States, [6]Neuroscience Graduate Program, University of California, San Francisco, San Francisco, CA, United States, [7]Graduate Program in Biomedical Sciences, University of California, San Francisco, San Francisco, CA, United States

Keywords: Hyperpolarized MR (Non-Gas), Alzheimer's Disease, Metabolism, Hyperpolarized MR, Proton MRS

Motivation: As metabolic impairment is key in AD, metabolic imaging could potentially improve diagnosis and monitoring of AD.

Goal(s): Our goal is to determine which metabolic imaging approach, or combination of approaches, provide the optimal set of biomarkers for AD.

Approach: We combined three metabolic imaging methods, ^{1}H MRS, HP ^{13}C MRSI and ^{18}F-FDG PET, with machine learning to characterize the neurometabolic profiles linked to AD-related risk factors, namely ApoE mutation, APP mutation, and sex in AD mouse models.

Results: Combining metabolic neuroimaging and machine learning can help discriminate between AD-related mutational status (APP and ApoE) and provide information of AD-related sexual dimorphism.

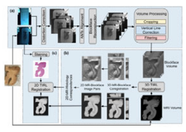
Impact: Knowing which metabolic imaging approach(es) is/are optimal to monitor progression in each subset of AD patients, based on sex and mutational status, would improve patient-centric clinical care and potentially create new avenues for assessment of new metabolism-targeting therapies.

0967

Pitch: 13:30

Poster: 14:30

Screen 27



Volumetric MR, Blockface Imaging, and Histology Deliver High Fidelity Coregistered MR-Histology

Yixin Wang[1], William Ho[2], Istvan N. Huszar[3], Hossein Moein Taghavi[2], Jeff Nirschl[4], Samantha Leventis[2], Philip Schlömer[5], Markus Axer[5], Wei Shao[6], Mirabela Rusu[2], Phillip DiGiacomo[2], Marios Georgiadis[2], and Michael Zeineh[2]

[1]Department of Bioengineering, Stanford University, Stanford, CA, United States, [2]Department of Radiology, Stanford University, Stanford, CA, United States, [3]Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School, Boston, MA, United States, [4]Department of Pathology, Stanford University, Stanford, CA, United States, [5]Forschungszentrum Jülich, Jülich, Germany, [6]Department of Electrical & Computer Engineering, University of Florida, Gainesville, FL, United States

Keywords: Alzheimer's Disease, Neurodegeneration

Motivation: Validating pathological findings from ultra-high-resolution *ex-vivo* MRI through histology is significant but challenging due to nonlinear 3D deformations between MRI and histological samples.

Goal(s): Addressing the challenge of accurately quantifying complex neurodegenerative diseases by improving the alignment of post-mortem MRI data with histological images.

Approach: We built a novel pipeline integrating advanced imaging techniques with innovative registration algorithms, linking high-resolution MRI with blockface imaging and histological sections.

Results: Our methodology successfully generated blockface volumes with minimal distortion and artifacts, accomplished precise alignment between MRI and blockface volumes, and achieved an accurate 2D correspondence between MRI and histology slides.

Impact: This study introduces an advanced correlative MRI-histology pipeline with robust 2D and 3D coregistration methods, promising to enhance our understanding of neurodegenerative diseases and contribute to the evolution of MRI-based biomarkers for the disease.

0968

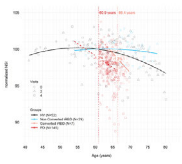
MERIT AWARD

MAGNA CUM LAUDE

Pitch: 13:30

Poster: 14:30

Screen 28



Detecting the pathogenic threshold of neuromelanin accumulation in Parkinson’s disease and prodromal Parkinson’s disease patients

Jean-Baptiste Perot[1], Rahul Gaurav[1], François-Xavier Lejeune[2], Sana Rebbah[2], Zeqian Mao[1], Romain Valabregue[3], Isabelle Arnulf[1], Marie Vidailhet[1], Jean-Christophe Corvol[4], Miquel Vila[5], and Stéphane Lehéricy[1,3]

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Keywords: Parkinson's Disease, Parkinson's Disease

Motivation: Neuromelanin is a pigment that accumulates specifically in neurons population that are vulnerable in Parkinson's disease. The role of neuromelanin in pathogenesis is still unclear.

Goal(s): We tested the hypothesis that there is a pathogenic threshold of neuromelanin accumulation that triggers neurodegeneration in Parkinson's disease patients.

Approach: We performed longitudinal neuromelanin-MRI imaging of the substantia nigra of Parkinson's disease, prodromal Parkinson's disease (iRBD) patients, and healthy volunteers.

Results: We confirmed accelerated decrease of neuromelanin-MRI signal in patients with Parkinson's disease, which started from the maximum of healthy volunteer, in line with hypothetic pathogenic threshold. iRBD patients showed similar trajectory delayed by 5 years.

Impact: Results support the hypothesis of a pathogenic threshold of neuromelanin. Its role in Parkinson's disease pathogenesis needs more investigations. Late reach of this threshold in prodromal patients results in delayed age of Parkinson's disease onset, suggesting different progression pattern.

0969

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MAGNA CUM LAUDE

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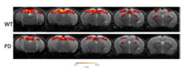
Screen 29



Visual deficits in a late-stage Parkinson's Disease mouse model revealed by functional MRI and validated by C-FOS expression and CBF measurements

Ruxanda Lungu Baião[1], Francisca Fernandes[1], Sara Monteiro[2], Patricia Figueiredo[2], Tiago Fleming Outeiro[3], and Noam Shemesh[1]

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Keywords: Parkinson's Disease, Parkinson's Disease

Motivation: The involvement of the brain's sensory systems in PD is poorly understood and visual deficits are often a complex and underappreciated aspect of the disease.

Goal(s): The goal of this study is to study the visual deficits in the PD mouse line by using fMRI, C-FOS expression and CBF.

Approach: Here we report aberrations in BOLD-fMRI responses along the visual pathway in mouse model of PD and validate via C-FOS protein expression and ASL.

Results: Our findings revealed decreased activity in the visual areas, decreased C-FOS confirmed the neural origin, and the ASL excluded any vascular differences that could alter the fMRI signals.

Impact: Many individuals with PD experience a decline in visual acuity. Thus, understanding and addressing visual deficits in Parkinson's disease is crucial for improving the overall well-being and daily functioning of individuals living with this condition.

0970

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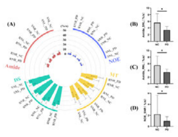
Poster: 14:30

Screen 30



Quantitative chemical exchange saturation transfer MR imaging of the substantia nigra and red nucleus in Parkinson's disease

Xinyang Li[1], Yaotian Tian[1], Dandan Zheng[2], Chunmei Li[1], and Min Chen[1]

[1]Department of Radiology, Beijing Hospital,National Center of Gerontology, Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, Beijing, China, [2]Clinical & Technique Support, Philips Healthcare, Beijing, China

Keywords: CEST / APT / NOE, CEST & MT, Z-spectrum fitting

Motivation: Achieving precise quantification of target molecules has been a prominent focus of chemical exchange saturation transfer (CEST) .

Goal(s): To investigate the alteration of CEST-MRI in the bilateral substantia nigra (SN) and red nucleus (RN) in Parkinson's disease (PD) and to explore its value of clinical application.

Approach: The signal change of CEST imaging was separated using the 4-pool Lorentz fitting model. The amide, nuclear overhauser enhancement (NOE), direct water saturation (DS), and magnetization transfer (MT) value were compared between the PD and NC group.

Results: The results indicated that CEST-MR can reveal the signal alterations the SN and RN in PD patients.

Impact: CEST-MRI, utilizing the 4-pool Lorentz fitting model, was employed to accurately delineate the amide signal alterations within the SN and RN of patients with PD. This approach demonstrates significant promise for enhancing the clinical diagnosis of PD.

0971 Pitch: 13:30 Poster: 14:30 Screen 31

Dynamic Causal Modeling Reveals Distinct Network-Specific Effective Connectivity within Olfactory Pathway between Healthy and Aged Rats

Teng Ma[1,2,3], Xuehong Lin[1,2], Xunda Wang[1,2], Qiuyi Lyu[1,4], Zhangjin Zhang[4], Peng Cao[3], Ed X Wu[1,2,5], and Alex T L Leong[1,2]

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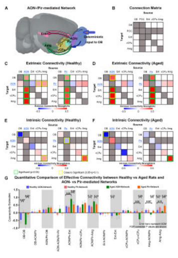


Keywords: Aging, Brain Connectivity, fMRI Analysis, functional connectivity, neuroscience, fMRI (task-based)

Motivation: Presently, olfactory dysfunctions such as with aging, neurodegenerative diseases and COVID-19 remain poorly understood at the systems level despite extensive knowledge of the microcircuit changes at the olfactory bulb (OB).

Goal(s): We aim to reveal the systematic abnormalities of downstream olfactory information processing from the OB in prematurely aged rats.

Approach: We examined the effective connectivity of olfactory networks in both healthy and aged rat models with optogenetic fMRI and dynamic causal modeling.

Results: We demonstrate that network-specific dynamics in the olfactory system between aged and healthy rats could be attributed to altered effective connectivity driven by primary olfactory regions downstream from OB.

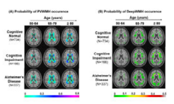
Impact: The ability to stimulate olfactory bulb excitatory neurons and model the downstream neural activity dynamics at the system level in healthy and aged animals has revealed key regions that are involved in olfactory dysfunctions, which can guide future therapeutic interventions.

0972 Pitch: 13:30 Poster: 14:30 Screen 32

Brain Region Mapping and Quantification of White Matter Hyperintensity: Estimating the Direct and Indirect impact of WMH Load on Cognition

Niraj Kumar Gupta[1], Neha Yadav[1], and Vivek Tiwari[1]

[1]Department of Biological Sciences, Indian Institute of Science Education and Research Berhampur, Berhampur, India



Keywords: Aging, Ischemia

Motivation: Understanding the magnitude and threshold of PVWMH and DWMH that disrupt cognitive abilities in MCI and AD, compared to healthy aging.

Goal(s): To investigate white matter hyperintensity distribution & its impact on cognitive functions.

Approach: Neuroanatomic segmentation & quantification of Periventricular WMH and DeepWMH, with mediation analysis assessing their impact on cognitive functions

Results: WMH load accrues vascular insult to brain structures, which in-turn mediates impaired cognitive functions, specifically motor and executive functions. WMH load in periventricular region abrogates the information processing and processing speed indirectly mediated through paracentral gyrus thickness, rostral middle frontal volume and lingual gyrus thickness.

Impact: Periventricular white matter hyperintensity progresses faster compared to DeepWMH with Aging. We establish that the Regional Distribution of DeepWMH load is distinct for CN, MCI and AD. High WMH load impairs Executive memory and Motor Memory via specific structural atrophy.

0973 Pitch: 13:30
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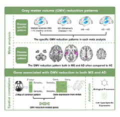
Screen 33



Common patterns of gray matter volume reduction and the genetic association in multiple sclerosis and Alzheimer's disease

Yunfei Zhao[1], Jie Sun[1], Wenjin Zhao[1], Zeyang Yu[1], Che Zhang[1], Han Zhang[1], Chen Zhang[2], Chunyang Sun[1,3], and Ningnannan Zhang[1]

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Keywords: Multiple Sclerosis, fMRI

Motivation: Both Alzheimer’s disease (AD) and multiple sclerosis (MS) patients exhibit brain atrophy driven cognitive impairment.

Goal(s): To identify the specific and common regions in GMV reduction in AD and MS and genetic basis associated with volume changes.

Approach: VBM meta-analyses and conjunction analyses were performed for comparison. GMV associated gene expression data were extracted from Allen Human Brain Atlas by cross-sample partial least squares regression.

Results: MS patients have reduced thalamic volume, while AD have hippocampal atrophy. Both MS and AD patients exhibit medial temporal lobe atrophy patterns, which were associated with 843 genes in functioning at biological processes, neurons, and immune cells.

Impact: MS and AD patients have specific and common patterns of gray matter volume reduction, given a neuroimage clue that the ageing population present with similar symptoms of cognitive impairment.

0974 Pitch: 13:30
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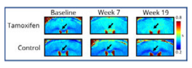
Screen 34



RAFF4, magnetization transfer and diffusion tensor MRI in a mouse model of demyelination and remyelination

Lenka Dvořáková[1], Raimo A. Salo[1], Hanne Laakso[1], Jenni Kyyriäinen[1], Thamara Zehnder[2], Thomas Mueggler[2], Basil Künnecke[2], Alejandra Sierra[1], and Olli Gröhn[1]

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Keywords: Other Neurodegeneration, Relaxometry, Demyelination, remyelination, RAFF4, MT, DTI

Motivation: In vivo assessment of myelin status is important for diagnostic and therapeutic purposes in multiple sclerosis.

Goal(s): The goal of this study was to explore the capability of RAFF4, MT, and DTI metrics to detect changes in the myelin content and integrity during both demyelination and remyelination.

Approach: A genetic mouse model of widespread demyelination and remyelination was imaged with RAFF4, MT, and DTI and the MRI metrics were compared with histological analyses.

Results: Both RAFF4 and MT detected differences between the disease model and control animals in both demyelination and remyelination. DTI differed only in the demyelination phase.

Impact: RAFF4 showed the ability to detect both demyelination and remyelination in the mouse brain. This suggests that RAFF4 has great potential in serving as a translational biomarker in the development of new therapeutic agents for myelin repair.

0975 MERIT AWARD MAGNA CUM LAUDE

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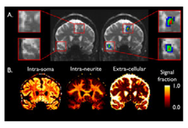
Poster: 14:30

Screen 35



<u>In-vivo evidence for cell body loss in cortical lesions in people with multiple sclerosis</u>

Eva A Krijnen[1,2], Samatha Noteboom[2], Hansol Lee[3], Florence L Chiang[3], Martijn D Steenwijk[2], Menno M Schoonheim[2], Eric C Klawiter[1], and Susie Y Huang[3]

[1]Department of Neurology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States, [2]MS Center Amsterdam, Anatomy and Neurosciences, Amsterdam Neuroscience, Amsterdam UMC location VUmc, Amsterdam, Netherlands, [3]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States

Keywords: Multiple Sclerosis, Neurodegeneration, High-Field MRI, Diffusion Modelling, Tissue Characterization

Motivation: Cortical lesions are linked to irreversible cortical atrophy as well as cognitive impairment in multiple sclerosis. High-gradient diffusion MRI is sensitive to the microstructural substrate of neurodegeneration in multiple sclerosis.

Goal(s): To identify *in-vivo* patterns of cell body density alterations, quantified by advanced diffusion MRI, in and surrounding focal cortical demyelination in people with multiple sclerosis.

Approach: The intra-cellular signal fraction, reflective of cell body density, was compared between cortical lesions, perilesional and normal-appearing cortex.

Results: Multiple sclerosis-related decreases in intra-cellular signal fraction were seen in cortical lesions compared to perilesional and normal-appearing cortex.

Impact: High-gradient diffusion MRI has the potential to identify cortical cell body loss *in-vivo*, potentially attributable to focal demyelination, relevant for cognition.

0976

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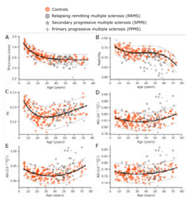
Screen 36



<u>High-resolution diffusion tensor imaging shows cortical microstructure changes in multiple sclerosis across the lifespan</u>

J Alejandro Acosta-Franco[1], Carly Weber[1], Diana Valdés Cabrera[1,2], Penny Smyth[3], Gregg Blevins[3], Colin Wilbur[4], Graham Little[5], and Christian Beaulieu[1,6]

[1]Biomedical Engineering, University of Alberta, Edmonton, AB, Canada, [2]Campbell Family Mental Health Research Institute, Toronto, ON, Canada, [3]Neurology, University of Alberta, Edmonton, AB, Canada, [4]Pediatric Neurology, University of Alberta, Edmonton, AB, Canada, [5]Computer Science, Université de Sherbrooke, Sherbrooke, QC, Canada, [6]Radiology and Diagnostic Imaging, University of Alberta, Edmonton, AB, Canada

Keywords: Gray Matter, Multiple Sclerosis

Motivation: Patterns of cortical microstructural damage in multiple sclerosis (MS) can be examined in vivo with high-resolution diffusion tensor imaging (DTI).

Goal(s): To assess cortical diffusion changes in MS across the lifespan.

Approach: High-resolution DTI from controls (5-74 years) and MS participants (13-72 years) were segmented using an only-DTI-based method. Thickness, standard DTI metrics and radiality were evaluated in the entire cortex in MS against normative development/aging.

Results: Cortical changes were observed in ~1/3 of MS participants versus controls over the entire lifespan, such as thinning, higher mean (MD), axial (AD) and radial (RD) diffusivities, and lower radiality.

Impact: This study highlights microstructural abnormalities in the cortex of multiple sclerosis (MS) patients throughout the lifespan. These findings will help to understand in vivo cortical pathology in MS that might precede atrophy and that could be linked with disease progression/phenotypes.

0977

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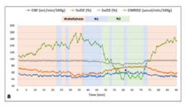
Screen 37



Obstructive Sleep Apnea: Feasibility of Concurrent Evaluation of Neurometabolic Rate and Upper Airway Architecture During Sleep in the Scanner

Felix W Wehrli[1], Michael C Langham[1], Andrew Wiemken[2], Jing Xu[1], John A Detre[3], Jeffrey Dennison[1], and Richard J Schwab[2]

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Keywords: Neuroinflammation, Brain Connectivity, Cerebral Metabolic Rate of Oxygen

Motivation: Obstructive sleep apnea (OSA) is a common disorder predisposing patients to heart disease, stroke, and cognitive dysfunction.

Goal(s): To gain insights into the association between brain metabolism and changes in upper airway architecture during spontaneous apneas during sleep in the scanner.

Approach: A time-resolved pulse sequence was designed that yields neurometabolic parameters and airway anatomy at 6-second temporal resolution, along with EEG monitoring during a 90-minute scan.

Results: Data demonstrate associations between transient airway architectural changes and brain vascular-metabolic alterations, notably a steep drop in cerebral metabolic rate of oxygen ($CMRO_2$) during sleep and following apneic events, providing new insight into the disorder.

Impact: Understanding the acute structural and neurometabolic consequences of apneic events in obstructive sleep apnea will provide new insight into the disease and provide a method to evaluate the response to treatment.

0978

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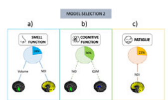
Pitch: 13:30

Poster: 14:30

Screen 38



Fatigue, smell and cognitive functions: multimodal MRI can explain the long-COVID syndrome

Elena Grosso[1], Antonio Ricciardi[2], Madiha Shatila[2], Michael S. Zandi[3], Marios C. Yannakas[2], Ferran Prados[2,4,5], Baris Kanber[2,4], Jed Wingrove[2], Nicolò Rolandi[1,2,6], Karin Shmueli[7], Francesco Grussu[2,8], Marco Battiston[2], Rebecca S. Samson[2], Olga Ciccarelli[2,9], Rachel L. Battheram[9,10], Janine Makaronidis[10,11], Egidio D'Angelo[1,12], Fulvia Palesi[1,12], Carmen Tur[2,13], and Claudia A.M. Gandini Wheeler-Kingshott[1,2,12]

[1]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, [2]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [3]Dept of Neuroinflammation, UCL Queen Square Institute of Neurology and National Hospital for Neurology and Neurosurgery, London, United Kingdom, [4]Department of Medical Physics and Biomedical Engineering, Centre for Medical Image Computing (CMIC), University College London, London, United Kingdom, [5]E-Health Center, Universitat Oberta de Catalunya, Barcelona, Spain, [6]Department of Clinical and Experimental Epilepsy, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [7]Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [8]Radiomics Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [9]National Institute of Health Research, Biomedical Research Centre at UCLH and UCL, London, United Kingdom, [10]Centre for Obesity Research, Department of Medicine, University College London, London, United Kingdom, [11]National Institute of Health Research, UCLH Biomedical Research Centre, London, United Kingdom, [12]Digital Neuroscience Centre, IRCCS Mondino Foundation, Pavia, Italy, [13]Neurology-Neuroimmunology Department Multiple Sclerosis Centre of Catalonia (Cemcat), Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain

Keywords: Data Processing, COVID-19, statistical models, clinical scores, fatigue, anosmia, cognitive impairment, multimodal qMRI

Motivation: Long-COVID is a disabling health problem caused by SARS-COV-2 syndrome, whose underlying biological mechanisms are still debated.

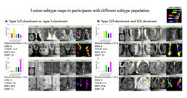
Goal(s): This study aimed at finding the set of quantitative MRI (qMRI) metrics that best correlate with fatigue, smell (i.e. anosmia),and cognitive dysfunction, common in this condition.

Approach: People with COVID19 history with and without long-COVID were assessed through a multimodal one-hour-long qMRI protocol and underwent clinical evaluation.

Results: Correlation analyses between qMRI metrics and clinical scores showed that neurite density index changes explain both fatigue and smell function (also affected by changes in brain stem volume),while mean diffusivity and magnetic susceptibility changes explain cognitive function.

Impact: This work sheds light on the underlying biological mechanisms of long-COVID (anosmia, fatigue, and cognitive impairment). Metrics sensitive to microstructure, inflammation and possible iron accumulation best explain persistent symptoms, emphasizing the role of multimodal qMRI in the clinic.

0979 Pitch: 13:30 Poster: 14:30 Screen 39



Identifying Multiple Sclerosis Lesion Subtypes with Distinct Microstructural Features using Advanced Microstructural MRI

Hyeong-Geol Shin[1,2], Blake E. Dewey[3], Jan Brabec[1,2], Jinwei Zhang[4], Omar Ezzedin[3], Kaitlyn Ecoff[3], Anna Kim[3], Alexandra Ramirez[3], Anna DuVal[3], Kathryn Fitzgerald[3], Linda Knutsson[1,2,5], Filip Szczepankiewicz[5], Jerry Prince[4], Shiv Saidha[3], Peter A. Calabresi[3], Peter van Zijl[1,2], and Xu Li[1,2]

[1]Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Research Institute, Baltimore, MD, United States, [3]Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [4]Department of Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, United States, [5]Department of Medical Radiation Physics, Clinical Sciences Lund, Lund University, Lund, Sweden

Keywords: Multiple Sclerosis, Multiple Sclerosis

Motivation: Conventional MRI struggles to capture heterogeneous histopathological subtypes within multiple sclerosis (MS) lesions, mainly due to a lack of microstructural specificity.

Goal(s): (i) To unveil distinct subtypes of microstructural alteration MS lesions using advanced multi-contrast microstructural MRI; (ii) increase sensitivity to individual microstructure.

Approach: K-means clustering was applied to multi-contrast microstructural MRI quantities, including parameters from diffusometry (μFA [axonal integrity marker], MD), susceptometry (QSM, χ_{dia} [demyelination marker] χ_{para} [marker for iron-laden microglia]), and relaxometry (R2*, R2, T1).

Results: Five MRI-driven lesion subtypes, each with unique microstructural property combinations, revealed potential histopathological features of MS lesions and showed enhanced sensitivities to clinical outcomes.

Impact: We used a novel imaging multi-biomarker for *in-vivo* MS pathology to assess lesion types for potential treatment monitoring in MS. Some MS subtypes with microstructure alterations, potentially related to disease histopathology, showed improved clinical sensitivity over conventional imaging markers.

0980 Pitch: 13:30 Poster: 14:30 Screen 40

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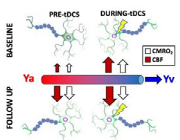


Neuronal and Cerebrovascular Response to tDCS in Multiple Sclerosis: A Simultaneous tDCS-MRI Study

Marco Muccio[1,2], Giuseppina Pilloni[3], Lauren Krupp[3], Abhishek Datta[4], Marom Bikson[5], Leigh Charvet[3], and Yulin Ge[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York City, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York City, NY, United States, [3]Neurology, New York University Grossman School of Medicine, New York City, NY, United States, [4]Research and Development, Soterix Medical Inc, Woodbridge Township, NJ, United States, [5]Biomedical Engineering, City College of New York, New York City, NY, United States

Keywords: Multiple Sclerosis, Metabolism, cerebral metabolism, neural stimulation. blood flow

Motivation: The cerebral metabolic underpinnings of tDCS, both during the stimulation itself and as result of repeated sessions are still not fully understood.

Goal(s): To quantify the immediate tDCS effects (simultaneous) using real-time tDCS-MRI and treatment-related effects (cumulative after repeated sessions) in multiple sclerosis (MS) patients.

Approach: MS patients had tDCS-MRI performed at baseline and after 20 tDCS treatment sessions. Imaging measurements were acquired pre-, during- (2.0mA left frontal anodal) and post-tDCS.

Results: During tDCS, at baseline, we observed a 7.6% increase in cerebral metabolic rate of oxygen ($CMRO_2$). tDCS-treatment induced a 9.6% increase of the pre-tDCS $CMRO_2$ levels.

Impact: The significant increase in neuronal metabolism following both real-time and repeated tDCS treatment in MS patients offers valuable insights into the biophysiological mechanisms regarding acute and cumulative tDCS effects, informing future clinical applications in MS and other neurodegenerative diseases.

Power Pitch

Pitch: Glymphatic System: What's New

Power Pitch Theatre 3

Wednesday
Pitches: 13:30 - 14:30
Posters: 14:30 - 15:30

Moderators: Vivek Yedavalli

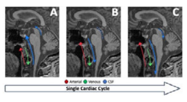
(no CME credit)

0981

Pitch: 13:30

Poster: 14:30

Screen 41



Blood and CSF Dynamics During One Cardiac Cycle in the Healthy Brain Measured with Cine Phase-Contrast MRI

Marco Muccio[1,2], Zhe Sun[1,2,3], Chenyang Li[1,2,3], David Chu[4], Lawrence Minkoff[4], and Yulin Ge[1,2]

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Keywords: Neurofluids, Brain

Motivation: Quantitative analysis of blood and CSF flow dynamics is vital to understand the intracranial pulsating fluid movement environment and its role in brain homeostasis.

Goal(s): To characterize the correlation between blood (arterial/venous) and CSF flow within one cardiac cycle.

Approach: Flow dynamic measurements in neck arteries and veins, cervical CSF (CSFc) and CSF in the aqueduct of Sylvius (CSFAq) were obtained using cine phase-contrast MRI from 18 healthy volunteers.

Results: Net blood and CSFc flow wave curves depict a compensatory mechanism resulting in balance of total fluid inflow and outflow. CSFAq flow patterns mimic CSFc ones with some temporal delay.

Impact: Understanding how blood and CSF flow influence each other in healthy subjects provides a reference frame to investigate alterations caused by neurological disease. We showed a dynamic interplay between neck blood and CSF flow at the cervical and aqueduct level.

0982

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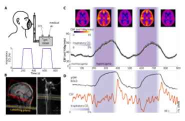
Screen 42



Neuronal activity can drive cerebrospinal fluid flux via brain blood volume

Benedikt Zott[1,2,3], Juliana Zimmermann[1,3,4], Clara Boudriot[1], Christiane Eipert[1], Gabriel Hoffmann[1], Rachel Nuttall[1,4], Sebastian Schneider[1,3], Lena Schmitzer[1], Jan Kufer[1], Stefan Kaczmarz[1], Dennis Martin Hedderich[1], Andreas Ranft[4], Daniel Golkowski[5,6], Rüdiger Ilg[5,7], Gerhard Schneider[4], Josef Priller[8,9,10], Claus Zimmer[1], Christine Preibisch[1,3], and Christian Sorg[1,3,8]

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Keywords: Neurofluids, Neurofluids

Motivation: A driver of macroscopic CSF flux across ventricles and basal cisternae is hypothesized to be global cerebral blood volume, possibly induced by changes in brain-wide neuronal activity.

Goal(s): We intended to test this hypothesis experimentally in healthy human subjects.

Approach: We performed two experiments: (1) electro-encephalography and functional MRI (fMRI) during burst-suppression anesthesia, and (2) arterial spin labeling and fMRI during transient hypercapnic challenges in wakefulness.

Results: Changes in brain blood volume, induced by neuronal activity switches during burst-suppression or brain blood flow during hyper-normocapnia transitions, cause fMRI signal changes in the basal cisternae which represent CSF flux from or into the brain.

Impact: Two distinct experiments revealed a consistent and direct coupling between macroscopic CSF flux and brain blood volume, which can be induced by changes in global neuronal activity. This may contribute to perivascular CSF flow and facilitate brain waste clearance.

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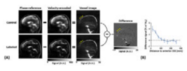

[Non-contrast MRI assessment of CSF drainage into superior sagittal sinus]

Dengrong Jiang[1], Jie Song[2], Yifan Gou[3], Zhiyi Hu[3], Wen Shi[3], Zixuan Lin[4], Abhay Moghekar[5], and Hanzhang Lu[1]

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Keywords: Neurofluids, Neurofluids

Motivation: The absorption of CSF into the superior-sagittal-sinus (SSS) is an important CSF drainage pathway and has been implicated in brain disorders like Alzheimer's disease and idiopathic-intracranial-hypertension. However, we still lack non-invasive and non-contrast techniques to evaluate this CSF-venous drainage system.

Goal(s): To develop a novel non-contrast MRI technique to assess the CSF drainage into the SSS.

Approach: We propose to magnetically label the CSF spins and use a control-label subtraction to isolate signals from the CSF spins that have been absorbed into SSS.

Results: In all subjects, we observed considerable signals from absorbed CSF spins in frontal SSS. Test-retest experiments demonstrated good reproducibility.

Impact: We have proposed a novel non-contrast MRI technique to assess the drainage of CSF into the superior-sagittal-sinus, which may address an important technical gap in evaluating the circulation of CSF.

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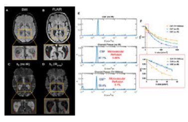

[Advancing Estimation of Microvascular Perfusion in the Choroid Plexus through Inversion Recovery Prepared IVIM MRI]

Chenyang Li[1,2,3], Zhe Sun[1,2,3], Eric E. Sigmund[1,2], Jiangyang Zhang[1,2], and Yulin Ge[1,2]

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Keywords: Neurofluids, Diffusion/other diffusion imaging techniques, IVIM, diffusion, choroid plexus

Motivation: Measuring vascular perfusion in the Choroid Plexus (ChP) is challenging due to its smaller size and the pronounced partial volume effects from CSF.

Goal(s): To improve blood perfusion assessment of ChP utilizing Inversion recovery (IR) prepared IVIM imaging.

Approach: Higher in-plane resolution ($1.5x1.5mm^2$) IVIM diffusion MRI data with and without the IR preparation were acquired. The signal was analyzed using inverse Laplace transform (ILT) to estimate diffusion compartments within ChP for IVIM-derived perfusion fraction analysis.

Results: ILT analysis of IR-prepared IVIM revealed three diffusion compartments within the ChP and reported higher perfusion fraction observed in IR-prepared IVIM versus IVIM without IR-preparation.

Impact: This study provides a novel approach to investigate the microvascular perfusion in Choroid Plexus (ChP) with CSF signal removed. IR preparation does not completely remove the free-diffusion compartment but increases the microvascular perfusion fraction estimation in ChP.

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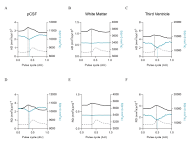

[Artery-pulsation dependence of the paravascular cerebrospinal fluid flow measured by dynamic diffusion tensor imaging in human brain]

Guangxu Han[1,2], Yinhang Jia[1,2], Yi-Cheng Hsu[3], and Ruiliang Bai[1,2]

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Keywords: Neurofluids, Neurofluids, Glymphatic system

Motivation: There is still lack non-invasive methods to quantitative measure the paravascular cerebrospinal fluid (pCSF) flow speed and directions pulsations of arterial vessel .

Goal(s): To explore whether dynamic $DTI_{low\text{-}b}$ could capture the artery-pulsation dependence of pCSF flow in human and how $DTI_{low\text{-}b}$ metrics are modulated by artery pulsation.

Approach: Six-direction dynamic $DTI_{low\text{-}b}$ was acquired simultaneously with finger pulse oximeter recording on eight subjects.

Results: Both the axial and radial diffusivity of pCSF and whole-brain white matter is increased by artery dilation. $DTI_{low\text{-}b}$ signal of pCSF at b = 0 mm^2/s also shows artery-pulsation dependence but lags from diffusivity changes.

Impact: The proposed dynamic $DTI_{low\text{-}b}$ with ultra-long TE could potentially capture the volume and flow dynamics of MRI-visible and -invisible pCSF in artery pulsation.

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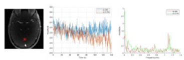

[Detection of vasomotion in the human brain using Fourier decomposition of T1-weighted Cine-FLASH MRI (FD-FLASH)]

Manuel Taso[1], Humberto Mestre[2], Geoffrey K Aguirre[2], and John A Detre[2,3]

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Keywords: Neurofluids, Neurofluids

Motivation: Vasomotion has been hypothesized as a mechanism for brain paravascular clearance, which could be impaired in multiple neurodegenerative conditions.

Goal(s): To measure vasomotion in vivo in human brains using MRI.

Approach: A single-shot T1-weighted Cine-FLASH sequence was optimized to provide high temporal resolution in two adults, as well as during a visual stimulation paradigm in one. We performed a Fourier decomposition of the signal in brain vascular structures.

Results: An ultra-low-frequency signal was observed consistent with vasomotion in posterior cerebral arteries while no such signal could be identified in the parenchyma. A substantial amplification of this signal could be observed during visual stimulation.

Impact: This method could help studying brain waste clearance and its dysfunction in humans in vivo.

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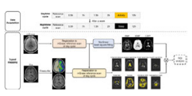

[Evaluation of the glymphatic system activity during sleep-wake states through quantitative CSF measurement using a three-pool water model]

Gawon Lee[1] and Se-Hong Oh[1]

[1]Biomedical Engineering, Hankuk University of Foreign Studies, Yongin-si, Korea, Republic of

Keywords: Alzheimer's Disease, Alzheimer's Disease, Glymphatic system, CSF

Motivation: The glymphatic system plays a crucial role in brain waste clearance, and dysfunction has been linked to neurodegenerative diseases like Alzheimer's Disease. Understanding this system is essential for advancing our knowledge of brain health.

Goal(s): We aim to develop a non-invasive method to assess glymphatic activity in the human brain.

Approach: We utilize a quantitative CSF measurement technique with a three-pool model and multi-echo spin-echo images.

Results: Significant variations in glymphatic activity were observed across different brain regions and found to be influenced by sleep.

Impact: Our method can potentially reveal sleep-influenced glymphatic activity variations, enabling early Alzheimer's Disease diagnosis.

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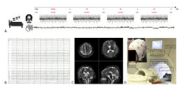

Extracellular Volume Change in Human Brains during Sleep: A Simultaneous Sodium (23Na) MRI and EEG Study

Xingye Chen[1,2,3], Ying-Chia Lin[1,2], Nahbila-Malikha Kumbella[1], Simon Henin[4], Zena Rockowitz[5], Anli Liu[4], Arjun Masurkar[5], James Babb[1,2], Yulin Ge[1,2], Yvonne Lui[1,2], and Yongxian Qian[1,2]

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Keywords: Neurofluids, Aging, Sodium MRI, EEG

Motivation: Alzheimer's disease is associated with neurotoxic amyloid-beta(Aβ) plaques. Studies in mice demonstrate that impaired cerebrospinal fluid(CSF) clearance reduces Aβ clearance by 70%. Sleep enhances CSF clearance by expanding extracellular space.

Goal(s): However, the impact of sleep on extracellular volume change remains unclear in human brains due to a lack of non-invasive technology.

Approach: To address this gap, we use sodium(^{23}Na) MRI to measure the extracellular volume fraction in 16 healthy human brains. We monitor the sleep stage with MRI-compatible Electroencephalography(EEG).

Results: On average, a decrease in extracellular volume fraction was observed in the gray matter significantly, but not significant in the white matter.

Impact: Our research may shed light on how sleep may facilitate Aβ clearance in humans, bridging the gap between animal and human studies.

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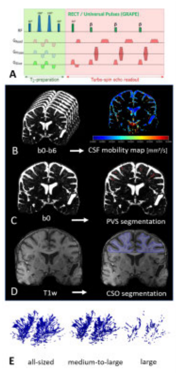

Altered perivascular CSF mobility in human cerebral amyloid angiopathy

Katerina Deike-Hofmann[1,2], Paul Scheyhing[1,2], Julia Nordsiek[3], Andreas Decker[2], Alexander Radbruch[1,2], and Gabor Petzold[2,3]

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Keywords: Neurofluids, Neurofluids, Brain Clearance

Motivation: Perivascular spaces (PVS) are mediating brain clearance, i.e. cerebrospinal fluid (CSF) - interstitial fluid exchange, and dilated PVS are a hallmark of cerebral amyloid angiopathy (CAA). However, until now, brain clearance function could not be assessed in humans in vivo.

Goal(s): Goal of this study was to assess perivascular cerebrospinal fluid (CSF) mobility in CAA patients.

Approach: A CSF mobility-specific 7-Tesla MRI sequence was applied for the first time in patients with CAA and healthy control (HC) subjects.

Results: The study revealed perturbed CSF mobility in enlarged perivascular spaces in CAA compared to HC subjects, suggesting impaired perivascular clearance in CAA.

Impact: With the finding of a perturbed CSF mobility in enlarged PVS in CAA patients, the study provides proof-of-principal for in vivo measurements of perivascular CSF mobility as a crucial component of the brain clearance pathway in health and disease.

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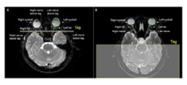

CSF Outflow and Egress in Optic Nerve: Non-contrast MRI Revelations

Diana Vucevic[1], Vadim Malis[1], Marin McDonald[1], and Mitsue Miyazaki[1]

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

Keywords: Neurofluids, Neurofluids

Motivation: The rose of cerebrospinal fluid (CSF) in neural health is recognized, yet its outflow and egress within the optic nerve, especially amidst new findings about the glymphatic system, remains less explored.

Goal(s): Investigate CSF interactions within the optic nerve using advanced MRI techniques, highlighting implications for conditions like glaucoma.

Approach: Utilized advanced Time-Slip sequences on a 3-T MR imager, targeting specific brain regions to study CSF outflow and egress.

Results: Clear CSF egress pathways through the optic nerve were found, with distinct outflow influenced by participants' optical attributes.

Impact: Enhances understanding of CSF outflow and egress, providing pivotal insights for addressing neuro-ophthalmological disorders like glaucoma.

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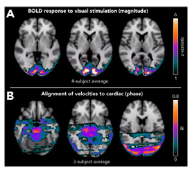

Dynamic measurement of concurrent BOLD and brain tissue displacement quantification in vivo at 7T using motion-encoded stimulated-echo EPI

Amelia Strom[1,2], Avery Berman[2,3,4], Timothy G. Reese[2], Zijing Dong[1,2,5], Klaus Scheffler[6], Laura D. Lewis[2,7], and Jonathan R. Polimeni[1,2,5]

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Keywords: Neurofluids, High-Field MRI, Tissue Characterization, Diffusion Acquisition, fMRI Analysis, Multi-Contrast

Motivation: Understanding the spatiotemporal relationships between blood volume changes, tissue displacement, and CSF flow is important for elucidating brain waste clearance mechanisms, and measuring these compartments concurrently would enable effective analysis.

Goal(s): To demonstrate the feasibility of leveraging both magnitude-valued and phase-valued data to measure BOLD fMRI and tissue motion simultaneously.

Approach: We apply a combination of computer simulations and *in vivo* imaging with visual stimulation using the Displacement Encoding with Stimulated Echoes (DENSE) pulse sequence.

Results: DENSE magnitude-valued data show significant response to visual stimulation in the visual cortex, while the phase-valued data show typical cardiac-gated motion in both cortex and brainstem.

Impact: BOLD fMRI can be acquired simultaneously with brain tissue displacement quantification using the DENSE pulse sequence, enabling future spatiotemporal analyses of concurrent blood volume changes, tissue displacement, and CSF flow for understanding waste clearance mechanisms.

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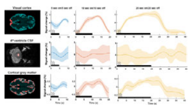

The effect of low frequency visual stimulation on CSF flow in the fourth ventricle measured with BOLD-fMRI

Leon Munting[1], Lydiane Hirschler[1], Emiel Roefs[1], Jasmin Keller[1], Thijs van Harten[2], Thijs van Osch[1], Louise van der Weerd[1], and Susanne van Veluw[2]

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Keywords: Neurofluids, fMRI (task based), CSF flow, brain clearance

Motivation: Glymphatic clearance is impaired in neurodegenerative disease. Vasomotion has been suggested to drive CSF flow and influence clearance. Furthermore, low frequency sensory stimulation can enhance vasomotion. Whether low frequency visual stimulation can drive CSF flow in humans is still unclear.

Goal(s): To study the effect of different visual stimulation frequencies on BOLD signal and CSF flow.

Approach: 7T BOLD-fMRI scans were acquired in healthy volunteers watching a checkerboard flashing at 0.025, 0.05, or 0.1 Hz.

Results: Visual cortex BOLD responses clearly oscillated at the stimulation frequencies, with increased power at lower frequencies. CSF flow responses observed in the fourth ventricle, however, were modest.

Impact: This preliminary study confirms that BOLD responses can be evoked locally in the brain with low frequency visual stimulation, but that there is only modest effect on ventricular CSF flow.

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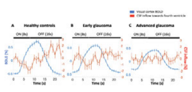

Effect of visual stimulation on cerebrospinal fluid flow is impaired in glaucoma patients

Ji Won Bang[1], Carlos Parra[1], Kevin Yu[1], Gadi Wollstein[1,2], Joel S Schuman[1,3,4,5], and Kevin C Chan[1,6]

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Keywords: Neurofluids, Neurofluids

Motivation: Glaucoma is an age-related neurodegenerative disease of the visual system. Recent studies suggested that glaucoma may lead to changes in cerebrospinal fluid (CSF) dynamics, which can be influenced by neural activity. However, it remains unclear how the CSF dynamics is altered in glaucoma.

Goal(s): To test whether the impact of visual stimulation on CSF inflow is impaired in glaucoma.

Approach: We used visually-evoked BOLD fMRI responses to compare the coupling between BOLD activity and CSF inflow across healthy individuals and glaucoma patients.

Results: Our findings indicate that the influence of visual stimulation on CSF inflow decreases with glaucoma severity.

Impact: Our findings suggest that CSF inflow is altered in glaucoma. Future studies should investigate whether this reduced impact of visual stimulation on CSF inflow is due to impaired neural activity or impaired interaction between cerebrovascular activity and CSF dynamics.

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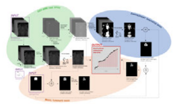

High-field contrast-enhanced magnetic resonance imaging demonstrates cerebrospinal fluid nasal efflux dynamics in vivo

Kelley M. Swanberg[1], Marios Kritsilis[1], Nagesh Shanbhag[1], Emily Johansson[1], Jari Jukkola[1], René In 't Zandt[2], and Iben Lundgaard[1]

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Keywords: Neurofluids, High-Field MRI, Cerebrospinal fluid efflux

Motivation: The astroglia-mediated circulation of metabolites and waste between cerebrospinal fluid (CSF) and blood or lymph, recently termed the glymphatic system, is implicated in processes from autoimmunity to neurodegeneration.

Goal(s): Many details of CSF dynamics, particularly efflux routes from brain to periphery including nasal pathways as we examine here, remain to be clarified.

Approach: Here we investigate CSF efflux in living mice using 9.4-T in vivo dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI).

Results: We show that gadolinium-based contrast agent injected into the cisterna magna (CM) of live mice dose-rate-dependently effluxes into the nasal mucosa in a manner affected by olfactory neuronal integrity.

Impact: Controversy surrounds the current model of CSF efflux from brain ventricles to periphery. We show with high-field DCE-MRI in live mice that nasal efflux of CSF from cisterna magna adapts to both a flow rate challenge and olfactory neuronal damage.

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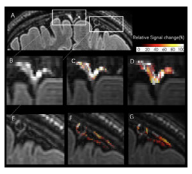

Imaging GBCA enhancement in the periosteal and meningeal layers of dura mater using high resolution MRI at 7T

Yinghao Li[1,2,3], Yuanqi Sun[1,2,3], Adrian Paez[1], Linda Knutsson[1,4], Peter C.M. Van Zijl[1,2,3], and Jun Hua[1,3]

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Keywords: Neurofluids, Neurofluids, CSF, dura mater

Motivation: The GBCA enhancement detected in the parasagittal dura (PSD) is hypothesized to originate from the dura mater blood vessels lacking a blood-brain-barrier. The dura mater consists of two layers: periosteal and meningeal dura mater. No prior study has examined the pattern of GBCA enhancement within these layers.

Goal(s): To visualize GBCA enhancement in the periosteal and meningeal layers of dura mater in the human brain.

Approach: High-resolution black-blood and FLAIR MRI were performed at 7T.

Results: The two layers and their GBCA-enhancement could be visualized. T1 and T2* values in each layer were measured.

Impact: This work allows us investigate the relationship between GBCA-enhancement in the dura mater and GBCA-induced-signal-changes in the PSD and meningeal-lymphatic-vessels. This is of importance given that GBCA-enhanced MRI has been a gold-standard technique for investigating human brain clearance.

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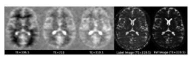


<u>T2 selective saturation labeling for imaging of water exchange between tissues and CSF.</u>

David C Alsop[1,2], Narjes Jaafar[1,2], and Manuel Taso[1,2]

[1]Beth Israel Deaconess Medical Center, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States

Keywords: Neurofluids, Neurofluids

Motivation: Water exchange between tissue and CSF may contribute to CSF production and glymphatic clearance. The large difference in T2 between tissue and fluid suggests T2 saturation transfer can be used to image this exchange.

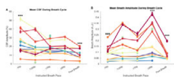
Goal(s): We aimed to develop a method for water exchange imaging using T2 saturation.

Approach: A novel strategy to control for systematic errors from direct effects of T2 saturation on fluid is proposed and evaluated in healthy volunteers.

Results: Three dimensional images at longer TE show exchange signal surrounding the choroid plexus, but also more modest exchange near the cerebellar vermis and the cerebellar and cerebral cortices.

Impact: A new strategy for T2 selective water exchange imaging can enable in vivo studies of CSF exchange that may reflect changes in glymphatic clearance or CSF production with aging, Alzheimer's disease, intracranial hypertension and other disorders.

0997 Pitch: 13:30 Poster: 14:30 Screen 57



<u>Distinct Effects of Respiratory Depth and Frequency on CSF Flow</u>

Makaila N Banks[1,2,3], Harrison Fisher[2,3,4], Baarbod Ashenagar[2,4,5], Daniel E. P. Gomez[2,3,6], Jonathan R. Polimeni[2,6,7], Vitaly Napadow[2,3], and Laura D. Lewis[2,3,4]

[1]Graduate Program for Neuroscience, Boston University, Boston, MA, United States, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [3]Institute for Medical Engineering and Science, Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [4]Department of Biomedical Engineering, Boston University, Boston, MA, United States, [5]Institute for Medical Engineering and Science, Electrical Engineering and Computer Science, Massachusetts General Hospital, Cambridge, MA, United States, [6]Department of Radiology, Harvard Medical School, Cambridge, MA, United States, [7]Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Neurofluids, Neurofluids, Cerebrospinal Fluid Flow, CSF, phase contrast, velocity

Motivation: The flow of cerebrospinal fluid (CSF) is essential for maintenance of brain function.

Goal(s): We aimed to understand the effects of respiration on CSF flow dynamics by quantitatively testing the change in CSF flow across varying paced breathing frequencies.

Approach: Using flow-sensitive fMRI, phase contrast imaging, and physiological recordings, we measured changes in CSF flow and velocity during a visually guided paced breathing task.

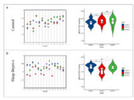
Results: We examined CSF flow across breath frequencies ranging from 0.1 Hz to 0.25 Hz, and found that slower frequencies of breathing increase CSF flow, independent of breath depth.

Impact: Our results demonstrate that key features of human respiration, its timing and its depth, induce separate effects on CSF flow. Our identification of respiratory frequency as a modulator of CSF flow provides an accessible mechanism to modulate CSF flow.

0998 Pitch: 13:30

Poster: 14:30

Screen 58



<u>Test-retest reliability of coupling between cerebrovascularoscillations and cerebrospinal fluid flow fluctuations</u>

Weiwei Zhao[1], Tianxin Mao[1], Yao Deng[1], and Hengyi Rao[1]

[1]*Center for Magnetic Resonance Imaging Research & Key Laboratory of Brain-Machine Intelligence for Information Behavior (Ministry of Education and Shanghai), Shanghai International Studies University, Shanghai, China*

Keywords: Neurofluids, Reproductive, gBOLD-CSF coupling, Glymphatics, Sleep deprivation

Motivation: The coupling strength of global blood-oxygen-level-dependent (gBOLD) signals and cerebrospinal fluid (CSF) inflow have been suggested to be an indicator of glymphatic system function. However, few studies have validated its test-retest reproducibility.

Goal(s): To assess the reproducibility of gBOLD-CSF coupling.

Approach: Thirteen adults of the sleep deprivation (SD) group and 14 adults of the control group underwent three fMRI. The reliability of gBOLD-CSF coupling was evaluated by the intraclass correlation coefficient (ICC).

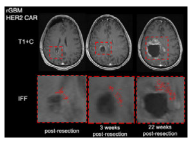
Results: A higher ICC (0.525, P = 0.001) was observed in the control group compared with the SD group (0.137, P = 0.086).

Impact: The gBOLD-CSF coupling shows good reproducibility, but care should be taken when interpreting longitudinal changes of the gBOLD-CSF coupling that may be influenced by participants' drowsiness. Sleep should be considered an important factor in future studies exploring the glymphatic system.

0999 Pitch: 13:30

Poster: 14:30

Screen 59



<u>Localized convolutional function regression: A computational method for measuring interstitial fluid flow and perfusion in DCE-MRI</u>

Ryan Woodall[1], Cora Esparza[2], Margarita Gutova[1], Maosen Wang[2], Jessica Cunningham[2], Alexander B Brummer[3], Caleb Stine[2], Christine C Brown[1], Jennifer M Munson[2], Jennifer M Munson[2], and Russell C Rockne[1]

[1]*City of Hope, Duarte, CA, United States,* [2]*Fralin Biomedical Institute, Virginia Polytechnic Institute, Roanoke, VA, United States,* [3]*College of Charleston, Charlston, NC, United States*

Keywords: Neurofluids, Perfusion

Motivation: Aggressive gliomas are known to migrate in the direction of interstitial fluid flow (IFF), though it is difficult to measure interstitial fluid flow using MRI.

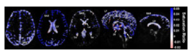
Goal(s): Our goal is to develop a computational method for measuring IFF using DCE-MRI.

Approach: We developed localized convolutional function regression (LCFR), validated in silico, in porous hydrogel, and apply it to in vivo tumors.

Results: LCFR accurately measures fluid flow and perfusion to less than 10% error in silico, and measures IFF in a mouse model of glioma to be 1.63E-3 mm/s. In a case study, the method tentatively predicts invasion across the corpus collosum.

Impact: This method will allow physicians and researchers to investigate how highly aggressive gliomas invade healthy tissue, and can be further used to predict how therapeutic agents or cells will disperse throughout the tumor, predicting disease progression and response.

1000 Pitch: 13:30
Poster: 14:30
Screen 60



Detecting magnetization exchange between human brain tissue and CSF compartments using selective parenchyma spin labeling and CSF imaging

Dahan Kim[1], Yujia Huang[1], and Jiaen Liu[1,2]

[1]*Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States,* [2]*Department of Radiology, UT Southwestern Medical Center, Dallas, TX, United States*

Keywords: Neurofluids, Neurofluids, CSF, MT, magnetization transfer

Motivation: While challenging in humans, measuring fluid exchange between the brain parenchyma tissue and CSF compartments is essential for understanding the role of CSF-mediated metabolic waste clearance in neurodegeneration.

Goal(s): We demonstrate the feasibility of detecting such fluid exchange in human brains, unaffected by CSF-flow and partial-volume artifacts.

Approach: Free-water spins inside parenchyma were selectively saturated and labeled by magnetization transfer, and subsequent partial saturations were quantified within CSF compartments.

Results: We found 3.6% saturation in subarachnoid space (SAS), significant saturation difference between SAS and lateral ventricles (1.3%), and higher saturations in slow-flowing, narrow compartments (e.g. SAS and longitudinal fissure) than larger ventricle spaces.

Impact: We demonstrated feasibility of detecting fluid exchange between brain parenchyma and CSF compartments in human brains through selective parenchyma saturation and CSF saturation quantification. Measuring such exchange is important for understanding the role of CSF-mediated metabolic waste clearance in neurodegeneration.

Member-Initiated Session

MRI for Biology-Guided RT: Are We There Yet?

Room 325-326 | Wednesday 13:30 - 15:30 | *Moderators:* Zhaoyang Fan

(no CME credit)

13:30 Introduction
Jie Deng
University of Texas Southwestern, Dallas, TX, United States

13:43 Spectroscopic MRI-Guided Radiation Therapy
Peter Barker
Johns Hopkins University, Baltimore, MD, United States

13:56 Oxygen-Enhanced MRI in Radiation Therapy
Stefan Reinsberg
University of British Columbia, Vancouver, BC, Canada

14:09 Four-Dimensional Magnetic Resonance Fingerprinting (4DMRF) for Liver Cancer Radiotherapy
Jing Cai
Hong Kong Polytechnic University, Hong Kong, China

14:22 MRI-Guided Functional Sparing in Liver Radiation Treatment Planning
Jonathan Goodwin
Calvary Mater Newcastle, Newcastle, Australia

14:35 129Xe Gas Exchange MRI for Functional-Avoidance RT Planning & Early Detection of Radiation-Induced Lung Injury
Leith Rankine
University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

14:48 Technical Challenges in Integrating MRI Biomarkers for Biology-Guided RT
Erin (Yu-Feng) Wang
University of Sydney, Camperdown, Australia

15:01 Towards Implementation of BIGART in Clinical Practice
Petra van Houdt

The Netherlands Cancer Institute, Amsterdam, Netherlands

15:14 Panel Discussion

Study Group Business Meeting
PET-MRI Business Meeting

Room 303-304 Wednesday 14:30 - 15:30

(no CME credit)

Study Group Business Meeting
MR in Radiation Therapy Business Meeting

Room 303-304 Wednesday 15:45 - 16:45

(no CME credit)

Study Group Business Meeting
Cardiac MR Business Meeting

Room 324 Wednesday 15:45 - 16:45

(no CME credit)

Weekday Course
Imaging of the Marrow

Organizers: Margaret Hall-Craggs, Jamie MacKay

Summit 1 Wednesday 15:45 - 17:45 *Moderators:* Raj Attariwala & Xiufeng Li

15:45 What's in the Marrow?

Jabed Iqbal[1]

[1]*Singapore General Hospital, Singapore*

16:15 What's Wrong with the Marrow?

Lianne Lee[1]

[1]*Singapore Health Services, Singapore*

16:45 Interrogating Bone Marrow

Timothy Bray[1]

[1]*University College London, London, United Kingdom*

Keywords: Musculoskeletal: Skeletal

This talk will discuss MRI methods for interrogating the bone marrow, building on the previous lectures that introduced the physiology and pathophysiology of the marrow. The discussion will focus on how MRI can be used to measure the size and properties of the key marrow compartments: the cellular and extracellular compartments, the fat compartment, the vascular compartment and trabecular compartment. Particular emphasis will be given to how MRI can be used to disentangle different marrow processes, thus enabling 'confounder-corrected' assessments of pathophysiology.

17:15 Whole-Body MRI in Marrow Evaluation

Rianne A van der Heijden[1,2]

[1]*University of Wisconsin-Madison, Madison, WI, United States,* [2]*Radiology and Nuclear Medicine, Erasmus University Medical Center, Rotterdam, Netherlands*

Keywords: Musculoskeletal: Skeletal, Image acquisition: Whole body

Whole body MRI has shown promise in bone marrow evaluation, for instance in diagnosing and staging of oncologic, inflammatory and metabolic diseases. In many cases, whole body multi-parametric MRI surpasses other modalities and thus is increasingly implemented in international clinical guidelines. However, whole body MRI faces several practical and technical challenges, such as long scan duration and B0 inhomogeneity. We will review the opportunities and challenges of often used imaging like fat-water separation, diffusion and perfusion. In addition, potential future solutions will be discussed and some practical insights will be shared.

Oral

Advancing Clinical Insights: Exploring Extended AI Applications for Diagnosis & Prognosis

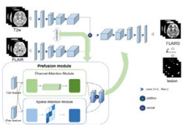
Hall 606 | Wednesday 15:45 - 17:45 | *Moderators:* Cem Deniz & Hua Guo

15:45 Introduction

Cem Deniz

New York University Langone Health, United States

1001 15:57 Deep Learning Combination of FLAIR and T2W for Improved TSC Lesion Detection



Ling Lin[1,2], Yihang Zhou[1], Rongbo Lin[3], Dian Jiang[1], Xia Zhao[3], Cailei Zhao[3], Dong Liang[1], Jianxiang Liao[3], Zhanqi Hu[3], and Haifeng Wang[1]

[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, Guangdong, China, [2]University of Chinese Academy of Sciences, Beijing, China, [3]Department of Neurology, Shenzhen Children's Hospital, Shenzhen, China

Keywords: Diagnosis/Prediction, Epilepsy

Motivation: This study seeks to address the challenge of limited visibility of periventricular lesions in Tuberous Sclerosis Complex (TSC).

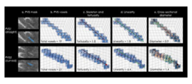
Goal(s): Develop FLAIR3, a deep neural network, for adaptive fusion of T2w and FLAIR images in TSC patients to improve lesion detection.

Approach: The study adopts a dual-stream U-Net network with a pre-fusion module and employs spatial and channel fusion weight for feature fusion. Gradient loss and segmentation annotations are utilized to generate fusion images with clear textures and improved contrast.

Results: The fused image, FLAIR3, demonstrates enhanced lesion contrast and outperforms T2w and FLAIR images in lesion segmentation.

Impact: The enhanced lesion visualization provided by FLAIR3 can aid doctors in accurately identifying and diagnosing cortical tubers, improving the overall epilepsy diagnosis and treatment in TSC patients. This work improves the accuracy of automatic tuber segmentation.

1002 16:09 Sleep and Cardiovascular Risk Variables Predict Perivascular Space Morphological Alterations in the Aging Brain



Hedong Zhang[1], Carlos Robles[1,2], Andrew Shinho Kim[1,3], Xingfeng Shao[1], Kyung Wook Kang[1,4], Jiyoung Kim[1,5], Yoon Sang Oh[1,6], Abigail Trang[1,7], Emily Lee[1,8], Hyunjin Jo[1,9], Yeonsil Moon[10], Hosung Kim[1], and Yaqiong Chai[1]

[1]Neurology, Laboratory of NeuroImaging, Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [2]Scripps College, Claremont, CA, United States, [3]Health Promotion and Disease Prevention Studies, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [4]Neurology, Chonnam National University Medical School and Hospital, Gwangju, Korea, Republic of, [5]Pusan National University School of Medicine, Busan, Korea, Republic of, [6]Neurology, College of Medicine, Catholic University of Korea, Seoul, Korea, Republic of, [7]Department of Biological Sciences,University of Southern California, Los Angeles, CA, United States, [8]University of California, Los Angeles, Los Angeles, CA, United States, [9]Neurology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of, [10]Neurology, Konkuk University, Seoul, Korea, Republic of

Keywords: Diagnosis/Prediction, Aging

Motivation: Enlarged perivascular space (PVS) has been brought into attention in aging populations. However, which cardiovascular risk factors contribute to enlarged PVS are not well understood.

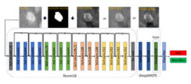
Goal(s): This study aims to quantify PVS morphology and investigate which cardiovascular risk factors contribute the PVS deformity in aging populations.

Approach: We employed random forest to predict PVS morphological changes using 9 cardiovascular risk factors and computed the importance index for all predictive factors.

Results: Our findings highlighted the significant role of sleep quality, being the best predictor to PVS count, linearity, and diameter. Cardiovascular risk factors such as triglycerides best predicted PVS tortuosity.

Impact: Our study is the first to investigate which cardiovascular risk factors are predictive of atypical PVS morphology. Our discovery provides valuable insights into the mechanism underlying PVS deformity and their subsequent impact on glymphatic system and cerebral vascular diseases.

1003 16:21



[Thin slice positive source QSM improves deep learning based paramagnetic rim detection in multiple sclerosis lesions]

Ha Manh Luu[1], Susan Gauthier[1], Ilhami Kovanlikaya[1], Yi Wang[1], Pascal Spincemaille[1], Mert Sisman[1], and Thanh Nguyen[1]

[1]*Weill Cornell Medicine, New York, NY, United States*

Keywords: Diagnosis/Prediction, Quantitative Susceptibility mapping

Motivation: Rim lesions are important subset of chronic active MS lesions that show strong correlation to patient disability. Rim identification by experts is time consuming.

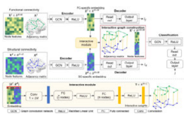
Goal(s): Develop tool for supporting the expert in Rim identification using 1 mm QSM.

Approach: We developed an automated deep learning-based network for PRL detection on thin-slice 1mm QSMp. We evaluated the improvement in performance compared with networks trained using 1mm QSM and 3mm QSMp.

Results: Use of high-resolution positive susceptibility source maps improves detection of Rim in MS patients compared to 1mm QSM and 3mm QSMp. The network does not require a precise QSM lesion mask to operate.

Impact: Using the Deep learning for detecting rim on 1mm QSMp, enabling reducing workload for human in detecting rim.

1004 16:33



[Brain structure-function interaction network via graph convolution network for Parkinson’s disease classification]

Jing Xia[1], Yi Hao Chan[1], Deepank Girish[1], and Jagath C. Rajapakse[1]

[1]*School of Computer Science and Engineering, Nanyang Technological University, Singapore, Singapore*

Keywords: Diagnosis/Prediction, Multimodal, functional connectivity, structural connectivity, graph convolution network, Parkinson's disease

Motivation: Brain functional connectivity (FC) and structural connectivity (SC) have distinct neural mechanisms for Parkinson’s disease (PD). Furthermore, the interactions between SC and FC could reveal underlying mechanisms and enhance classification performance.

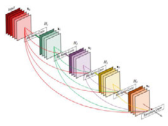
Goal(s): We aim to utilize structure-function interactions for PD classification.

Approach: We propose a brain structure-function interaction model via graph convolution network to incorporate both modality-specific embeddings and structure-function interactions.

Results: Results on 72 PD patients and 69 normal controls demonstrate that our method outperforms other state-of-the-art methods. We identify strong structure-function couplings in the precentral gyrus, prefrontal, superior temporal, cingulate cortices, and cerebellum that are associated with PD.

Impact: We proposed a novel brain structure-function interaction network based on GCN to utilize modality-specific features and interactions of SC and FC for PD classification. Our method identified the coupling strengths between SC and FC associated with PD.

1005 16:45 [Deep Learning techniques to predict treatment outcomes in newly diagnosed epilepsy]



Debabrata Mishra[1], Richard Shek-kwan Chang[1,2], Shani Ngyuen[1], Daniel Thom[1,2], Mohamad Nazem-Zadeh[1], Zhibin Chen[1], Meng Law[1,3], Patrick Kwan[1,2], and Benjamin Sinclair[1,2]

[1]Department of Neuroscience, Monash University, Melbourne, Australia, [2]Department of Neurology, The Alfred Hospital, Melbourne, Australia, [3]Department of Radiology, The Alfred Hospital, Melbourne, Australia

Keywords: Diagnosis/Prediction, Epilepsy, medication; depp learning

Motivation: Epilepsy is a complex neurological disorder with a high degree of heterogeneity. Selecting the appropriate antiseizure medication(ASM) is a time-consuming trial-and-error process that requires expert knowledge from neurologists.

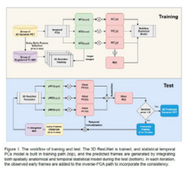
Goal(s): Our goal was to utilise Deep Learning(DL) techniques with neuroimaging information to predict the treatment outcome of ASM.

Approach: We developed a DL model that utilises multi-modal information (MRI scans and clinical characteristics) to predict seizure outcomes of initial ASM for patients with newly diagnosed epilepsy.

Results: Our model achieved AUROC/AUPRC of 0.72/0.71 respectively in predicting treatment outcomes, demonstrating the potential of brain MRI scans as a biomarker for treatment response.

Impact: The model showed promise for development of decision-support systems that could help neurologists select the best ASM, potentially improving treatment outcomes. Clinical translation will require larger datasets and external validation, but this work implies that MRI contains additional prognostic information.

1006 16:57 [4D Dynamic Brain PET Prediction Using Anatomical and Statistical Models]



Hamed Yousefi[1], Hamed Yousefi[1], Chunwei Ying[2], Yujie Wang[2], Biwen Wang[3], and Hongyu An[2]

[1]Washington University in St.Louis, Creve Coeur, MO, United States, [2]Washington University in St.Louis, St. Louis, MO, United States, [3]Washington University in St. Louis, St. Louis, MO, United States

Keywords: Diagnosis/Prediction, Machine Learning/Artificial Intelligence, 4D Dynamic PET, PCA

Motivation: The reduction in PET scan duration not only improves the efficiency of the scanning process but also contributes to a more comfortable experience for patients.

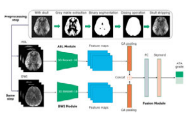
Goal(s): Leveraging the temporal models in conjunction with previously predicted weights of PCs, we aim to reconstruct entire 4D dynamic PET frames using an inverse PCA method.

Approach: A novel technique has been developed to generate pseudo-T1 images from noisy 4D PET data, as well as the reverse process, obtaining the initial components of 4D dynamic PET images from MRI data.

Results: The results endorsed that only 5 minutes observation is enough to predict whole 70 minute data.

Impact: We predicted later PET frames from noisy initial frames using a novel approach combining anatomical and statistical temporal PCs from MRI data. This method has clinical potential for insights into dynamic processes, radiation reduction, and identifying abnormalities in medical imaging.

1007 17:09 [A Multi-Parametric MRI Deep Learning Fusion Model for Grading Arterial Transit Artifacts]



Yuchi Tian[1], Yi Li[1], and Xiaoyun Liang[1]

[1]Institute of Research and Clinical Innovations, Neusoft Medical Systems Co., Ltd, Shanghai, China

Keywords: Diagnosis/Prediction, Machine Learning/Artificial Intelligence

Motivation: ATAs are essential indicators of collateral pathways in cerebral perfusion anomalies. However, the conventional grading systems for ATA suffer from subjectivity, which may subjectively leads to variability

Goal(s): We aim to standardize ATA grading by a deep learning fusion model that combines information from ASL and DWI

Approach: A deep learning fusion model was developed, which applies two 3D CNNs to extract respective feature map of each modality; this model combines the high-level feature maps to fuse the multi-sequence MRI information

Results: The fusion model shows significant improvements over a single modality model, achieving an AUC value of 0.895

Impact: The good ATA evaluation performance of the deep learning fusion model shows its clinical potential in assisting neuroradiologists in conducting the treatment and prognosis analysis for patients with ischemic stroke

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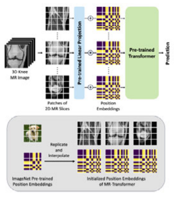
1008 17:21

MERIT AWARD
MAGNA CUM LAUDE



MR-Transformer: Vision Transformers for Total Knee Replacement Prediction using Magnetic Resonance Imaging

Chaojie Zhang[1], Shengjia Chen[1], Haresh Rengaraj Rajamohan[2], Kyunghyun Cho[2], Richard Kijowski[3], and Cem M. Deniz[1,3]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Data Science, New York University, New York, NY, United States, [3]Department of Radiology, New York University Langone Health, New York, NY, United States

Keywords: Diagnosis/Prediction, Data Analysis, Deep Learning

Motivation: Current deep learning methods for assessing knee osteoarthritis have limitations in learning long-range spatial information from magnetic resonance imaging (MRI).

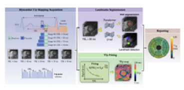
Goal(s): This study aims to develop a new deep learning model for total knee replacement (TKR) prediction using MRI.

Approach: We proposed a novel transformer-based model, MR-Transformer, adapted from the ImageNet pre-trained vision transformer DeiT-Ti. The model can capture long-range spatial information from MR images with transformer architecture. We evaluated our model on TKR prediction using MR images with different tissue contrasts.

Results: The experimental results demonstrated an improved performance of MR-Transformer compared to conventional deep learning models.

Impact: Our proposed MR-Transformer enhances computer-aided diagnosis accuracy in total knee replacement prediction using MRI. It has the potential to provide rapid and quality diagnostic outcomes, assisting physicians in making timely and informed treatment decisions.

1009 17:33



Fully automated analysis of contrast agent-free T1-rho mapping for enhanced myocardial tissue characterization

Victor de Villedon de Naide[1,2], Kalvin Narceau[1], Manuel Villegas-Martinez[1,2], Valéry Ozenne[1], Victor Nogues[1], Nina Brillet[1], Jana Huiyue Zhang[3], Ilyes Ben lala[1,2], Matthias Stuber[1,3,4], Hubert Cochet[1,2], and Aurélien Bustin[1,2,3]

[1]IHU LIRYC, Electrophysiology and Heart Modeling Institute, Université de Bordeaux, INSERM, Centre de Recherche Cardio-Thoracique de Bordeaux, U1045, Avenue du Haut Lévêque, Bordeaux, France, [2]Department of Cardiovascular Imaging, Hôpital Cardiologique du Haut-Lévêque, CHU de Bordeaux, Avenue de Magellan, Bordeaux, France, [3]Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland, [4]CIBM Center for Biomedical Imaging, Lausanne, Switzerland

Keywords: Diagnosis/Prediction, Quantitative Imaging, Cardiac T1-rho mapping; automated analysis

Motivation: Contrast agent-free myocardial T1-rho (T1ρ) mapping has shown promise in myocardial injury quantification. However, the lack of analysis tools hinders its clinical use and induces increased workload and operator variability.

Goal(s): To explore the feasibility and benefits of clinically-integrated artificial intelligence-driven analysis of myocardial T1ρ mapping.

Approach: The automated process combines left ventricular wall segmentation, right ventricular insertion point detection and the creation of a 16-segment American Heart Association model for segmental T1ρ values analysis.

Results: Automated T1ρ mapping showcased strong agreement with manual processing, enhanced with time efficiency.

Impact: Artificial intelligence-driven analysis of myocardial T1-rho mapping exhibits strong agreement with manual processing, bolstered by time efficiency. This approach shows promise for the rapid and non-invasive assessment of heart disease without the need for contrast agents.

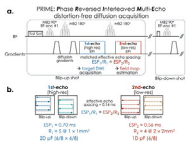
Oral

New Diffusion Acquisitions & Reconstruction Methods

Nicoll 1 Wednesday 15:45 - 17:45 *Moderators:* Nan-kuei Chen & Congyu Liao

1010

15:45



<u>PRIME: Phase Reversed Interleaved Multi-Echo acquisition enables highly accelerated distortion-free diffusion MRI</u>

Yohan Jun[1,2], Qiang Liu[2,3], Jaejin Cho[1,2,4], Xingwang Yong[1,2,5], Shohei Fujita[1,2], Susie Y Huang[1,2,6], Yogesh Rathi[2,3,7], and Berkin Bilgic[1,2,6]

[1]*Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States,* [2]*Department of Radiology, Harvard Medical School, Boston, MA, United States,* [3]*Department of Psychiatry, Brigham and Women's Hospital, Boston, MA, United States,* [4]*Pediatric Imaging Research Center, Massachusetts General Hospital, Boston, MA, United States,* [5]*Zhejiang University, Hangzhou, China,* [6]*Harvard/MIT Health Sciences and Technology, Cambridge, MA, United States,* [7]*Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States*

Keywords: Diffusion Acquisition, Diffusion/other diffusion imaging techniques

Motivation: Current distortion-free multishot diffusion MRI (dMRI) techniques rely on interim reconstructions to estimate a fieldmap, whose quality deteriorates at high accelerations, thus precluding high-resolution imaging.

Goal(s): To develop a distortion-free acquisition that reaches high accelerations with high fidelity.

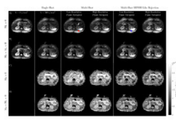
Approach: We propose PRIME, which incorporates a second echo acquired at lower resolution and acceleration, but with matching echo spacing as the first echo. This yields high-fidelity fieldmaps to be used in 10-fold accelerated scans.

Results: PRIME enables high-quality distortion-free dMRI at $R_{inplane}$×SMS=5×2 and 1mm^3 resolution without prolonging the scan thanks to utilizing the dead time in gSlider RF-encoded acquisitions.

Impact: We propose a distortion-free dMRI sequence, PRIME, that reaches $R_{inplane}$×SMS=5×2 at 1mm^3 resolution with high fidelity owing to its ability to estimate a high-quality fieldmap from a second echo inserted without prolonging the TR in gSlider RF-encoded acquisitions.

1011

15:57



<u>Robust Multi-Shot Diffusion Weighted Imaging of the Abdomen with Region-Based Shot Rejection</u>

Philip Kenneth Lee[1], Xuetong Zhou[1,2], and Brian Andrew Hargreaves[1,2,3]

[1]*Radiology, Stanford University, Stanford, CA, United States,* [2]*Bioengineering, Stanford University, Stanford, CA, United States,* [3]*Electrical Engineering, Stanford University, Stanford, CA, United States*

Keywords: Diffusion Reconstruction, Diffusion/other diffusion imaging techniques

Motivation: To improve the motion robustness of multi-shot DWI in the abdomen and reduce signal dropouts and ADC overestimation caused by unresolved shot-to-shot phase.

Goal(s): Demonstrate that region-based weighting of different shots improves diffusion contrast in rapidly moving abdominal organs.

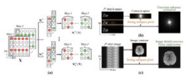
Approach: Shot rejection was evaluated in the pancreas. Multiple shot rejection formulations were tested, and compared using conventional monopolar, and motion-compensated diffusion encodings.

Results: Shot rejection allows conventional monopolar encoding to achieve diffusion weighting and ADCs similar to the motion-compensated encoding in the pancreas. The reconstruction is linear, requires no modifications to the sequence, and is applicable to many encoding trajectories.

Impact: Shot rejection may improve the consistency and robustness of multi-shot abdominal DWI in the clinic, as well as its ability to differentiate pathologies. This will improve repeatability of DWI studies of rapidly moving organs, such as the pancreas and heart.

1012 MERIT AWARD MAGNA CUM LAUDE

16:09



[Low-distortion Spine DWI with Ultra-high Shot and Navigator-free Reconstruction]

Chen Qian[1], Mingyang Han[1], Feiqiang Guan[1], Yucheng Guo[1], Zhigang Wu[1], Jiangzheng Wang[2], Boyu Jiang[3], Ran Tao[3], Liuhong Zhu[4], Di Guo[5], Jianjun Zhou[4], and Xiaobo Qu[1]

[1]Xiamen University, Xiamen, China, [2]Philips Healthcare, Beijing, China, [3]United Imaging Healthcare, Shanghai, China, [4]Department of Radiology, Zhongshan Hospital (Xiamen), Fudan University, Xiamen, China, [5]Xiamen University of Technology, Xiamen, China

Keywords: Diffusion Reconstruction, Diffusion/other diffusion imaging techniques

Motivation: State-of-the-art low-rank methods recover multi-shot DWI with 2D structured matrix completion, but are hindered by long computation time (tens of minutes per image) and unsatisfactory ultra-high shot reconstruction (no more than 8-shot).

Goal(s): Fast and reliable ultra-high (above 8-shot) DWI reconstruction.

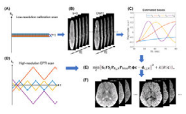
Approach: ODLRS: A 1D low-rank Hankel reconstruction method with self-adaptive subspace.

Results: ODLRS is a novel 1D low-rank framework for multi-shot DWI reconstruction. Compared to conventional low-rank methods, ODLRS achieves 109 times accelerated reconstruction, and low-distortion spine DWI with 12 shots.S

Impact: This work achieves fast (109 times acceleration) and reliable ultra-high (10 and 12 shots) DWI reconstruction, reducing the deformation of conventional spinal cord DWI significantly.

1013

16:21



[A Data-Driven Subspace Reconstruction for Distortion-Free Diffusion-Relaxometry Echo Planar Time-Resolved Imaging]

Erpeng Dai[1] and Jennifer A McNab[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States

Keywords: Diffusion Reconstruction, Relaxometry

Motivation: The subspace-based reconstruction is an SNR-efficient approach for distortion-free diffusion-relaxometry MRI with highly under-sampled echo-planar time-resolved acquisition (EPTI), in which the needed bases can be estimated from simulations. However, the simulations may not be able to fully capture the signal evolution in complex human tissue.

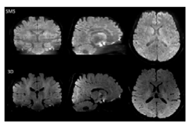
Goal(s): To improve the subspace-based EPTI reconstruction by estimating the bases from acquired calibration data.

Approach: The efficacy of the new data-driven subspace reconstruction was evaluated with in vivo EPTI experiments.

Results: High-resolution, under-sampled EPTI images are reliably reconstructed using the data-driven subspace reconstruction.

Impact: Our study presents a new data-driven approach for estimating the bases for the subspace-based echo-planar time-resolved imaging (EPTI) reconstruction, which may better reflect the underlying microstructure than the numerical simulation and further facilitate studies with diffusion-relaxometry MRI.

1014 16:33



[Towards Genuine Three-dimensional Diffusion Imaging with Second Order Gradient Moment Nulling]

Yishi Wang[1], Dehe Weng[2], Jieying Zhang[3], Tianyi Qian[3], Wenzhang Liu[3], Kun Zhou[2], Yanglei Wu[1], Baogui Zhang[3], and Qing Li[3]

[1]MR Research Collaboration Team, Siemens Healthineers Ltd., Beijing, China, [2]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China, [3]Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China

Keywords: Diffusion Acquisition, Pulse Sequence Design

Motivation: While 3D acquisition has the advantages of achieving high resolution and signal-to-noise ratio and has been established for most sequences, diffusion imaging, has predominantly adhered to 2D acquisition or partial 3D such as multi-slab acquisition for over 50 years.

Goal(s): We aim to bring diffusion imaging to the next era by implementing a genuine 3D diffusion imaging sequence.

Approach: The sequence was implemented using gradient moment nulling and 3D EPI acquisition and basic reconstruction methods.

Results: Whole brain 3D diffusion imaging was achieved at isotropic sub-millimeter resolution and a practical scan time.

Impact: This work liberates diffusion imaging from 2D or partial 3D acquisition to true 3D acquisition.

1015 16:45

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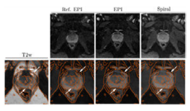


[Unprecedented SNR Efficiency in Prostate DWI By Combining Ultra-Strong Gradients and Spiral Readouts]

Malwina Molendowska[1,2], Lars Müller[1,3], Fabrizio Fasano[4,5], Derek K Jones[1], Chantal MW Tax[1,6], and Maria Engel[1]

[1]Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom, [2]Medical Radiation Physics, Lund University, Lund, Sweden, [3]Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, United Kingdom, [4]Siemens Healthcare Ltd, Camberly, United Kingdom, [5]Siemens Healthcare GmbH, Erlangen, Germany, [6]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands

Keywords: Diffusion Acquisition, Prostate, Field monitoring

Motivation: Prostate DWI with high b-values holds promise for microstructural tissue characterization but is notoriously SNR-deprived.

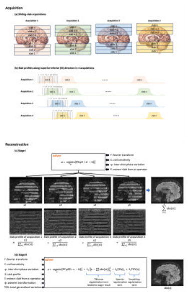
Goal(s): (i) To boost the SNR of prostate DWI; (ii) to reduce artefacts resulting from scanner imperfections that are exacerbated by the methods used to increase the SNR.

Approach: Spirals and strong gradients (≤300mT/m) are used to attain short TEs and thus high SNR. An expanded encoding model including measured static and dynamic fields is deployed to obtain high image quality.

Results: The approach is demonstrated in a healthy subject and a patient diagnosed with prostate cancer. It delivers higher SNR and improved cancerous lesion conspicuity.

Impact: We provide the demonstration of prostate DWI with ultra-strong gradients and spiral readouts. Using high b-values and short echo times enhances lesion conspicuity and holds potential for early and non-invasive disease detection.

1016 16:57 [Improved SLIPEN (iSLIPEN) for Three-Dimensional Multi-slab Diffusion-Weighted Imaging by Partial Fourier and Prior Information]



Xiaorui Xu[1], Shihui Chen[2], Liyuan Liang[2,3], Chenglang Yuan[2], Hailin Xiong[2], and Hing-Chiu Chang[2,3]

[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]Department of Biomedical Engineering, The Chinese University of Hong Kong, Hong Kong, Hong Kong, [3]Multi-Scale Medical Robotics Center, Hong Kong, Hong Kong

Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging

Motivation: SLIPEN is a promising technique to obtain 3D multi-slab DWI without suffering slab boundary artifacts. However, its performance is degraded when encountering limited signal SNR.

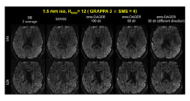
Goal(s): An improved SLIPEN is desired to achieve robust perfomance regardless of limited signal SNR.

Approach: Partial Fourier was applied to design an optimized sampling pattern and prior information was also incorporated into the model to improve the performance.

Results: The improved SLIPEN could achieve comparable results to gold standard for in-vivo DWI images and DTI maps, with the need of only one third of gold standard data.

Impact: 3D isotropic high-resolution DWI without suffering from slab boundary artifacts can be robustly achieved by our method with the use of 2D navigator, therefore benefiting the neuroscience study in evaluating crossing and kissing fibers.

1017 17:09 [Accelerated multi-shell diffusion MRI with Gaussian processes estimated reconstruction of multi-band imaging]



Xinyu Ye[1], Karla Miller[1], and Wenchuan Wu[1]

[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, Univeristy of Oxford, Oxford, United Kingdom

Keywords: Diffusion Reconstruction, Diffusion/other diffusion imaging techniques

Motivation: Advanced diffusion MRI models that utilize multi-shell data provide higher specificity about tissue microstructure but require longer scan time, hindering wider application.

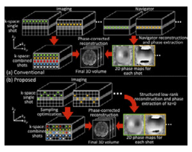
Goal(s): To increase the acquisition speed of multi-shell diffusion MRI for rapid tissue microstructure mapping.

Approach: We integrated multi-band imaging with the extended multi-shell Diffusion Acceleration with Gaussian process Estimated Reconstruction (ems-DAGER), including eddy-current corrected joint k-q reconstruction. The method was evaluated with in vivo data.

Results: Simulated and in-vivo results demonstrate that ems-DAGER method can significantly improve the image quality of reconstructed dMRI data with both in-plane and slice-wise acceleration to enable advanced multi-shell diffusion analysis.

Impact: Highly accelerated dMRI with the proposed method can shorten the scan time of multi-shell dMRI without sacrificing quality compared to conventional practice. This may facilitate a wider application of advanced dMRI models in basic and clinical neuroscience.

1018 17:21



[Self-navigated 3D multi-slab EPI for SNR-efficient high-resolution diffusion MRI]

Ziyu Li[1], Karla L. Miller[1], Xi Chen[1,2,3], Mark Chiew[1,4,5], and Wenchuan Wu[1]

[1]Wellcome Centre for Integrative Neuroimaging, FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [4]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [5]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada

Keywords: Diffusion Acquisition, Sparse & Low-Rank Models, 3D multi-slab imaging, Navigator, Diffusion acquisition, Diffusion reconstruction

Motivation: 3D multi-slab EPI achieves superior SNR efficiency for high-resolution diffusion MRI but requires navigators for phase correction, which increase scan time and SAR.

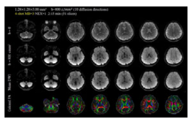
Goal(s): To eliminate the requirement for navigators in 3D multi-slab diffusion MRI.

Approach: 3D imaging is intrinsically highly segmented, making self-navigation challenging. Our optimized multi-shot sampling facilitates self-navigation by ensuring each shot intersects with kz=0 plane. The overall sampling pattern's overlap and gaps are also minimized. A structured low-rank reconstruction is leveraged to reconstruct 2D phase maps from these intersections for phase correction.

Results: Compared to navigated imaging our self-navigated method achieves comparable image quality with 31.4% shorter scan time.

Impact: By removing the need for navigation, our method enables 3D multi-slab diffusion MRI to efficiently achieve TRs with near-optimal SNR efficiency. This approach may permit wider adoption of high-resolution diffusion MRI for basic and clinical neuroscience.

1019 17:33



[Slice-POCS-ICE: a navigator-free reconstruction for SMS-accelerated multi-shot spiral-based diffusion-weighted imaging]

Guangqi Li[1], Yuancheng Jiang[1], Yajing Zhang[2], and Hua Guo[1]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, [2]MR R&D, Philips Health Technology (Suzhou), Suzhou, China

Keywords: Diffusion Acquisition, Diffusion/other diffusion imaging techniques, Spiral diffusion imaging

Motivation: Simultaneous multi-slice (SMS) technique can further enhance the acquisition efficiency of spiral-based diffusion imaging.

Goal(s): Our goal was to achieve SMS-accelerated navigator-free multi-shot spiral-based diffusion imaging.

Approach: RF pulse phase encoding strategy was optimized to introduce the CAIPI phase modulation. Furthermore, we proposed the slice-POCS-ICE algorithm to simultaneously perform CAIPI phase demodulation, inter-shot phase error correction, and diffusion image reconstruction. The proposed algorithm was tested on simulated and in-vivo data.

Results: Our proposed slice-POCS-ICE algorithm can simultaneously accomplish CAIPI phase demodulation and remove the shot-to-shot phase variations, for SMS-accelerated multi-shot navigator-free spiral-based DWI. The proposed slice-POCS-ICE has a stable convergence behavior.

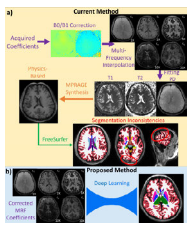
Impact: The proposed slice-POCS-ICE reconstruction algorithm can successfully reconstruct multi-shot diffusion images from SMS-accelerated navigator-free spiral acquisitions with optimized CAIPI phase modulation, which may be valuable for speeding up multi-shot spiral-based DWI acquisitions, to facilitate both neuroscience research and clinical diagnosis.

Oral

Analysis Methods: Segmentation

Nicoll 2 | Wednesday 15:45 - 17:45 | *Moderators:* Marco Castellaro & Augustin Ogier

1020 15:45



[MRF-SEG: Accelerated Brain MRI Acquisition and Segmentation]

Ashwin Kumar[1], Zihan Zhou[1], Quan Chen[1], Xiaozhi Cao[1], Benjamin Billot[2], Bruce Fischl[2], Akshay Chaudhari[1], and Kawin Setsompop[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Segmentation, Segmentation

Motivation: Despite the availability of rapid high-resolution MRF sequences that can be used to synthesize MPRAGE, acquiring MPRAGE scans remains necessary for accurate downstream segmentation.

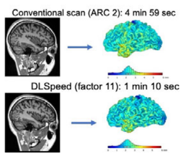
Goal(s): The aim is to perform accurate-segmentation directly on MRF time-resolved data, eliminating the need for a lengthy MPRAGE scan, resulting in significant time savings, and providing quantitative tissue parameter maps.

Approach: We used deep learning to directly segment MRF time-resolved data and generate multi-tissue brain segmentation maps.

Results: Our findings indicate that deep learning segmentation methods trained directly on MRF data, both quantitatively and qualitatively perform better than segmentation on synthesized MPRAGE.

Impact: Applying deep learning directly on MRF data improves MRF segmentation compared to synthesizing MPRAGE and performing segmentation on it. This strengthens the validation of MRF and enhances its clinical potential by rapidly acquiring and segmenting brain images.

1021 15:57



[0.9mm isotropic 1min MPRAGE using highly-accelerated Deep learning Reconstruction for Brain Structural Analysis]

Keita Watanabe[1,2], Sera Kasai[2], Yoshihito Umemura[2], Soichiro Tatsuo[2], Kazuhiko Oyu[2], Atsushi Nozaki[3], Xucheng Zhu[4], Tetsuya Wakayama[3], and Shingo Kakeda[2]

[1]Radiology, Kyoto prefectural university of medicine, Kyoto, Japan, [2]radiology, Hirosaki university, Hirosaki, Japan, [3]GE Healthcare, Tokyo, Japan, [4]GE Healthcare, Menlo Park, CA, Japan

Keywords: Gray Matter, Machine Learning/Artificial Intelligence

Motivation: The project was driven by the need to reduce 3D T1-weighted MRI acquisition times, which are often prolonged, leading to motion artifacts and compromised image quality in structural nuroimaging analysis.

Goal(s): To evaluate whether deep learning reconstruction can shorten MRI scan times without significantly compromising image quality, facilitating efficient clinical and research neuroimaging.

Approach: We employed a deep learning technique, DL-speed, to reconstruct undersampled data from accelerated MRI scans, assessing image quality against conventional methods using a standardized rating system.

Results: Images with DL-speed maintained image quality, despite a slight quality trade-off, suggesting its viability for rapid, motion-artifact-reduced neuroimaging in various patient populations.

Impact: Our results impact clinicians and patients by enabling faster, high-quality MRIs, reducing patient discomfort and motion-related artifacts. This advance opens avenues for more efficient neuroimaging protocols, enhancing patient care and research productivity.

1022 16:09 [Segmentation of Brain Lesions Using Posterior Distributions Learned by Subspace-assisted Generative Model]

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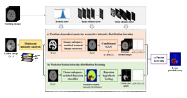


Huixiang Zhuang[1], Yue Guan[1], Yi Ding[1], Chang Xu[1], Yuhao Ma[1], Ziyu Meng[1], Ruihao Liu[1,2], Zhi-Pei Liang[2,3], and Yao Li[1]

[1]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [2]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States

Keywords: Segmentation, Segmentation, Lesion segmentation; Generative model

Motivation: Deep learning shows great potential for brain lesion segmentation but poor generalization (due to limited training data) could lead to false positives.

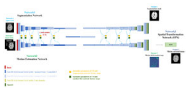
Goal(s): Our goal was to improve the segmentation accuracy by learning target-specific posterior distributions.

Approach: We proposed a new Bayesian brain lesion segmentation method, leveraging posterior distributions learning, including both posterior normal and lesion distributions, through a subspace-assisted deep generative model.

Results: The proposed method achieved significantly improved segmentation performance across multiple public datasets with stroke, tumor, and multiple sclerosis lesions, in comparison with the state-of-the-art methods.

Impact: The proposed method significantly improved accuracy and robustness of lesions segmentation in brain MR images, which may provide a useful tool for brain lesion delineation in image processing and clinical applications.

1023 16:21 [Brain Tissue Segmentation robust to motion artifacts using Deformation-Aware Network]



Sunyoung Jung[1], Yoonseok Choi[1], Mohammed A. Al-masni[2], Yongjeon Choeng[3], Seonkyoung Lee[3], Jihyun Bae[3], Min-Young Jung[3], and Dong-Hyun Kim[1]

[1]Department of Electrical and Electronic Engineering, College of Engineering, Yonsei University, Seoul, Korea, Republic of, [2]Department of Artificial Intelligence, College of Software & Convergence Technology, Daeyang AI Center, Sejong University, Seoul, Korea, Republic of, [3]Cognitive Science Research Group, Korea Brain Research Institute, Daegu, Korea, Republic of

Keywords: Segmentation, Segmentation, Brain tissue

Motivation: Motion artifacts in MRI scans present challenges by causing blurred images with tissue-like appearances, significantly complicating the tissue segmentation process.

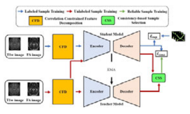
Goal(s): Our goal is to achieve accurate brain tissue segmentation even in the presence of motion artifacts.

Approach: We propose a brain tissue segmentation method robust to motion artifacts, that generates a motion deformation map and a prediction mask for brain tissue segmentation. The motion deformation map serves as an indicator within the segmentation network, aiding in the identification of regions impacted by motion artifacts.

Results: Our method demonstrates superior performance compared to other segmentation models, especially when dealing with motion-corrupted data.

Impact: We propose a motion-robust segmentation network that incorporates prior motion knowledge via a motion estimation network. By employing a multi-task learning approach involving joint motion estimation and segmentation networks, we improve brain tissue segmentation by recovering incorrectly segmented structures.

1024 16:33



[Visual Pathway Delineation via Correlation-Constrained Feature Decomposition and Consistency-based Sample Selection]

Alou Diakite[1,2], Cheng Li[1], Lei Xie[3], Yuanjing Feng[3], Hua Han[1], Hairong Zheng[1], and Shanshan Wang[1,4]

[1]Paul C Lauterbur Research Center for Biomedical Imaging, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]University of Chinese Academy of Science, Beijing, China, [3]Zhejiang University of Technology, Hangzhou, China, [4]Peng Cheng Laboratory, Shenzhen, China

Keywords: Segmentation, Multimodal, Multi-parametric MRI, Deep Learning

Motivation: Accurate segmentation of visual pathway (VP) in multi-parametric MRI is crucial for reliable diagnosis of visual disorders. However, existing methods face challenges due to complex multi-parametric MRI relationships and limited labeled training data.

Goal(s): The goal is to improve automatic VP delineation by developing a new framework that handles complex multi-parametric MRI relationships and incorporates unlabeled data.

Approach: Our framework incorporates a correlation-constrained feature decomposition module to better exploit multi-parametric MRI information and a consistency-based sample selection method for more effective semi-supervised learning.

Results: Experiments on the HCP dataset show that the proposed framework achieved superior VP delineation performance compared to state-of-the-art approaches.

Impact: The results of this study could have a significant impact on scientists, clinicians, and patients by improving the understanding of the human visual system and enhancing the diagnosis accuracy of visual pathway disorders.

1025 16:45

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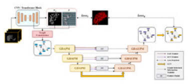


[CF-VCENet: Coarse-to-Fine Vascular Connectivity Enhancement Network for Hepatic Vessel Segmentation in MR Images]

Ziqi Zhao[1], Wentao Li[2], Xiaoyi Ding[3], Guoliang Shao[4], Jianqi Sun[1], and Lisa X. Xu[1]

[1]Shanghai Jiao Tong University, Shanghai, China, [2]Fudan University Shanghai Cancer Center, Shanghai, China, [3]Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, [4]Zhejiang Cancer Hospital, Hangzhou, China

Keywords: Segmentation, Blood vessels

Motivation: Vessel location must be pinpointed for precise avoidance during probe insertion for liver ablation.

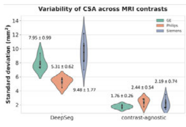
Goal(s): Our goal was to segment the hepatic vessel from MR images and to ensure the connectivity of the segmentation results.

Approach: Hepatic vessel MR images were obtained from the records of 105 patients. Coarse-to-fine vascular connectivity enhancement algorithm was trained and tested using a five-fold cross-validation method.

Results: Results demonstrated that our two-stage algorithm improved the connectivity of vessel segmentation results, with the dice coefficient increasing by up to 1.8% compared to the initial segmentation.

Impact: Accurate segmentation results and enhanced connectivity provide a basis for hepatic vessel location and modeling. The results can assist doctors in preoperative planning while reducing the risk of damage to normal tissue in patients.

1026 16:57



Automatic spinal cord segmentation: Generalization across MR parameters, sites, vendors and pathologies

Sandrine Bedard[1], Naga Karthik Enamundram[1,2], Merve Kaptan[3,4], Falk Eippert[3], Nawal Kinany[5,6], Ilaria Ricchi[5,6], Dimitri Van De Ville[5,6], Patrick Freund[7,8], Markus Hupp[7], Lisa Eunyoung Lee[9,10], Anthony Traboulsee[11], Roger Tam[12], Alexandre Prat[13,14], Zachary Vavasour[12], Shannon Kolind[11], Jiwon Oh[9,10], Christoph S. Aigner[15], and Julien Cohen-Adad[1,2,16,17]

[1]NeuroPoly Lab, Institute of Biomedical Engineering, Polytechnique Montréal, Montréal, QC, Canada, [2]Mila - Quebec AI Institute, Montréal, QC, Canada, [3]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [4]Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Stanford, CA, United States, [5]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [6]Neuro-X Institute, École Polytechnique Fédérale de Lausanne (EPFL), Geneva, Switzerland, [7]Spinal Cord Injury Center, Balgrist University Hospital, University of Zürich, Zürich, Switzerland, [8]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [9]Department of Medicine (Neurology), University of Toronto, Toronto, ON, Canada, [10]BARLO Multiple Sclerosis Centre & Keenan Research Centre, St. Michael's Hospital, Toronto, ON, Canada, [11]University of British Columbia, Vancouver, BC, Canada, [12]School of Biomedical Engineering, Faculties of Applied Science and Medicine, University of British Columbia, Vancouver, BC, Canada, [13]Department of neuroscience, Université de Montréal, Montréal, QC, Canada, [14]Neuroimmunology research laboratory, University of Montreal Hospital Research Centre (CRCHUM), Montréal, QC, Canada, [15]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, [16]Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montréal, QC, Canada, [17]Centre de Recherche du CHU Sainte-Justine, Université de Montréal, Montréal, QC, Canada

Keywords: Segmentation, Spinal Cord, Segmentation; Deep Learning; Morphometrics; Atrophy; Variability; Reproducibility; Vendors

Motivation: Spinal cord cross-sectional area (CSA) is an important biomarker for neurodegenerative and traumatic diseases. However, CSA measurements vary across MRI contrasts and imaging protocols, limiting its use in multi-center studies.

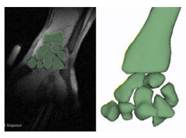
Goal(s): The goal is to evaluate CSA variability using a novel contrast-agnostic segmentation method.

Approach: We compared this method to the Spinal Cord Toolbox's DeepSeg, analyzing CSA across different sites, and MRI vendors. Additionally, we compared the segmentations in diverse datasets and pathologies.

Results: The contrast-agnostic segmentation showed lower CSA variability, and superior performance in most cases, except for intramedullary cord compression, where the Spinal Cord Toolbox's DeepSeg was more accurate.

Impact: The contrast-agnostic method yields reliable spinal cord CSA measurements, independent of MRI contrasts and vendors. This, combined with a soft segmentation output, can potentially detect subtle spinal cord atrophy in prospective multi-center cohorts.

1027 17:09



Functional Kinematic Assessment of the Wrist Using Volumetric Dynamic MRI

Batool Abbas[1,2], Ruoxun Zi[1,2,3], Kai Tobias Block[1,2], Catherine Petchprapa[1,2], James Fishbaugh[4], Guido Gerig[5], and Riccardo Lattanzi[1,2,3]

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Keywords: Segmentation, Joints, Wrist

Motivation: Dynamic imaging can be useful for the evaluation of wrist instability.

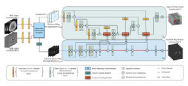
Goal(s): To propose a semi-automatic approach for carpal bones segmentation on 3D dynamic wrist MRI to enable kinematic assessment.

Approach: We segmented carpal bones on a high-resolution 3D static MRI, registered it to a template created from the dynamic frames, and transferred back the segmentations onto individual 3D dynamic volumes. Bones surfaces were reconstructed and the reproducibility of motion patterns was assessed on repeated scans.

Results: Our proposed image processing and visualization pipeline enables semi-automatic segmentation of carpal bones and provides a framework for qualitative and quantitative analysis of wrist kinematics.

Impact: This work demonstrates semi-automatic segmentation of real-time dynamic MRI of the wrist to extract carpal bones motion. It could be used for quantitative kinematic analysis to detect and characterize wrist abnormalities.

1028 17:21 [Active Gradient Guidance Based Susceptibility and Magnitude Information Complete Network for Basal Ganglia Segmentation]



Jiaxiu Xi[1] and Lijun Bao[1]

[1]*Department of Electronic Science, Xiamen University, Xiamen, China*

Keywords: Segmentation, Segmentation, Susceptibility Imaging, Basal Ganglia, Segmentation Network, Magnitude Information Complete, Active Gradient Guidance

Motivation: Accurate segmentation of basal ganglia is a crucial prerequisite for subsequent clinical practice and research. The boundaries of BG remain challenging to segment especially when dealing with data affected by severe artifacts.

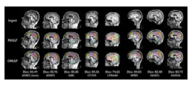
Goal(s): This work aims to propose an automatic BG segmentation method with radiologist comparable accuracy and high inference speed.

Approach: An active gradient guidance-based susceptibility and magnitude information complete network(AGNet). With newly designed modules, AGNet can efficiently capture the inter-slice information and exploit it as attention guidance to facilitate the segmentation process.

Results: AGNet has superior segment accuracy over existing methods with ***ADSC***=0.874 and ***AHD*=2.010**, especially near boundaries of target VOI.

Impact: The proposed model achieves more accurate segmentation at the boundary contour. Automatic and precise segmentation of basal ganglia is a prerequisite for the quantification of tissue magnetic susceptibility analysis and can serve as a fundamental tool for neurodegenerative disease research.

1029 17:33 [A Rapid Deep Learning Approach to Parcellate 280 Anatomical Regions to Cover the Whole Brain]



Kei Nishimaki[1,2], Kengo Onda[1], Kumpei Ikuta[2], Jill Chotiyanonta[1], Yuto Uchida[1], Susumu Mori[1], Hitoshi Iyatomi[2], and Kenichi Oishi[1,3]

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Keywords: Segmentation, Segmentation

Motivation: Whole-brain MRI parcellation serves as a feature extraction technique, allowing for the condensation of over a million pixels of information into a few hundred neuroanatomically defined elements.

Goal(s): The multi-atlas label-fusion (MALF) method is known for accurate parcellation but typically necessitates several hours to process a single image. Our goal was to develop a faster parcellation tool with an accuracy comparable to that of MALF.

Approach: We introduce open-source multiple anatomical parcellation T1 (OpenMAP-T1), based on deep learning and multi-processing.

Results: The OpenMAP achieves an equivalent parcellation performance to MALF and is 40 times faster.

Impact: OpenMAP significantly accelerates processing speed, allowing for large-scale data analysis using volumetric information derived from detailed parcellation of the whole brain, including both gray and white matter regions.

Oral

How Many Are Enough: RF Arrays

Nicoll 3 Wednesday 15:45 - 17:45 *Moderators:* Irena Zivkovic & Fraser Robb

15:45 Introduction

Irena Zivkovic
Eindhoven University of Technology, Netherlands

1030 15:57

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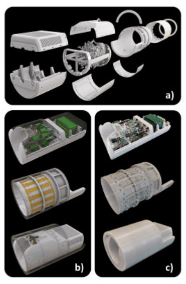

A 72-Channel Head Coil with an Integrated 16-Channel Field Camera for the Connectome 2.0 Scanner

Mirsad Mahmutovic[1], Manisha Shrestha[1], Gabriel Ramos-Llordén[2], Alina Scholz[1], John E. Kirsch[2], Lawrence L. Wald[2], Harald E. Möller[3], Choukri Mekkaoui[2], Susie Y. Huang[2], and Boris Keil[1,4]

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Keywords: RF Arrays & Systems, RF Arrays & Systems

Motivation: Diffusion MRI utilizing ultra-high performance gradients for high b-value *in vivo* brain images still suffers from low SNR and increased eddy currents artifacts.

Goal(s): To construct a high-density coil array with an integrated field monitoring system. To enhance SNR and parallel image encoding, while capturing 3rd-order field dynamics.

Approach: Utilizing simulations, 3D printing technology, and radiofrequency electronics to construct a 72-channel head coil and incorporate a field monitoring system. Optimization of the combined system to operate jointly in a space-constraint MRI gradient coil environment.

Results: High-resolution, high b-value diffusion *in vivo* imaging with greatly minimized image artefacts.

Impact: The constructed 72-channel head coil along with the new Connectome 2.0 scanner will enable the investigation of new microstructure features and connectivity in the living human brain.

1031 16:09

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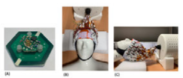

A 32-Channel Cap for Temporal Lobes Exploration at 11.7 T

Paul-François Gapais[1,2], Michel Luong[3], Eric Giacomini[1], Jules Guillot[1], Shajan Gunamony[4], Son Chu[4], Sajad Hosseinnezhadian[2], and Alexis Amadon[1]

[1]Université Paris-Saclay, CEA, Joliot, NeuroSpin, Gif-Sur-Yvette, France, [2]Multiwave Imaging SAS, Marseille, France, [3]Université Paris-Saclay, CEA, IRFU, Gif-sur-Yvette, France, [4]Imaging Centre of Excellence, University of Glasgow, Glasgow, United Kingdom

Keywords: RF Arrays & Systems, RF Arrays & Systems

Motivation: Our newly operational 11.7 T machine provides an improved signal-to-noise ratio (SNR) in the human brain. This gain in SNR can be even enhanced by designing region-focused receive arrays.

Goal(s): Our main goal was to maximize the SNR in the temporal lobes and provide high-acceleration capabilities for fMRI studies.

Approach: We developed a modular 32-channel receive array made of non-overlapped hexagonal loops placed on a flexible cap, using high-impedance coils (HIC). We compared our coil to a 32-channel whole-brain receive array at 11.7 T.

Results: The cap receive array provides a significant SNR boost in the targeted region.

Impact: Our cap receive array should ease sub-millimeter resolution fMRI with high SNR in the temporal lobes. Moreover, the detachable hexagonal modules could easily be re-arranged to target any other brain region, with no need for retuning.

1032 16:21

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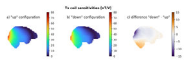

[First experimental results using RF Elements with Switching Transmit Sensitivities at ultrahigh field MRI]

Dario Bosch[1,2], Georgiy Solomakha[1], Martin Freudensprung[3], Felix Glang[1], Nikolai Avdievich[1], and Klaus Scheffler[1,2]

[1]MPI for Biological Cybernetics, Tübingen, Germany, [2]University Hospital Tübingen, Tübingen, Germany, [3]Institute of Neuroradiology, Universitätsklinikum Erlangen, Friedrich-Alexander Universität Erlangen-Nürnberg, Erlangen, Germany

Keywords: Parallel Transmit & Multiband, High-Field MRI

Motivation: Dipole RF elements with electronically switchable B_1 field patterns have been shown to improve receive performance. The question whether they are beneficial for transmission is still open.

Goal(s): Improve flip angle homogeneity by modulating the Tx sensitivity of a dipole during excitation.

Approach: An RF coil built from eight dipoles with electronically switchable sensitivities was constructed. Achievable flip angle homogeneity with 2-kT-points pulses was evaluated in simulations and in experiments.

Results: Flip angle homogeneity could be increased by electronically switching the Tx sensitivity during the course of the RF pulse.

Impact: RF elements with switchable transmit sensitivities offer a novel degree of freedom for excitation that promises improved flip angle homogeneity. This addresses one of the most pressing problems in ultra-high field MRI.

1033 16:33

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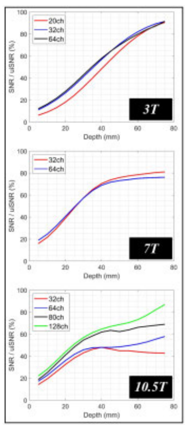

Capturing Central uiSNR at Ultrahigh Field: Number and Size of the Receive Elements Matter

Alireza Sadeghi-Tarakameh[1], Andrea Grant[1], Ilias I Giannakopoulos[2,3], Matt Waks[1], Russell L Lagore[1], Lance DelaBarre[1], Edward Auerbach[1], Riccardo Lattanzi[2,3], Gregor Adriany[1], Kamil Ugurbil[1], and Yigitcan Eryaman[1]

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Keywords: RF Arrays & Systems, RF Arrays & Systems

Motivation: In addition to peripheral SNR gain, the promise of a quadratic increase of SNR at the center of a human head with field strength draws significant attention to many ultrahigh field head MRI applications.

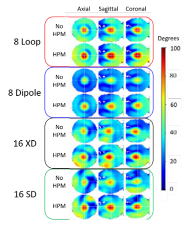
Goal(s): Assess the performance of state-of-the-art RF receive array coils in capturing the theoretical upper limit of central head SNR across different field strengths.

Approach: We experimentally investigated the impact of combining transceiver elements with highly-dense conventional loop arrays to capture the ultimate intrinsic SNR in head applications.

Results: We demonstrated that achieving central SNR gains at UHF requires an increased number of receive elements and larger transceiver elements.

Impact: Capability of conventional loop technology to capture the SNR's upper-limit in human head is investigated across different field strengths, which can pave the way for the RF technology developments focused on capturing the SNR gain in ultrahigh field head applications.

1034 16:45



The Impacts of High Permittivity Materials on Various Multichannel Transceiver Arrays for Human Head Imaging at 10.5 Tesla

Matt Waks[1], Andrea Grant[1], Alireza Sadeghi-Tarakameh[1], Steve Jungst[1], Russell Lagore[1], Lance DelaBarre[1], Sebastian Rupprecht[2], Qing Yang[2,3], Michael Lanagan[2,3], Yigitcan Eryaman[1], Gregor Adriany[1], and Kamil Ugurbil[1]

[1]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States,* [2]*HyQ Research Solutions, LLC, College Station, TX, United States,* [3]*Penn State University, State College, PA, United States*

Keywords: RF Arrays & Systems, RF Arrays & Systems

Motivation: Since RF power requirements increase with operating frequency, SAR levels at UHF represent practical limitations. Here we evaluate possible improvements in overall transmit efficiency and SNR of array coils for the human head at 10.5T through the utilization of high permittivity materials.

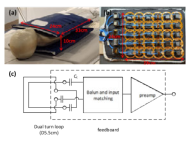
Goal(s): Our goal was to evaluate the impact of high permittivity materials (HPM) on the transmit efficiency and SNR for various transceiver array designs.

Approach: We experimentally evaluated four multichannel transceiver arrays of different architectures with and without a formfitting HPM former.

Results: The HPM coil former achieved improvements in transmit efficiency and SNR compared to a typical polycarbonate coil former.

Impact: Incorporating high permittivity dielectric materials into the design and fabrication of pTx-capable transceiver array coils demonstrated improved transmit efficiency and SNR. This technology has the potential to improve imaging and spectroscopic applications in the human head at 10.5T and beyond.

1035 16:57



A 60-channel high-density flexible receive array for pediatric abdominal MRI

Wonje Lee[1], Yunjeong Stickle[2], Clyve Follante[2], Thomas Grafendorfer[2], Taeyoung Yang[2], Fraser Robb[2], Fan Zhang[1], Greig Scott[1], John Pauly[1], Shreyas Vasanawala[1], and Ali Syed[1]

[1]*Stanford University, Stanford, CA, United States,* [2]*GE HealthCare, Aurora, OH, United States*

Keywords: RF Arrays & Systems, RF Arrays & Systems

Motivation: Conventional MRI coils offer suboptimal parallel imaging performance for young children.

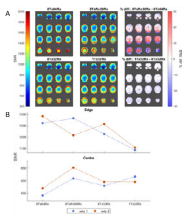
Goal(s): Our goal was to enhance imaging acceleration by dedicated flexible high-density coil design for pediatric patients at 3T.

Approach: We design, construct, and evaluate a highly flexible small element dense array constituted by dual turn loops with minimum inter-component interference layout design.

Results: Both phantom and in-vivo studies demonstrated superior parallel imaging performance using the proposed coil.

Impact: A dedicated high-channel count coil that allows highly localized coil sensitivities by minimum interference layout design may benefit small pediatric patients.

1036 17:09 Combining transceiver loops with a conventional receive array increases central SNR in brain imaging at 7T



Belinda Ding[1], Jiaruo Yan[2,3], Rosemary Woodward[4], Sarah Allwood-Spiers[4], Sydney Williams[2], Graeme A Keith[2], Paul McElhinney [2], Natasha Fullerton[4], David Porter[2], and Shajan Gunamony[2,3]

[1]Siemens Healthcare Limited, Camberley, United Kingdom, [2]Imaging Centre of Excellence, University of Glasgow, Glasgow, United Kingdom, [3]MR CoilTech Limited, Glasgow, United Kingdom, [4]NHS Greater Glasgow and Clyde, Glasgow, United Kingdom

Keywords: RF Arrays & Systems, Brain

Motivation: Previous studies have reported central SNR improvements at 7T with dipole transceivers, but not with loops-based arrays.

Goal(s): Assess the performance of an 8TxRx56Rx loop-based transceiver array against three conventional 8Tx32/64Rx arrays.

Approach: SNR and g-factor maps were acquired from phantom and healthy volunteers for four head coils (1Tx32Rx, 8Tx32Rx, 8Tx64Rx, 8TxRx56Rx) at 7T

Results: The modified 8TxRx56Rx coil showed a 12.6% increase in central SNR for in vivo scans. The peripheral SNR and g-factor maps remain comparable to their 8Tx64Rx counterpart, and both 64Rx coils performed significantly better than 32Rx coils at high acceleration factors.

Impact: A 56-channel receive 8-channel loop-based transceiver array can improve central image SNR at 7T without compromising g-factor compared to a conventional 64-channel receive 8-channel transmit coil.

1037 17:21 A 16-Channel Ankle Conformal Array Coil for Robot Assisted Dynamic Ankle Joint Imaging at 1.5T MRI

Matthäus Poniatowski[1], Ilan Elias[2,3], Mirsad Mahmutovic[1], Alexander M. König[4], Andreas H. Mahnken[4], and Boris Keil[1]

[1]Institute of Medical Physics and Radiation Protection, TH Mittelhessen University of Applied Sciences, Gießen, Germany, [2]Motionrad GmbH, Mainz, Germany, [3]Formerly Rothman Institute Department of Orthopaedics, Thomas Jefferson University Hospital, Philadelphia, PA, United States, [4]Diagnostic and Interventional Radiology, Philipps-University Marburg, Marburg, Germany

Keywords: RF Arrays & Systems, RF Arrays & Systems, MSK

Motivation: Many musculoskeletal disorders cannot be detected in static MRI, making surgical intervention necessary.

Goal(s): Our Goal was to enable motion controlled dynamic MRI to potentially add diagnostic findings and reduce surgical interventions.

Approach: We advanced our apparatus for controlled passive movement of the foot (Robotic Motion Device) and implemented an adapted 16-channel Ankle Coil for accelerated imaging.

Results: Combining the Robotic Motion Device and the 16-channel Ankle Coil allowed us to perform controlled passive foot movement and acquire high SNR images.

Impact: The combination of a Robotic Motion Device and an adapted 16-channel Ankle Coil enables dynamic image acquisition with controlled passive movement of the ankle joint, potentially adding and improving diagnostic findings and reducing surgical interventions.

17:33 Discussion

Irena Zivkovic

Eindhoven University of Technology, Netherlands

Oral

Novel Contrast Agents & Innovative Modellings

Room 331-332 | Wednesday 15:45 - 17:45 | *Moderators:* Celia Martinez de la Torre

15:45 Introduction

Celia Martinez de la Torre

Memorial Sloan Kettering Cancer Center, New York, NY, United States

1038 15:57

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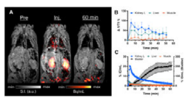

A Novel PET/MRI Hybrid Probe enables Non-invasive Imaging of Perfusion and Excretion in vivo

Remy Chiaffarelli[1,2], Jan Kretschmer[1,2], Jonathan Cotton[1,2], Miloslav Polasek[3], and André Martins[1,2,4]

[1]Werner Siemens Imaging Center, University Hospital Tuebingen, Tuebingen, Germany, [2]Cluster of Excellence iFIT (EXC 2180) "Image-Guided and Functionally Instructed Tumor Therapies", University of Tuebingen, Tuebingen, Germany, [3]Institute of Organic Chemistry and Biochemistry of the CAS, Prague, Czech Republic, [4]German Cancer Consortium (DKTK), partner site Tübingen, German Cancer Research Center (DKFZ), Heidelberg, Germany

Keywords: Contrast Agents, PET/MR, Perfusion Kidney Gadolinium

Motivation: Our work is driven by the conviction that the integration of PET and MRI in molecular imaging has the potential to revolutionize diagnostic precision and patient care.

Goal(s): Enhance precision molecular imaging through the development of a unique hybrid PET/MRI perfusion probe, **[^{18}F][Gd(FL^{1})]**.

Approach: Develop a PET/MRI probe, **[^{18}F][Gd(FL^{1})]**, that is exceptionally stable, rapidly synthesized, efficiently radiolabeled, and allows simultaneous PET/MR imaging, focusing on tissue perfusion and renal filtration in preclinical models.

Results: After achieving high-yield radiosynthesis with a unique approach, our dual-modality probe showed consistent signals in both imaging modalities and was reliably quantified thanks to the combination of PET and MRI.

Impact: The first-of-its-kind hybrid PET/MR probe **[^{18}F][Gd(FL^{1})]** can be readily and efficiently radio-synthetized and allows simultaneous PET/MR quantitative measurement of perfusion and excretion. This probe opens the path for quantifying molecular imaging probes in research and clinical practice.

1039 16:09

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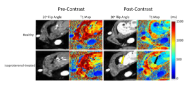


Non-invasive magnetic resonance imaging agent for in-vivo detection of cardiac fibrosis.

Kyle David William Vollett[1,2], Anlan Hong[1,2], and Hai-Ling Margaret Cheng[1,2,3]

[1]Biomedical Engineering, University of Toronto, Toronto, ON, Canada, [2]Ted Rogers Centre for Heart Research, University of Toronto, Toronto, ON, Canada, [3]Electrical and Computer Engineering, University of Toronto, Toronto, ON, Canada

Keywords: Contrast Agents, Molecular Imaging, fibrosis, myocardium, hypertension, diabetes

Motivation: Fibrosis is a progressive pathological process that contributes to 45% of deaths worldwide and is associated with the accumulation of collagen and the destruction of tissue architecture. While progression of fibrosis is often slow, early detection is difficult, leading to intervention at late stage when transplant may be the only option.

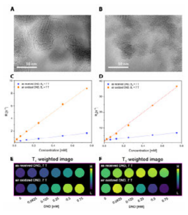
Goal(s): Establish a targeted MRI contrast agent for detecting early fibrosis.

Approach: Validation of agent sensitivity in-vivo with isoproterenol-induced heart fibrosis in a mouse model.

Results: Our novel fibrosis agent surpassed the sensitivity and specificity of Gd contrast enhanced T_1 mapping for detecting mild cardiac fibrosis.

Impact: This project sets out to create a new, hitherto inaccessible window on fibrogenesis, providing a new paradigm for diagnosing patients with fibrosis and the study of anti-fibrosis intervention before fibrosis becomes extensive and irreversible.

1040 16:21 Nanodiamonds as a novel T1-contrast agent for MRI



Jelena Lazovic[1] and Metin Sitti[1]

[1]*Intelligent Systems, Max Planck Institute, Stuttgart, Germany*

Keywords: Novel Contrast Mechanisms, Contrast Agent, nanodiamonds, cell labeling

Motivation: The structural defects in diamond particles, are known for their paramagnetic properties. Here we aim to determine if the presence of paramagnetic centers in detonation nanodiamonds particles can be exploited to enhance longitudinal relaxation time (T_1).

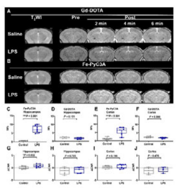
Goal(s): Introduce nanodiamonds as a novel T_1-contrast agent and contrast differences with gadolinium chelates.

Approach: Using high-field, 7 T MRI, longitudinal and transverse relaxation rates were measured and compared between detonation and air-oxidized detonation nanodiamonds. *In-vivo* demonstration was carried out using chicken embryos.

Results: Air-oxidized detonation nanodiamonds have superior longitudinal and transverse relaxivity compared to detonation nanodiamonds. We demonstrate their potential as an alternative, gadolinium-free T_1-contrast agent.

Impact: Nanodiamonds hold great promise for biomedical applications mostly due to their biocompatibility, non-toxicity and versatile functionalization. A possibility for direct visualization by means of T_1-weighted MRI is opening new venues for tracking over time without a concern for Gd^{3+}-toxicity.

1041 16:33 Molecular MRI of neuroinflammation using a redox-active iron complex



Chunxiang Zhang[1,2], Can Zhang[3], Eric M. Gale[1], and Iris Y. Zhou[1]

[1]*Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital/Harvard Medical School, Charlestown, MA, United States,* [2]*Department of Radiology, The Third Affiliated Hospital of Zhengzhou University, Zhengzhou, China,* [3]*Genetics and Aging Research Unit, McCance Center for Brain Health, Mass General Institute for Neurodegenerative Diseases (MIND), Department of Neurology, Massachusetts General Hospital/Harvard Medical School, Charlestown, MA, United States*

Keywords: Contrast Agents, Contrast Agent, Neuroinflammation

Motivation: Neuroinflammation is a critical pathophysiological process implicated in the development of neurodegenerative disorders. _

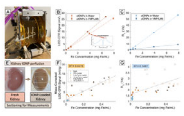
Goal(s): Imaging to detect, monitor, and surveil neuroinflammatory processes could profoundly improve how patients suffering neurodegenerative diseases are diagnosed and managed.

Approach: We evaluated brain imaging with the oxidatively activated contrast agent, Fe-PyC3A, as a proxy for inflammatory microglial activity in a mouse model of lipopolysaccharide(LPS)-induced neuroinflammation.

Results: Fe-PyC3A generated significantly greater enhancement in LPS-treated mice than in saline-treated controls, correlating with immunohistochemical quantification of microglial activation. Imaging using Gd-DOTA as negative control probe and NOX-2 deficient mice as loss of function control links Fe-PyC3A enhancement with reactive microglial activity.

Impact: MRI using oxidatively activated probes as a potential marker to detect and quantify neuroinflammatory processes could profoundly improve how patients suffering neurodegenerative diseases are diagnosed and managed.

1042 16:45



T1 relaxometry or EPR signal intensity – Which is best for quantifying iron oxide nanoparticles in tissues non-destructively?

Saurin Kantesaria[1], Xueyan Tang[1], Steven Suddarth[1], Jacqueline Pasek-Allen[1], Bat-Erdene Namsrai[1], Arjun Goswitz[1], Mikaela Hintz[1], John Bischof[1], and Michael Garwood[1]

[1]University of Minnesota, Minneapolis, MN, United States

Keywords: Electron Paramagnetic Resonance, Electron Paramagnetic Resonance, iron oxide nanoparticles, T1 relaxometry

Motivation: Currently there is no low-cost method to nondestructively quantify iron oxide nanoparticles (IONPs) in tissue across a wide concentration range (0.05-100 mg Fe/mL).

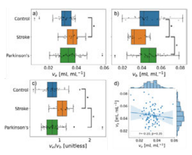
Goal(s): Our lab has developed a low-cost, LOngitudinally Detected Electron Paramagnetic Resonance (LOD-EPR) system. This work aims to evaluate LOD-EPR IONP quantification accuracy.

Approach: We compare IONP Fe quantification accuracy of R_1 ($=1/T_1$) from MR relaxometry versus LOD-EPR signal in solution and IONP-perfused rat kidney sections used in cryopreservation.

Results: LOD-EPR signal vs Fe concentration is linear in 0.05-10 mg Fe/mL IONP solutions and in IONP-perfused tissue, whereas R_1 vs Fe concentration is linear in solution but not in tissue.

Impact: Accurate quantification of IONPs in tissues at room temperature can be done using low-cost, benchtop LOD-EPR. Our primary application is in IONP rewarming of cryopreserved organs, however other applications such as dosimetry and oxygen sensing should also be possible.

1043 16:57



Validating DCE-MRI estimates of leakage volumes associated with subtle blood-brain barrier dysfunction using two-photon microscopy.

Martin Kozár[1,2], Sarah Al-Bachari[3], Laura Parkes[2,4], Hervé Boutin[5,6], Ingo Schiessl[2,6], and Ben R Dickie[1,2]

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Keywords: Contrast Agents, DSC & DCE Perfusion

Motivation: DCE-MRI can be used to quantify subtle blood-brain barrier disruption. In this setting, it is generally assumed that contrast agent has access to the entire interstitial space. Prior work from our group indicates that contrast agent has access to a leakage volume much smaller than the interstitial space.

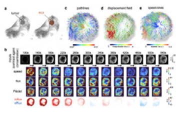
Goal(s): To provide independent validation of DCE-MRI leakage-to-vessel volume ratios (v_e/v_b) in the case of subtle BBB impairment.

Approach: The v_e/v_b ratio of Sulphorhodamine-101 (MW = 606.7g/mol) was measured in mouse brain using two-photon microscopy and compared to DCE-MRI estimates.

Results: The v_e/v_b ratio of sulphorhodamine-101 agrees well with DCE-MRI estimates.

Impact: Our results indicate that DCE-MRI kinetic models that assume infinite leakage volume (e.g. Patlak model) do not accurately reflect how Gd-DOTA distributes within the brain when BBB impairment is subtle.

1044 17:09 A novel mathematical model to quantify tumor fluid properties on longitudinal breast DCE-MRI for neoadjuvant chemotherapy response assessment



Xinan Chen[1], Wei Huang[2], Amita Shukla-Dave[1,3], Ramesh Paudyal[1], Allen Tannenbaum[4], and Joseph Deasy[1]

[1]Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Advanced Imaging Research Center, Oregon Health & Science University, Portland, OR, United States, [3]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]Applied Mathematics & Statistics and Computer Science, Stony Brook University, Stony Brook, NY, United States

Keywords: Contrast Agents, Perfusion, Modelling, Tumors, Biomarkers, Quantitative Imaging

Motivation: To advance the field of pharmacokinetic analysis of breast DCE-MRI by developing a model accounting for inter-fluid transport within tumor tissue

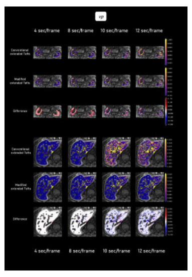
Goal(s): To develop a novel DCE-MRI pharmacokinetic method to quantify and visualize fluid flows in tumors and identify predictive imaging biomarkers of therapeutic response to neoadjuvant chemotherapy (NACT) in breast cancer.

Approach: We developed a mathematical model in computational fluid dynamics termed the unbalanced regularized optimal mass transport (urOMT)

Results: Our urOMT model provides fluid transport properties of the tumor using breast DCE-MRI; the urOMT-derived quantitative metrics may be future predictive imaging biomarkers to measure treatment effectiveness in patients treated with NACT.

Impact: We developed a novel mathematical model to quantify, track, and visualize fluid flows in tumors with breast DCE-MRI data. The proposed quantitative metrics after validation may serve as predictive imaging biomarkers for breast cancer patients treated with neoadjuvant chemotherapy.

1045 17:21 A correction for modeling of radial, spiral, and PROPELLOR DCE data: time-averaged extended Tofts



Natalia V Korobova[1], Marian A Troelstra[1], and Oliver J Gurney-Champion[1]

[1]Radiology and Nuclear Medicine, Amsterdam University Medical Centers, Amsterdam, Netherlands

Keywords: Contrast Agents, DSC & DCE Perfusion, Perfusion, Pharmacokinetics, Body, Liver, DCE, Diagnosis

Motivation: Accurate quantification of pharmacokinetic parameters in dynamic contrast-enhanced (DCE) MRI requires high temporal resolution, often reached through non-cartesian sampling patterns that oversample the center of k-space (e.g. radial, spiral, PROPELLOR). In pharmacokinetic models, image contrast is assumed to be formed instantly at discrete time-points. However, in acquisitions oversampling the k-space center, the signal per time-frame becomes an average over acquisition time.

Goal(s): To correct for the time-averaged signals.

Approach: We proposed a modification to DCE modeling and tested it in simulations and in-vivo.

Results: Modern sampling patterns predominantly affect the pharmacokinetic parameter estimates for longer sampling times (>8s) per DCE frame.

Impact: We verified that for short acquisitions per frame (<8s) per DCE-frame, conventional Toft's modeling is sufficient. However, for longer sampling times (>8s) per DCE frame, our time-averaged extended Toft's model is needed for accurate estimations of pharmacokinetic parameters.

17:33 Discussion

Celia Martinez de la Torre

Memorial Sloan Kettering Cancer Center, New York, NY, United States

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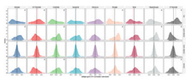
Oral

Neuroinflammation: Follow-Up from 2023 Clinical Focus Meeting

Room 334-336 | Wednesday 15:45 - 17:45 | *Moderators:* Anja van der Kolk & Nina Salman

1046 15:45



Distinct virtual histology of gray matter atrophy in neuroinflammatory diseases

Jun Sun[1], Yuerong Lizhu[1], Min Guo[1], Siyao Xu[1], Xianchang Zhang[2], Zhizheng Zhuo[1], and Yaou Liu[1]

[1]Capital Medical Universtiy, Beijing Tiantan Hospital, Beijing, China, [2]MR Research Collaboration, Siemens Healthineers Ltd., Beijing, China

Keywords: Neuroinflammation, Neuroinflammation, virtual histology

Motivation: Gray matter (GM) atrophied early in multiple sclerosis (MS), anti-aquaporin-4 antibody-positive [AQP4+] / -negative [AQP4-] neuromyelitis optica spectrum disorder (NMOSD), and myelin oligodendrocyte glycoprotein antibody-associated disease (MOGAD). Their neurobiological underpinnings have not been clarified.

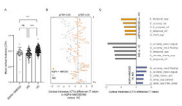
Goal(s): The purpose was to explore their GM atrophy-associated histology using a multicenter cohort.

Approach: 324 MS, 197 AQP4+ NMOSD, 75 AQP4- NMOSD, 47 MOGAD, and 2,169 healthy controls (HCs) were examined by virtual histology method.

Results: The unique virtual histology was glial cells for MS, astrocytes for AQP4+ NMOSD and oligodendrocytes for MOGAD. The neuronal and endothelial cells were shared potential targets.

Impact: It might help to optimize therapy.

1047 15:57



Identification of transcriptomic signatures associated with cortical thinning in neuromyelitis optica spectrum disorder

Min Guo[1], Zhizheng Zhuo[1], Minghao Wu[1], Jun Sun[1], Yu-Xin Yang[2], Yunyun Duan[1], and Yaou Liu[1]

[1]Department of Radiology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China, [2]United Imaging Research Institute of Intelligent Imaging, Beijing, China

Keywords: Neuroinflammation, Genetics

Motivation: Determining the potential transcriptomic signatures driving cortical thinning in neuromyelitis optica spectrum disorder (NMOSD) and multiple sclerosis (MS).

Goal(s): To compare the cortical atrophy patterns and the underlying molecular mechanisms between NMOSD and MS.

Approach: A partial least squares (PLS) regression model was used to associate the CTh alteration profile with the expression of genes from the Allen Human Brain Atlas (AHBA) database, then Metascape analysis was performed to identify the functional biological processes.

Results: Distinct cortical atrophy patterns and underlying cell signaling pathways were observed in NMOSD and MS.

Impact: The distinct cortical atrophy patterns will help in differential diagnosis of NOMOSD and MS. The identified genes and signaling pathways will help understand the pathological mechanism of both diseases and provide potential therapeutic targets.

1048 16:09

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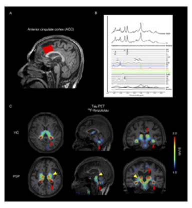


[In vivo assessment of astrocyte reactivity in patients with progressive supranuclear palsy]

Kosei Hirata[1,2], Kiwamu Matsuoka[1], Kenji Tagai[1], Hironobu Endo[1], Harutsugu Tatebe[1], Maiko Ono[1], Naomi Kokubo[1], Yuko Kataoka[1], Asaka Oyama[1], Hitoshi Shinoto[1], Keisuke Takahata[1], Takayuki Obata[1], Masoumeh Dehghani[3], Jamie Near[3,4], Kazunari Kawamura[1], Ming-Rong Zhang[1], Hitoshi Shimada[1,5], Hiroshi Shimizu[5], Hiroshi Shimizu[5], Takanori Yokota[2], Takahiko Tokuda[1], Makoto Higuchi[1], and Yuhei Takado[1]

[1]National Institutes for Quantum Science and Technology, Chiba, Japan, [2]Tokyo Medical and Dental University, Tokyo, Japan, [3]Sunnybrook Research Institute, Tronto, ON, Canada, [4]University of Toronto, Tronto, ON, Canada, [5]Niigata University, Niigata, Japan

Keywords: Dementia, Neuro, magnetic resonance spectroscopy, progressive supranuclear palsy, astrocyte reactivity

Motivation: Although astrocytic pathology is a pathological hallmark of progressive supranuclear palsy (PSP), the role of astrocytes in the pathophysiology of PSP is not fully understood.

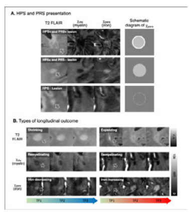
Goal(s): This study aimed to evaluate astrocyte reactivity *in vivo* in patients with PSP.

Approach: Astrocyte reactivity was assessed by magnetic resonance spectroscopy and plasma biomarkers, which were verified via tau-PET and histopathological analysis.

Results: Our results suggest that, in the anterior cingulate cortex, astrocyte reactivity precedes pronounced tau deposition and neurodegenerative processes and modulates brain function in PSP. Elevated myo-inositol was associated with high lactate levels, suggesting a link between reactive astrocytes and brain energy metabolism changes.

Impact: This study assessed astrocyte reactivity *in vivo* using magnetic resonance spectroscopy and plasma biomarkers, providing insights into the involvement of astrocytes in the pathogenesis of progressive supranuclear palsy.

1049 16:21



[Association of Iron Deposition in Early-Stage Multiple Sclerosis Lesion with Remyelination Capacity: chi-separation imaging study]

Hyeong-Geol Shin[1,2], Woojun Kim[3], Hyun-soo Lee[4], Jiwoong Kim[5], Yoonho Nam[6], Xu Li[1,2], Peter van Zijl[1,2], Jongho Lee[7], and Jinhee Jang[8]

[1]Radiology, Johns Hopkins University, Baltimore, MD, United States, [2]Kennedy Krieger Institute, Baltimore, MD, United States, [3]Neurology, Seoul St. Mary's Hospital, Seoul, Korea, Republic of, [4]Siemens Healthineers, Seoul, Korea, Republic of, [5]Mathematics and Statistics, University of South Florida, Tampa, FL, United States, [6]Biomedical Engineering, Hankuk University of Foreign Studies, Yongin, Korea, Republic of, [7]Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of, [8]Radiology, Seoul St. Mary's Hospital, Seoul, Korea, Republic of

Keywords: Multiple Sclerosis, Multiple Sclerosis, χ-separation

Motivation: In multiple sclerosis (MS) lesion, factors influencing myelin dynamics and future remyelination are under active investigation.

Goal(s): To assess dynamic changes of MS lesions from their early stage and explore the factors related to their future remyelination outcomes.

Approach: Longitudinal changes of MRI phenotypes in MS lesions were assessed from their early stage, particularly focusing on longitudinal alternations in diamagnetic myelin and paramagnetic iron signals using susceptibility source-separation (chi[χ]-separation).

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Results: 26 lesions show remyelination and 36 did not. The hyperintensity in paramagnetic iron signal (hyper-paramagnetic sign, HPS) at early stage of lesion development was significantly associated to future remyelination.

Impact: Iron deposition sign in early-stage MS lesion, which detected by added sensitivity of χ-separation to iron and myelin, can offer potential imaging marker for the impaired remyelination capability in MS pathology.

1050

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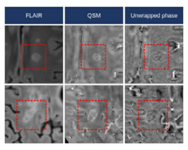
16:33



Multiparametric Quantitative MRI Shows Enhanced Degeneration in Paramagnetic Rim Lesions and Their Perilesional Tissue in Multiple Sclerosis

Alessandro Cagol[1,2,3,4], Mario Ocampo-Pineda[1,2,3], Batuhan Ayci[1,5], Pascal Benkert[6], Po-Jui Lu[1,2,3], Matthias Weigel[1,2,3,7], Lester Melie-Garcia[1,2,3], Xinjie Chen[1,2,3], Antoine Lutti[8], Thanh D. Nguyen[9], Yi Wang[9], Jongho Lee[10], Jens Kuhle[2,3], Ludwig Kappos[1,2,3], Maria Pia Sormani[4], and Cristina Granziera[1,2,3]

[1]Translational Imaging in Neurology (ThINk) Basel, Department of Biomedical Engineering, University Hospital Basel and University of Basel, Basel, Switzerland, [2]Department of Neurology, University Hospital Basel, Basel, Switzerland, [3]Research Center for Clinical Neuroimmunology and Neuroscience Basel (RC2NB), University Hospital Basel and University of Basel, Basel, Switzerland, [4]Department of Health Sciences, University of Genova, Genova, Italy, [5]Cerrahpasa Medical School, Istanbul University-Cerrahpasa, Istanbul, Turkey, [6]Department of Clinical Research, University Hospital Basel, University of Basel, Basel, Switzerland, [7]Division of Radiological Physics, Department of Radiology, University Hospital Basel, Basel, Switzerland, [8]Laboratory for Research in Neuroimaging, Department of Clinical Neuroscience, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland, [9]Department of Radiology, Weill Cornell Medical College, New York, NY, United States, [10]Laboratory for Imaging Science and Technology, Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of

Keywords: Multiple Sclerosis, Multiple Sclerosis, Paramagnetic rim lesions; quantitative MRI

Motivation: Paramagnetic rim lesions (PRLs), a subset of chronic active lesions identifiable through susceptibility-based imaging, are linked to insidious disease progression in multiple sclerosis (MS). However, data on local microstructural changes in PRLs remain limited.

Goal(s): To comprehensively characterize pathological alterations within PRLs and the surrounding perilesional tissue.

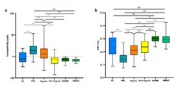
Approach: Employing multiparametric quantitative 3T MRI on 175 people with MS, we obtained contrasts sensitive to tissue microstructural damage.

Results: PRLs exhibited more pronounced pathological alterations compared to other white matter lesions, displaying enhanced demyelination, neuro-axonal loss, and iron accumulation. Remarkably, these alterations extended into the perilesional tissue appearing normal on conventional MRI.

Impact: In people with multiple sclerosis, paramagnetic rim lesions (PRLs) exhibit pronounced microstructural quantitative MRI alterations. This strengthens PRLs as reliable biomarkers for lesions with smoldering degenerative activity, and offers potential insights into their association with a more severe disease course.

1051

16:45



The changes of oxygen extraction fraction in different types of lesions in multiple sclerosis: A cross-sectional and follow-up study

Yan Xie[1] and Wenzhen Zhu[1]

[1]Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

Keywords: Multiple Sclerosis, Multiple Sclerosis

Motivation: Multiple sclerosis (MS) lesions with different pathologic conditions could be distinguished by MRI. There may be differences in oxygen metabolism in different types of lesions.

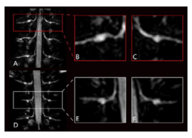
Goal(s): To explore the oxygen metabolism of different types of lesions in MS patients by oxygen extraction fraction (OEF) both cross-sectionally and longitudinally.

Approach: The OEF map was reconstructed from a 3D multi-echo gradient echo scan. White matter lesions were classified into four types based on contrast-enhanced T1WI and quantitative susceptibility mapping.

Results: There were differences in OEF among different types of MS lesions. The OEF in the lesion and the lesion type may change as time progresses.

Impact: This study revealed tissue damage and oxygen metabolism level in different types of MS lesions. The OEF may contribute to further understanding of the pathological mechanisms in MS lesion evolution.

1052 16:57



Postherpetic Neuralgia and Morphological Alterations in the Human Dorsal Root Ganglia: A Study Using 3T MR Neurography

Dejun She[1], Yalan Yan[1], Xiance Zhao[2], and Dairong Cao[1]

[1]The First Affiliated Hospital of Fujian Medical University, Fuzhou, China, [2]Philips Healthcare, Shanghai, China, Shanghai, China

Keywords: Neuroinflammation, Neuroinflammation

Motivation: Despite the crucial role of imaging in localizing lesions, excluding causes, and guiding surgery, there remains a paucity of reports pertaining to the radiological manifestations in patients with herpetic neuralgia.

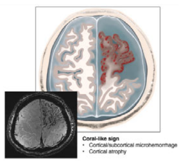
Goal(s): To investigate the correlation between the volume and T2 signal intensity (SI) of the ganglia in 3T MRN with clinical and serological parameters in herpetic neuralgia patients.

Approach: With 18 patients examined by MRN. Volume, T2 signal measurements of the T1-T12 ganglia were performed manually for each patient.

Results: The changes in ganglion volume observed on MRN may reflect disease progression. Among all serological indicators, ESR was correlated with the volume ratio.

Impact: This study is the first to quantify ganglia in herpetic neuralgia patients, and the first to investigate the correlation between ganglia volume and serological data. In herpetic neuralgia patients, these MRN findings will contribute to the diagnosis and management.

1053 17:09



Cortical Microhemorrhage Presentation of Small Vessel Primary Angiitis of the Central Nervous System

Ai Guo[1], Zhe Zhang[1], Ge-Hong Dong[1], Yuan Li[2], Lei Su[3], Chenyang Gao[3], Mengting Zhang[1], Xiaoyu Shi[1], Huabing Wang[1], Xinghu Zhang[1], De-Hong Lu[1], Ying Fu[4], Jing Jing[1], Fu-Dong Shi[1], and De-cai Tian[1]

[1]Beijing Tiantan Hospital, Beijing, China, [2]MR research collaboration team, siemens healthineers, Beijing, China, [3]Tianjin General Hospital, Tianjin, China, [4]The First Affiliated Hospital of Fujian Medical University, Fuzhou, China

Keywords: Neuroinflammation, Neuroinflammation

Motivation: PACNS entails a biopsy for diagnosis, but only with an intermediate sensitivity. It is necessary to revisit PACNS with advanced imaging technique to provide a non-invasive diagnostic standard.

Goal(s): We aim to find more pathological details with enough sensitivity and specificity to provide potential biomarkers for PACNS.

Approach: 21 patients with small-vessel PACNS were included in this study. T1-MPRAGE, T2 T2*W, and SWI images were collected.

Results: Our study highlighted the image features of patients with small-vessel PACNS with coral-like signs through 7T MRI. Due to the small patient cohort, no specific clinical differences between hemorrhagic and non-hemorrhagic patients were found.

Impact: The signal characteristics of the coral-like sign represent cerebral cortical microhemorrhages with atrophy, which could be an important MRI pattern of small-vessel PACNS.

1054 17:21

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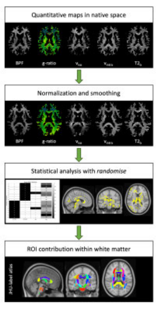


<u>COVID-19-related anosmia is driven by inflammation and myelin alterations as shown by Voxel Based Analysis</u>

Eleonora Lupi[1], Marta Gaviraghi[1], Elena Grosso[1], Anita Monteverdi[2], Marco Battiston[3], Francesco Grussu[3,4], Baris Kanber[3,5], Ferran Prados Carrasco[3,5,6], Janine Makaronidis[7,8], Rebecca S Samson[3], Marios C Yiannakas[3], Egidio D'Angelo[1,2], Fulvia Palesi[1,2], and Claudia A. M. Gandini Wheeler-Kingshott[1,2,3]

[1]Department of Brain & Behavioral Sciences, University of Pavia, Pavia, Italy, [2]Digital Neuroscience Centre, IRCCS Mondino Foundation, Pavia, Italy, [3]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [4]Radiomics Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [5]Department of Medical Physics and Biomedical Engineering, Centre for Medical Image Computing (CMIC), University College London, London, United Kingdom, [6]E-Health Center, Universitat Oberta de Catalunya, Barcelona, Spain, [7]Centre for Obesity Research, Department of Medicine, University College London, London, United Kingdom, [8]National Institute of Health Research, UCLH Biomedical Research Centre, London, United Kingdom

Keywords: White Matter, COVID-19, Neuroinflammation, Voxel Based Analysis, g-ratio

Motivation: Voxel Based Analysis (VBA) can be a powerful tool to detect localized alterations.

Goal(s): Here VBA was used to understand the underpinnings of COVID-19-related anosmia.

Approach: Quantitative magnetization transfer and diffusion-weighted imaging derived maps were used to detect pathological changes affecting white matter structures.

Results: Microstructural differences were detected between healthy controls and subjects experiencing anosmia or those who recovered from it. Results highlighted the presence of widespread inflammation in persistent anosmia subjects, with myelin damage and possible repair in those who recovered. Myelin alterations involved the olfactory circuit, as well as other brain regions, providing insights into possible mechanisms of COVID-19-related anosmia.

Impact: Voxel Based Analysis is a powerful tool to highlight local tissue disruption linked to neuroinflammatory processes. Here VBA provided an insight into microstructure and myelin changes associated to COVID-19-related persistent or recovered anosmia symptoms.

17:33 Discussion

Anja van der Kolk

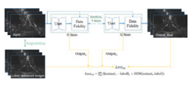
Radboudumc Nijmegen, Netherlands

Oral

Striking a Cord: Neuroimaging of the Spine & Nerves

Summit 2 | Wednesday 15:45 - 17:45 | *Moderators:* Ann Choe & Virginie Callot

1055 15:45



<u>A Potential Substitution for Gadolinium in Brachial Plexus Magnetic Resonance Neurography: Deep Learning-Based Virtual Enhancement.</u>

Weiqiang Liang[1], Yi Li[2], Guangliang Ju[3], Xiaoyun Liang[2], and Jing Zhang[1]

[1]Department of Radiology, Department of Radiology,Tongji Hospital, Tongji Medical College, HUST, Wuhan, China, Wuhan, China, [2]Institute of Research and Clinical Innovations, Neusoft Medical Systems Co., Ltd, Shanghai, China, Shanghai, China, [3]Smart Imaging Software R&D Center, Neusoft Medical Systems Co., Ltd, Shenyang, China, Shenyang, China

Keywords: Peripheral Nerves, Neurography

Motivation: Contrast-enhanced Magnetic Resonance Neurography (MRN) improves visualization of brachial plexus, but gadolinium risks limit clinical use. To reduce reliance on gadolinium contrast in brachial plexus (BP) MRN, we explore deep learning's potential for virtual enhancement.

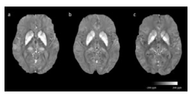
Goal(s): To investigate the feasibility of virtually enhancing brachial plexus MRN without gadolinium.

Approach: An image enhancement network based on 2.5D U-Net was trained to generate virtually enhanced BP images from non-enhancement BP images, achieving high image quality and nerve visualization.

Results: The virtual enhancement BP images showed comparable vascular suppression and image quality to gadolinium-enhanced images, demonstrating the potential for gadolinium substitution in brachial plexus MRN.

Impact: This work opens the door to safer and more accessible BP MRN by reducing reliance on gadolinium. It may lead to broader clinical adoption and facilitate research on non-contrast imaging methods, benefiting both clinicians and patients.

1056 15:57 [Increased brain iron deposition in the basal ganglia is associated with cognitive and motor dysfunction in type 2 diabetes]



Chaofan Sui[1], Meng Li[2], Qihao Zhang[3], Jing Li[4], Yian Gao[1], Xinyue Zhang[1], Na Wang[1], Changhu Liang[1], and Lingfei Guo[1]

[1]Department of Radiology, Shandong Provincial Hospital Affiliated to Shandong First Medical University, Jinan, China, [2]Department of Psychiatry and Psychotherapy, Jena University Hospital; Center for Intervention and Research on adaptive and maladaptive brain Circuits underlying mental health (C-I-R-C)., Jena, Germany, [3]Department of Radiology, Weill Cornell Medical College, New York, NY, United States, [4]Department of Radiology, Beijing Tsinghua Changgung Hospital, Beijing, China

Keywords: Peripheral Nerves, Neurodegeneration, quantitative susceptibility mapping, type 2 diabetes, diabetic peripheral neuropathy, motor dysfunction

Motivation: Diabetes is thought to be related to an imbalance in iron homeostasis and abnormal iron accumulation.

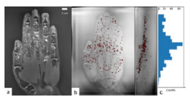
Goal(s): To explore the changing mode of brain iron metabolism in basal ganglia in type 2 diabetes (T2DM) patients with diabetic peripheral neuropathy (DPN) and diabetes without DPN (NDPN) using quantitative susceptibility mapping (QSM).

Approach: Brain iron of T2DM was assessed using QSM.

Results: Susceptibilities in the putamen and the caudate nucleus were higher in T2DM than in healthy controls, while there was no significant difference between the DPN and NDPN groups. Susceptibility of the putamen negatively correlated with moto- and cognitive function in T2DM.

Impact: Iron-based susceptibility in the putamen, measured by QSM, can reflect the motor function in patients with type 2 diabetes, and might hint micro pathological changes in brain tissue in patients with type 2 diabetes.

1057 16:09 [High-resolution mapping of hand innervation: novel approaches at 7T MRI]



Pauline Coralie Guillemin[1], David Ferreira Branco[2], Yacine M'Rad[1], Loan Mattera[3], Orane Lorton[1], Pierre-Alexandre Poletti[2], Gian-Franco Piredda[4,5], Antoine Klausser[4,5], Roberto Martuzzi[3], Rares Salomir[2], and Sana Boudabbous[2]

[1]Image guided Interventions Laboratory (949), Faculty of Medicine, University of Geneva, Geneva, Switzerland, [2]Radiology Department, University Hospitals of Geneva, Geneva, Switzerland, [3]Fondation Campus Biotech Geneva, Geneva, Switzerland, [4]Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland, [5]CIBM Centre for Biomedical Imaging, Geneva, Switzerland

Keywords: Peripheral Nerves, Nerves, Pacinian corpuscles

Motivation: Exploit the high resolution provided by the 7T MRI technology to detect fine structures in the hand.

Goal(s): To create an atlas of hand structures, with a specific focus on nerves and Pacinian corpuscles. This atlas is intended to serve both diagnostic purposes and to support reconstructive surgical procedures.

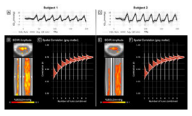
Approach: An ethics committee was obtained to scan volunteers using 7T MRI. Post-processing was carried out to delineate the nerve fiber network and mechanoreceptors.

Results: We successfully reconstruct and describe the anatomy of all nerve fibers from the carpus to the digital nerve division, as well as the Pacinian corpuscles, for three healthy volunteers.

Impact: A visual interactive “Hand Nerves Atlas” matching morphology and fiber tracking of hand nerves on high-field will be delivered to the scientific community for fundamental research, to clinicians for microscopic surgery of nerves, and for educational purposes in medical schools.

1058 16:21

MERIT AWARD
MAGNA CUM LAUDE



[Mapping spinal cord vascular reactivity and vascular territories using fMRI in highly sampled individuals]

Kimberly J. Hemmerling[1] and Molly G. Bright[1]

[1]*Northwestern University, Chicago, IL, United States*

Keywords: Spinal Cord, fMRI

Motivation: Impaired vascular function in the spinal cord contributes to numerous neurological pathologies and it is important to be able to image those changes in individuals.

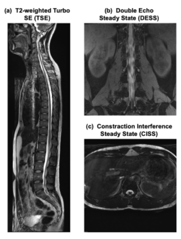
Goal(s): Map spinal cord vascular reactivity (SCVR) amplitude and hemodynamic delay at the individual level in two highly sampled adults.

Approach: Participants performed 18 spinal cord fMRI runs of a breath-holding task. SCVR amplitude was mapped using an end-tidal CO_2 regressor and hemodynamic delay was mapped by temporally shifting that regressor.

Results: Individual SCVR amplitude and hemodynamic delay maps reveal an earlier ventral response and later dorsal response, aligning with vascular territories of the cervical spinal cord.

Impact: Individual maps of spinal cord vascular reactivity (SCVR) hemodynamic delay align with arterial territories. These are the first non-invasive maps of vascular territories in the human spinal cord. Future work will map altered SCVR in patients with neurological conditions.

1059 16:33



[Personalized Lumbosacral Spinal Nerve Roots 3D Reconstruction and Computer Simulation for Spinal Cord Stimulation]

Yuxing Zhou[1], Jionghui Liu[1], Wenqi Zhang[2], Ying-Hua Chu[3], and Fumin Jia[1]

[1]*Institute of Science and Technology for Brain-Inspired Intelligence, Fudan University, Shanghai, China,* [2]*School of Information Science and Technology, Fudan University, Shanghai, China,* [3]*MR Research Collaboration Team, Siemens Healthineers Ltd., Shanghai, China*

Keywords: Spinal Cord, Spinal Cord, Spinal Cord Stimulation, Nerve Roots, 3D reconstrcution

Motivation: Spinal cord stimulation requires personalized 3D reconstructed model to address challenges arising from individual variability.

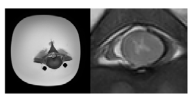
Goal(s): This study aims to image the entire spinal cord with lumbosacral nerve roots and propose a method for reconstructing a 3D model for simulation.

Approach: Three MRI sequences were collected for reconstruction and nerve roots annotation. Then the 3D spinal cord model was reconstructed using a custom interpolating algorithm guided by anatomical rules.

Results: A tailored imaging protocol and reconstruction method designed for the spinal cord and its nerve roots have been proposed, resulting in a 3D personalized spinal cord model.

Impact: The protocol offers an effective guide for researchers and clinicians conducting spinal cord and nerve roots imaging. Additionally, it enables the creation of personalized computational spine models with nerve roots and rootlets from MRI images, facilitating simulation studies.

1060 16:45



[High Resolution R1rho Dispersion Imaging in Swine Spinal Cord: A Specimen Study]

David B Wang[1], Katherine Li[2], Mitchell J Christiansen[3,4], Alan Rivera-Garcia[5], and Ping Wang[3,6]

[1]*Gilbert Classical Academy, Gilbert, AZ, United States,* [2]*Desert Vista High School, Phoenix, AZ, United States,* [3]*Neuroimaging Innovation Center, Barrow Neurological Institute, Phoenix, AZ, United States,* [4]*Creighton University School of Medicine, Phoenix, AZ, United States,* [5]*Arizona State University, Phoenix, AZ, United States,* [6]*Translational Neuroscience, Barrow Neurological Institute, Phoenix, AZ, United States*

Keywords: Spinal Cord, Relaxometry, T1rho dispersion

Motivation: R1rho imaging can provide novel information on dynamic processes within tissues, allowing for a more comprehensive analysis of the parameters of chemical exchange and/or intrinsic microstructure.

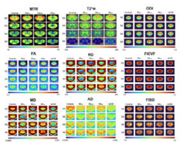
Goal(s): To examine the feasibility of R1rho imaging in spinal cord.

Approach: We performed high resolution R1rho imaging in the swine spinal cord of swine spine specimens.

Results: The results showed that the dispersion is measurable in both spinal white matter and gray matter, suggesting that R1rho dispersion may have potential to characterize the de/remyelination and nerve injuries/repairs in neurological disorders.

Impact: The study suggested that R1rho dispersion is measurable in spinal cord, which may have potential to characterize the de/remyelination and nerve injuries/repairs in spinal cord disorders.

1061 16:57 Parkinson’s disease in the spinal cord: an exploratory study to establish T2*w, MTR and diffusion-weighted imaging metric values



Samuelle St-Onge[1], Camille Coustaury[1], Caroline Landelle[2], Linda Solstrand Dahlberg[2], Ovidiu Lungu[2], Julien Doyon[2], and Benjamin De Leener[1,3,4]

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Keywords: Spinal Cord, Diffusion Tensor Imaging, MTR, NODDI, T2*w, Biomarkers

Motivation: Much remains unknown about the impact of Parkinson's disease on the central nervous system, particularly how it affects the spinal cord microstructure.

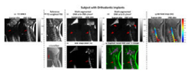
Goal(s): This exploratory study aims to establish DWI, MTR and T2*w metric values to explore potential morphometric alterations in the spinal cord related to Parkinson’s disease.

Approach: DWI, MTR and T2*w metrics were extracted from both Parkinson’s disease patients and healthy controls.

Results: Significant correlations were found in several regions of the spinal cord, particularly for ODI, FICVF and FA, suggesting the relevance of further studying these metrics in the spinal cord of Parkinson's disease patients.

Impact: This study is the first to establish values for MTR, T2* and DWI metrics in the spinal cord of a population with Parkinson’s disease, which could contribute to a better understanding of this disease in the central nervous system.

1062 17:09 Correcting Susceptibility artifacts with Unified RF/Shim Coil (UNIC) in Cervical Spine MRI for Subjects with and without Orthodontic Implants



Archana Vadiraj Malagi[1], Nader Binesh[2], Fardad Michael Serry[1], Jeremy Zepeda[1], Ziyang Long[1,3,4], Chia-Chi Yang[1], Li-Ting Huang[1], Yi Zhang[1], Hyunsuk Shim[5], Debiao Li[1], Hsin-Jung Yang[1], and Hui Han[4]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Imaging, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Department of Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States, [4]Department of Radiology, Weill Cornell Medical, New York, NY, United States, [5]Department of Radiation Oncology, Emory University School of Medicine, Atlanta, GA, United States

Keywords: Spinal Cord, Spinal Cord, B0 Shimming; Cervical spine; DWI; DTI

Motivation: Metallic orthodontic devices can introduce strong susceptibility artifacts that hinder clinical interpretation of cervical spine MRI.

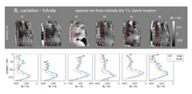
Goal(s): Using novel unified RF/shim coils (UNIC) to reduce field variation caused by metal susceptibility artifact.

Approach: Total of eighteen subjects (5 with braces) were scanned with a UNIC coil research prototype.

Results: The integrated UNIC shim array significantly increased the voxel percentage from 28% with scanner-shimming to 46% in DWI, reducing distortion by 61% with braces and 15% without braces in DWI, and by 41% in DTI. It also decreased B0 field variation by 63% with braces and 31% without.

Impact: Unified RF/shim coil delivered improved quality and corrected image distortions in cervical spine scans by mitigating magnetic field variation, including those from orthodontic braces, ensuring more accurate diffusion measurements and consistently reducing susceptibility artifacts.

1063 17:21



Investigating Respiration Induced B0 Field Variations in the Thoracic and Lumbar Spinal Cord at 7T

Christoph Stefan Aigner[1], Alexandre D'Astous[2,3], Sebastian Dietrich[1], Max Lutz[1], Eva Alonso-Ortiz[2,3], Julien Cohen-Adad[2,3,4,5], and Sebastian Schmitter[1,6,7]

[1]Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany, [2]NeuroPoly Lab, Institute of Biomedical Engineering, Polytechnique Montréal, Montreal, QC, Canada, [3]Centre de recherche du CHU Sainte-Justine, Université de Montréal, Montréal, QC, Canada, [4]Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montréal, QC, Canada, [5]Mila-Quebec AI Institute, Montréal, QC, Canada, [6]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [7]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

Keywords: Spinal Cord, High-Field MRI, 7 Tesla, Spinal Cord, B0 Shimming, Respiration Resolved

Motivation: Respiration-related B_0 variations and their modulation in the thoracolumbar spinal cord (SC) at 7T have not been thoroughly investigated. Knowing B_0 variations is crucial for assessing the potential of SC imaging.

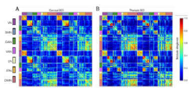
Goal(s): Quantification of B_0 variations in the thoracolumbar SC across different respiratory states and evaluation of the effectiveness of tailored B_0 shims in mitigating these variations.

Approach: Non-Cartesian respiration-resolved 3D B_0 field maps were acquired during free-breathing and employed for B_0 shimming using the SC Shimming Toolbox.

Results: Tailored B_0 shims reduce the B_0 variations to approximately 50Hz (standard deviation) across the thoracolumbar SC. Respiration introduces up to 40Hz of additional field-offset.

Impact: Our results quantify B_0 fluctuations in the thoracolumbar SC and show that customized B_0 shims effectively reduce these fluctuations to a standard deviation of around 50Hz. Further investigation of deep breathing is crucial for optimizing shim strategies in future uses.

1064 17:33



Impact of Spinal Cord Injury (SCI) level on Cortical Reorganization

Lukman E. Ismaila[1,2], Farzad V. Farahani[3], Cristina L. Sadowsky[4,5], Haris I. Sair[1,6], James J. Pekar[1,2], and Ann S. Choe[1,2]

[1]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, United States, [4]International Center for Spinal Cord Injury, Kennedy Krieger Institute, Baltimore, MD, United States, [5]Department of Physical Medicine and Rehabilitation, Johns Hopkins School of Medicine, Baltimore, MD, United States, [6]The Malone Center for Engineering in Healthcare, Whiting School of Engineering, Johns Hopkins University, Baltimore, MD, United States

Keywords: Spinal Cord, Brain Connectivity, Spinal Cord, Graph Theory

Motivation: We aimed to fill the knowledge gap regarding the impact of spinal cord injury (SCI) level on cortical reorganization.

Goal(s): We sought to investigate cortical reorganization patterns in chronic SCI patients, specifically differentiating between cervical and thoracic injuries.

Approach: Employing graph theory analysis of functional connectivity, we analyzed data from 32 chronic SCI patients and 32 healthy controls.

Results: Significant alterations in somatomotor and visual networks in SCI cohort was observed. Notably, those with thoracic injuries exhibited more pronounced functional segregation within the somatomotor network, dividing it into dorsolateral and paramedian SMN regions and a ventrolateral SMN region.

Impact: Our findings on the influence of SCI level on brain reorganization may impact clinicians, researchers, and rehabilitation specialists, guiding tailored interventions and raising new questions about optimizing SCI recovery.

Power Pitch

Pitch: Image Reconstruction

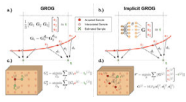
Power Pitch Theatre 1

Wednesday
Pitches: 15:45 - 16:45
Posters: 16:45 - 17:45

Moderators: Julia Velikina & Yihang Zhou

(no CME credit)

1065 Pitch: 15:45 Poster: 16:45 Screen 1



Implicit Neural Representations of GRAPPA Kernels for Rapid Non-Cartesian and Time-Segmented Reconstructions

Daniel Abraham[1], Mark Nishimura[1], Xiaozhi Cao[2], Congyu Liao[2], and Kawin Setsompop[1,2]

[1]*Electrical Engineering, Stanford University, Stanford, CA, United States,* [2]*Radiology, Stanford University, Stanford, CA, United States*

Keywords: Image Reconstruction, Image Reconstruction

Motivation: Using non-Cartesian trajectories allows for motion robustness, and a more efficient encoding. However, these non-Cartesian acquisitions necessitate the use of NUFFTs and field correction techniques, leading to costly reconstruction times.

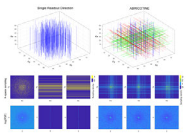
Goal(s): We aim to remove the need for NUFFTs in non-Cartesian MRI, and drastically reduce the computational footprint of field correction.

Approach: Our approach is to correct the raw k-space data of phase due to field imperfections and off-grid sampling using an implicit representation of GRAPPA kernels.

Results: We show an order of magnitude increase in comparison to current standard techniques with near identical reconstructions quality.

Impact: This work aims to significantly reduce the computational requirement for reconstructing non-Cartesian data. This will help with the adoption of long readout non-Cartesian acquisitions, which naturally accelerate MRI exams.

1066 Pitch: 15:45 Poster: 16:45 Screen 2



ABRICOTINE MRI: Enhancing Sparsity Across the Three Dimensions of the Fourier Domain in Cartesian Sampling

Antoine Klauser[1,2], Gian Franco Piredda [1,2], Thomas Yu[1,3,4], Patrick Alexander Liebig[5], Roberto Martuzzi [6], Tobias Kober[1,3,4], and Tom Hilbert[1,3,4]

[1]*Advanced Clinical Imaging Technology, Siemens Healthineers International AG, Lausanne, Switzerland,* [2]*Center for Biomedical Imaging (CIBM), Geneva, Switzerland,* [3]*Department of Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland,* [4]*LTS5, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland,* [5]*Siemens Healthcare GmbH, Erlangen, Germany,* [6]*Human Neuroscience Platform, Fondation Campus Biotech Geneva, Geneva, Switzerland*

Keywords: New Trajectories & Spatial Encoding Methods, Sparse & Low-Rank Models, Sparse sampling

Motivation: With the increasing demand for high-resolution and short MRI exams, especially at high and ultra-high field, there is a need for fast acquisition techniques.

Goal(s): To improve highly accelerated compressed-sensing by introducing a novel sampling named Alternating Basis Readout Imaging with COmpressed$$$\,$$$sensing with Three-dImensioNal Encoding (ABRICOTINE).

Approach: ABRICOTINE incorporates sparse phase-encoding in three orthogonal directions, achieving true three-dimensional undersampling of the Fourier domain. This differs from conventional compressed$$$\,$$$sensing, which only undersamples within two phase-encoding dimensions.

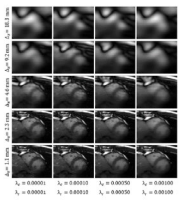
Results: We demonstrate significant enhancements in brain image quality through both simulations and true ABRICOTINE-accelerated acquisitions. It surpasses conventional compressed$$$\,$$$sensing methods and enables 0.5mm isotropic imaging in 4min.

Impact: ABRICOTINE allows for a substantial improvement in compressed-sensing acceleration compared to traditional sparse sampling techniques, especially when high acceleration factors are required. It thus shows great potential for further accelerating high resolution MRI acquisitions.

1067 Pitch: 15:45
Poster: 16:45
Screen 3

[A Multi-Resolution Approach to Estimate Cardiac and Respiratory Motion Fields for 5D Whole-Heart MR Image Reconstruction – a Proof of Concept]

Jérôme Yerly[1,2], Augustin Ogier[1], Christopher W Roy[1], Ruud B van Heeswijk[1], and Matthias Stuber[1,2,3]



[1]*Diagnostic and Interventional Radiology, Lausanne University Hospital (CHUV), Lausanne, Switzerland,* [2]*Center for Biomedical Imaging (CIBM), Lausanne, Switzerland,* [3]*Electrophysiology and Heart Modeling Institute, IHU LIRYC, Bordeaux, France*

Keywords: Image Reconstruction, Image Reconstruction

Motivation: Estimating cardiac and respiratory inter-bin deformation fields from 5D motion-resolved free-running data is particularly challenging due to a high level of undersampling.

Goal(s): To address this challenge through an innovative multi-resolution approach to estimate the deformation fields and reconstruct 5D motion-resolved images.

Approach: The approach consists of a sequence of compressed-sensing image reconstructions that iteratively progresses from low to high spatial resolutions, where one lower-resolution iteration's output is exploited as input for the next higher resolution until target resolution is reached.

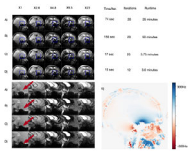
Results: Using optimized regularization weights, the proposed approach achieved left-ventricular ejection fraction within a 4% error margin compared the 2D cine.

Impact: This study presents a multi-resolution framework for estimating cardiac and respiratory inter-bin deformation fields aimed at improved motion-resolved whole-heart 5D-imaging. This multi-resolution compressed sensing framework has the potential to accurately estimate deformation fields and reduce compression artefacts.

1068 Pitch: 15:45
Poster: 16:45
Screen 4

[Efficient Constrained Reconstruction of Non-Cartesian Time-Segmented Data with Implicit GROG and Polynomial Preconditioning]

Mark Nishimura[1], Daniel Abraham[1], Xiaozhi Cao[1,2], Congyu Liao[1,2], John Pauly[1], and Kawin Setsompop[1,2]



[1]*Electrical Engineering, Stanford University, Stanford, CA, United States,* [2]*Radiology, Stanford University, Stanford, CA, United States*

Keywords: Image Reconstruction, MR Fingerprinting

Motivation: Fast, regularized subspace reconstruction would enable the acquisition and synthesis of a standard clinical brain protocol in mere minutes.

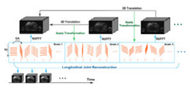
Goal(s): Our goal is to make high-resolution, image reconstruction faster and more robust to $$$B_0$$$ inhomogeneities.

Approach: Our reconstruction alternates between data consistency (DC) and spatio-temporal low rank regularization. We leverage coil sensitivities to "snap" non-Cartesian trajectories to the kspace grid, speeding up DC steps and enabling $$$B_0$$$-robust reconstructions with fewer time segments. Polynomial preconditioning enables convergence in up to 2x fewer iterations, reducing expensive proximal updates.

Results: Our method reduces the reconstruction time by an order of magnitude while retaining quality.

Impact: The ability to reconstruct MRF quickly should make integration of MRF into clinical workflows not just possible, but convenient. Additionally, the efficiency gains from this framework can make even the most sophisticated and expensive regularizers computationally feasible.

1069 Pitch: 15:45 Poster: 16:45 Screen 5



Accelerating Longitudinal Dynamic MRI by Exploiting Multi-Session Temporal Correlations

Jingjia Chen[1,2], Daniel K Sodickson[1,2], and Li Feng[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Image Reconstruction, Image Reconstruction

Motivation: Longitudinal MRI scans performed on the same patient offer valuable temporal redundancy that can be exploited for image reconstruction. However, this wealth of information is usually ignored in current clinical practice, with data from different sessions typically reconstructed separately.

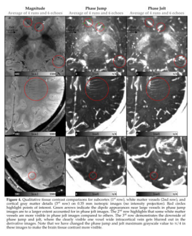
Goal(s): This study introduces a longitudinal dynamic MRI framework that leverages temporal correlations across multiple imaging sessions to improve image reconstruction.

Approach: Our reconstruction approach aims to reconstruct multi-session data jointly as a dynamic image series employing a combination of low-rank subspace and spatiotemporal constraints.

Results: The initial results demonstrate that joint longitudinal reconstruction outperforms standard separate reconstructions, which may allow for additional acceleration.

Impact: By exploiting image correlations across multiple sessions, our longitudinal dynamic MRI framework can improve image reconstruction and enable higher acceleration compared to standard separate reconstruction.

1070 Pitch: 15:45 Poster: 16:45 Screen 6



Phase jolt: Second spatial derivative of phase images is a new contrast that offers many benefits for SWI type processing

Omer Faruk Gulban[1,2], Andreas Deistung[3], Desmond Ho Yan Tse[4], Saskia Bollmann[5], Renzo Huber[6], Rainer Goebel[1,2], Kendrick Kay[7], and Dimo Ivanov[1]

[1]Department of Cognitive Neuroscience, Maastricht Univesity, Faculty of Psychology and Neuroscience, Maastricht, Netherlands, [2]Brain Innovation, Maastricht, Netherlands, [3]Polyclinic for Radiology, University Hospital Halle, Halle, Germany, [4]Scannexus, Maastricht, Netherlands, [5]School of Electrical Engineering and Computer Science, The University of Queensland, Brisbane, Australia, [6]National Institutes of Health, Washington DC, MD, United States, [7]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States

Keywords: Image Reconstruction, Contrast Mechanisms, Phase

Motivation: Unlike magnitude images, even simple averaging is difficult with phase images, because of the circular nature of phase, spanning 2pi radians range.

Goal(s): In our research that uses mesoscopic imaging (< 0.5 mm isotropic) at 7 T, we need to average multiple acquisitions to increase SNR. Being unable to average straightforwardly together with the lack of natural zero point is a critical constraint.

Approach: To address this problem, we propose to operate on the magnitude of the second spatial derivative of phase images - called “phase jolt”.

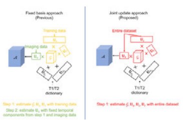
Results: Our results show phase jolt offers benefits for processing associated with SWI imaging.

Impact: Phase jolt is an easy to implement new contrast where vessels and non brain tissue are highlighted and background bias field is mitigated. Therefore, phase jolt images have potential to be impactful in any setting where phase images are used.

1071 Pitch: 15:45

Poster: 16:45

Screen 7



Alternating low-rank tensor reconstruction for more precise and repeatable multiparametric mapping with Cardiovascular MR Multitasking

Tianle Cao[1,2], Xianglun Mao[2], Alan C. Kwan[2,3], Daniel S. Berman[3], Yibin Xie[2], Debiao Li[2,4], and Anthony G. Christodoulou[1,2]

[1]Department of Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States, [2]Biomedical imaging research institute, Cedars Sinai Medical Center, Los Angeles, CA, United States, [3]Departments of Imaging and Cardiology, Cedars Sinai Medical Center, Los Angeles, CA, United States, [4]Department of Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States

Keywords: Quantitative Imaging, Sparse & Low-Rank Models

Motivation: While MR Multitasking shows initial promise as a free-breathing, non-ECG approach for multiparametric CMR, its precision and repeatability still require further improvement to match the widely adopted clinical protocols.

Goal(s): To improve precision and repeatability of multiparametric mapping by cardiovascular MR Multitasking.

Approach: A novel low-rank tensor reconstruction strategy was developed to improve the reconstruction performance. Numerical simulations and in-vivo studies on healthy volunteers and cardiomyopathy patients were used to evaluate the proposed technique.

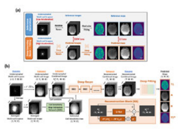
Results: Compared to conventional recontruction, the proposed approach showed lower RMSE in numerical simulations, and improved precision by ~20% and repeatability by ~30% in in-vivo studies.

Impact: The improved cardiovascular MR Multitasking has the potential to be an efficient and subject friendly (free-breathing, non-ECG) alternative for diagnosis of CMR patients whose T1 and T2 changes are greater than 100 ms and 2 ms, e.g., amyloidosis patients.

1072 Pitch: 15:45

Poster: 16:45

Screen 8



DeepGrasp-Quant: A General Framework for Deep Learning-Enabled Quantitative Imaging Based on Golden-Angle Radial Sparse Parallel MRI

Haoyang Pei[1,2,3], Jingjia Chen[1,2], Yuhui Huang[1,2], Xiang Xu[4], Ding Xia[4], Yao Wang[3], Fang Liu[5], Hersh Chandarana[1,2], Daniel K Sodickson[1,2], and Li Feng[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York City, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York City, NY, United States, [3]Department of Electrical and Computer Engineering, NYU Tandon School of Engineering, New York City, NY, United States, [4]Biomedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai, New York City, NY, United States, [5]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

Keywords: Quantitative Imaging, Quantitative Imaging, Deep Learning

Motivation: Quantitative MRI typically involves a multi-step imaging pipeline from data acquisition to parameter estimation. Deep learning holds great promise to improve and streamline the entire workflow for quantitative MRI.

Goal(s): This work presents a general deep learning-based rapid quantitative MRI framework, called DeepGrasp-Quant, for efficient and accurate quantification of MRI parameters based on Golden-angle RAdial Sparse Parallel (GRASP) MRI.

Approach: DeepGrasp-Quant was designed with cascaded deep learning modules for reconstruction and parameter fitting, enabling direct estimation of MR parameters from undersampled images.

Results: Two examples of DeepGrasp-Quant (DeepGrasp-T1 and DeepGrasp-T1-Dixon) were demonstrated for rapid accurate T1 mapping of the brain and the liver.

Impact: DeepGrasp-Quant is expected to be a promising technique for efficient and accurate quantification of MRI parameters from highly-accelerated free-breathing data acquisition. In addition to T1 mapping, it can also be integrated with other quantitative MRI methods for different clinical applications.

1073 Pitch: 15:45

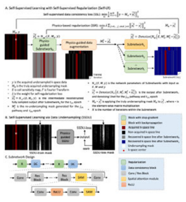
Poster: 16:45

Screen 9

High-Resolution Free-breathing Perfusion MRI with High Slice Coverage via SAM in Self-Supervised Learning with Self-Regularization

Changyu Sun[1,2], Senthil Kumar[3], and Talissa Altes[2]

[1]*Chemical and Biomedical Engineering, University of Missouri Columbia, Columbia, MO, United States,* [2]*Radiology, University of Missouri Columbia, Columbia, MO, United States,* [3]*Medicine-Cardiology, University of Missouri Columbia, Columbia, MO, United States*



Keywords: Image Reconstruction, Perfusion

Motivation: Enhancing myocardial perfusion MRI with self-supervised learning is key to achieving higher image quality and fidelity, especially in patients with varying image matrix sizes and asymmetric echo.

Goal(s): To enhance perfusion MRI by increasing resolution and slice coverage using self-supervised learning, self-regularization, and spatial attention, tailored for varied image sizes and asymmetric echo.

Approach: Implemented an accelerated perfusion MRI sequence with asymmetric echo; collected data from 20 patients; developed self-LR with SAM to enhance image quality.

Results: Self-LR with SAM yielded superior image quality and fewer artifacts in varied sizes and asymmetric echo, outperforming other methods, confirmed by expert evaluations.

Impact: The integration of Spatial Attention Module (SAM) with Self-Supervised Learning and Self-Regularization significantly enhances myocardial perfusion MRI, enriching spatial resolution and slice coverage. This development could potentially improve diagnostic accuracy, facilitating non-invasive whole-heart assessments with improved image quality.

1074 Pitch: 15:45

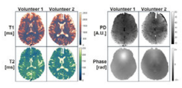
Poster: 16:45

Screen 10

Fast Quantitative T1, T2, PD, B1 and QSM Mapping Using A Single MR Fingerprinting Acquisition And A Phase-Sensitive Deep Reconstruction Network.

Jessica A. Martinez[1], Ricardo Otazo[1], and Ouri Cohen[1]

[1]*Medical Physics, Memorial Sloan Kettering Cancer Center, New York,, NY, United States*



Keywords: Quantitative Imaging, MR Fingerprinting, Quantitative Susceptibility Mapping

Motivation: Incorporating MR phase into the MRF scheme can provide further diagnostic information, such as QSM. However, the MRF dictionary exponentially grows with the number of parameters to estimate.

Goal(s): To validate QSM and B1 mapping using MRF and PS-DRONE reconstruction network against conventional reference maps.

Approach: Data were acquired at 3T with an EPI-MRF, a multi-echo GRE sequence for QSM and a Bloch Siegert sequence for B1 mapping.

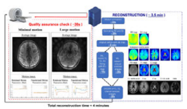
Results: PS-DRONE enabled simultaneous quantification of T1, T2, PD, B1 and maps in 2 minutes. Tissue parameter maps were reconstructed in 1 second. Strong correlations were observed to reference B1 and QSM maps.

Impact: The ability of PS-DRONE to quantitatively image T1, T2, PD, B1 and QSM with similar accuracy to conventional techniques, but in a fraction of the time, would promote the use of multiparametric quantitative MRI in clinical practice.

1075 Pitch: 15:45

Poster: 16:45

Screen 11



Development and validation of a rapid robust 3D-MRF with fast online recon suitable for large-scale neuroscientific and clinical applications

Zihan Zhou[1,2], Xiaozhi Cao[1,3], Congyu Liao[1,3], Mark Nishimura[3], Sophie Schauman[1,3], Mengze Gao[1], Mahmut Yurt[3], Nan Wang[1,3], Maya Yablonski[4], Zhitao Li[1], Bruno P. Soares[5], Ali Syed[1], Adam Kerr[3], Jason D. Yeatman[2,4,6], and Kawin Setsompop[1,3]

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Keywords: Software Tools, Software Tools, Pipeline, MR Fingerprinting

Motivation: A number of promising multiparameter mapping approaches have been developed but are not yet in routine-use in clinical and neuroscientific settings.

Goal(s): To create a rapid and robust 3D-MRF acquisition/reconstruction package, suitable for large-scale neuroscientific and clinical applications.

Approach: 3D-MRF acquisition is developed for 1-mm whole-brain-mapping in 2.5-minutes, with build-in robustness to motion, and quantification bias from B0&B1 inhomogeneities. Highly-efficient reconstruction package is created for online generation of quantitative maps and synthesized-contrasts within 4 minutes of scan-completion, benchmarked using a consumer-grade GPU.

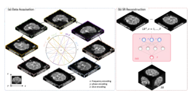
Results: The pipeline has been validated on over 100-scans performed across clinical and neuroscientific settings with plan for open-source distribution soon.

Impact: The distribution of such an acquisition/reconstruction package should help facilitate wide-spread deployment of multiparameter mapping.

1076 Pitch: 15:45

Poster: 16:45

Screen 12



Rotating-view super-resolution (ROVER)-MRI reconstruction using tailored Implicit Neural Network

Jun Lyu[1], Lipeng Ning[1], William Consagra[1], Qiang Liu[1], and Yogesh Rathi[1]

[1]Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

Keywords: Machine Learning/Artificial Intelligence, Machine Learning/Artificial Intelligence

Motivation: Direct acquisition of high resolution data is time-consuming and degrades SNR. Super-resolution reconstruction (SRR) is widely used to address these challenges. However, existing reconstruction tools use algorithms that are sensitive to noise and motion.

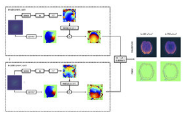
Goal(s): Our study aims to develop a training-free deep learning-based SRR method that integrates multi-view thick-slice data to reconstruct images with enhanced spatial resolution and high SNR.

Approach: We used an implicit neural representation (INR) network, leveraging data from scans at various views, to achieve high isotropic SRR.

Results: Our technique exhibited 30% better SNR and significant motion-robustness compared to existing techniques.

Impact: Implicit neural representations allow continuous functional representation of MRI images thereby being a natural candidate for performing SRR in low SNR regimes. Our study validates the feasibility of employing INRs to reduce scan time, motion artifacts, and achieve high-quality SRR.

1077 Pitch: 15:45 Poster: 16:45 Screen 13



High-Fidelity Intravoxel Incoherent Motion (HIFIVIM) Parameter Mapping Using Locally Low-Rank with Temporal Subspace Constraint

Alan Finkelstein[1], Congyu Liao[2], Xiaozhi Cao[2], Merry Mani[3], Giovanni Schifitto[4,5,6], and Jianhui Zhong[1,5,7]

[1]Department of Biomedical Engineering, University of Rochester, Rochester, NY, United States, [2]Department of Radiology, Stanford University, Stanford, CA, United States, [3]University of Iowa, Iowa City, IA, United States, [4]Department of Neurology, University of Rochester, Rochester, NY, United States, [5]Department of Imaging Sciences, University of Rochester, Rochester, NY, United States, [6]Department of Electrical and Computer Engineering, University of Rochester, Rochester, NY, United States, [7]Department of Physics and Astronomy, University of Rochester, Rochester, NY, United States

Keywords: Image Reconstruction, Diffusion/other diffusion imaging techniques, Intravoxel Incoherent Motion, Model-Based Reconstruction, Subspace Reconstruction

Motivation: Intravoxel incoherent motion (IVIM) is a measure in MRI to quantify tissue perfusion. However, clinical applications are limited by noisy parameter estimates for the perfusion fraction (f) and pseudodiffusion coefficient (D*).

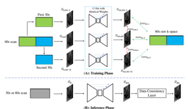
Goal(s): We sought to improve IVIM parameter estimation using a model-based reconstruction

Approach: We combined locally low-rank (LLR) and temporal subspace constraints to reliably perform joint reconstruction of IVIM images before fitting while correcting shot-to-shot phase variations between each b-value.

Results: Our method resulted in smoother signal decay curves before fitting and improved the estimation of IVIM parameter maps with less noise and fewer outliers.

Impact: A model-based reconstruction with low rank and temporal constraints improved IVIM image reconstruction, reducing noise and outliers in parameter estimates. Spline interpolation further facilitated reliable estimation of IVIM maps from just 5 b-values, benefiting clinical situations like stroke.

1078 Pitch: 15:45 Poster: 16:45 Screen 14



Subspace dual-domain-loss for self-supervised deep learning reconstruction of dynamic MRI: Method and Application to CMR Multitasking

Zihao Chen[1,2,3], Yibin Xie[1], Debiao Li[1,3], and Anthony G. Christodoulou[1,2,3]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [3]Department of Bioengineering, UCLA, Los Angeles, CA, United States

Keywords: Machine Learning/Artificial Intelligence, Image Reconstruction, self-supervised learning, subspace, dynamic MRI

Motivation: Supervised deep learning (DL) can reduce reconstruction time for CMR Multitasking, but the lack of ground truth limits the quality of supervised DL to that of iteratively reconstructed labels.

Goal(s): Our goal was to develop a self-supervised learning (SSL) reconstruction method, whose performance is not limited by the iterative reconstruction.

Approach: We developed a dual-domain subspace SSL reconstruction method for non-Cartesian dynamic MRI, applying it to CMR Multitasking.

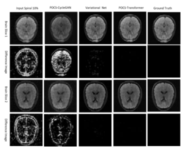
Results: The proposed method can perform image reconstruction without reference images and shows better interscan consistency than supervised DL.

Impact: With the proposed method, image quality of DL reconstruction for CMR Multitasking can potentially surpass iterative reconstruction. We applied subspace constraints to SSL reconstruction, showing an efficient way to relieve the computational burden of dynamic MRI SSL reconstruction.

1079 Pitch: 15:45

Poster: 16:45

Screen 15



[POCS-Transformer for MR Image Reconstruction]

Anam Nazir[1], Muhammad Nadeem Cheema[1], Yiran Li[1], Yulin Chang[2], John A Detre[3], and Ze Wang[1]

[1]Department of Diagnostic Radiology and Nuclear Medicine, School of Medicine, University of Maryland,, Baltiomore, MD, United States, [2]Siemens Healthineers, Baltimore, MD, United States, [3]Department of Neurology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States

Keywords: Image Reconstruction, Brain, Reconstruction

Motivation: Transformers excel in medical image processing but require many parameters and training data. We mitigated this issue with the POCS-Transformer method.

Goal(s): POCS-Transformer goal was to enhances MR image reconstruction along with preserving image quality with various under-sampling masks.

Approach: The POCS-Transformer, built on Swin-T using FastMRI data, employed binary undersampling, POCS augmentation, data consistency penalties, and was compared to VN and POCS-CycleGAN on test data.

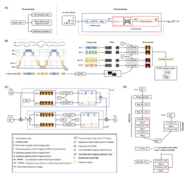
Results: POCS-Transformer outperformed POCS-CycleGAN with superior image quality and less blurring. POCS-Transformer achieved higher mean PSNR and SSIM compared to both VN and POCS-CycleGAN in knee and brain image datasets.

Impact: The POCS-Transformer improves MR image reconstruction in terms of reducing blurring even under diverse under-sampling conditions. Its impact extends to healthcare and research. New questions involve its applications in medical imaging, merging traditional and modern methods to inspire further innovations.

1080 Pitch: 15:45

Poster: 16:45

Screen 16



[Proximal Gradient Decent Network for Respiratory-Correlated Four-Dimensional Abdominal MR Fingerprinting Reconstruction (PGDN-RC-4DMRF)]

Lu Wang[1], Chenyang Liu[1], Shaohua Zhi[1], Ge Ren[1], Tian Li[1], Peng Cao[2], and Jing Cai[1]

[1]The Hong Kong Polytechnic University, Hong Kong, China, [2]The University of Hong Kong, Hong Kong, China

Keywords: MR Fingerprinting, Radiotherapy

Motivation: Four-dimensional MR fingerprinting (4D-MRF) has the potential to improve precision and efficacy in abdominal radiotherapy (RT). However, the long reconstruction time of the state-of-the-art reconstruction method, compress-sensed-based respiratory-correlated 4D-MRF (CS-RC-4DMRF), limits its clinical application.

Goal(s): The study aims to develop a novel method to reduce the reconstruction time of CS-RC-4DMRF.

Approach: We developed PGDN-RC-4DMRF by integrating a deep proximal gradient descent network (PGDN) into 4D-MRF. Tumor motion tracking accuracy, tissue quantification accuracy, and image quality were evaluated.

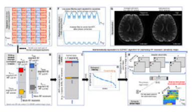
Results: The proposed PGDN-RC-4DMRF method reduce the reconstruction time by a factor of 120, decreasing it from 8 min/slice to 4 s/slice while maintaining other metrics.

Impact: The improvement in the reconstruction speed of 4D-MRF through PGDN-RC-4DMRF may enhance the practicality of 4D-MRF in clinical settings for clinicians and potentially benefit RT outcomes for patients.

1081 Pitch: 15:45

Poster: 16:45

Screen 17



[Navigator-free multi-shot EPI with shift-invariant kernel extraction in subspace]

Rui Tian[1], Martin Uecker[2], and Klaus Scheffler[1,3]

[1]High-Field MR center, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Institute of Biomedical Imaging, Graz University of Technology, Graz, Austria, [3]Department for Biomedical Magnetic Resonance, University of Tuebingen, Tuebingen, Germany

Keywords: Image Reconstruction, Image Reconstruction

Motivation: In functional and diffusion MRI, multi-shot EPI enhances spatial resolution and minimizes distortion compared to single-shot scans. However, its vulnerability to shot-to-shot phase variations presents a significant challenge, with various proposed methods having drawbacks.

Goal(s): We propose a robust, navigator-free, computational efficient multi-shot method without SNR penalty.

Approach: In readout-segmented multi-shot EPI, we exploit the k-space overlapped regions between adjacent segments to extract relative phase fluctuations. This method, inspired by ESPIRiT and nonlinear gradient calibration, efficiently extracts shot-dependent phase variations in subspace.

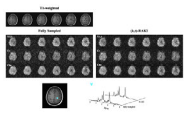
Results: Our ex-vivo and in-vivo scans, including diffusion-weighted imaging, successfully achieves a high in-plane resolution of about 0.6mm without ghost artifacts.

Impact: Our proposed multi-shot technique eliminates the needs for time-consuming navigators, provides robust high-resolution diffusion and potentially functional imaging, and could be easily adapted for interleaved Cartesian and spiral EPI allowing robust phase error estimation from merely small k-space regions.

1082 Pitch: 15:45

Poster: 16:45

Screen 18



[A (k,t)-RAKI Method for Interpolating Sparse Data in Accelerated MRSI Acquisitions]

Yunrui Zhang[1], Ruiyang Zhao[2,3], and Zepeng Wang[3,4]

[1]Department of Automation, Tsinghua University, Beijing, China, [2]Department of Electrical and Computer Engineering, University of Illinois Urbana-Champaign, Urbana, IL, United States, [3]Beckman Institute for Advanced Science and Technology, University of Illinois Urbana-Champaign, Urbana, IL, United States, [4]Department of Bioengineering, University of Illinois Urbana-Champaign, Urbana, IL, United States

Keywords: Image Reconstruction, Spectroscopy

Motivation: To further accelerate high-resolution MRSI acquisitions leveraging parallel imaging.

Goal(s): While standard parallel imaging techniques such as (k,t)-GRAPPA can interpolate the sparsely sampled (k,t)-space in MRSI, learning-based nonlinear interpolation has demonstrated better performance in parallel MRI. But these methods have not effectively utilized the time/free induction decay (FID) dimension, which should be leveraged to improve interpolation accuracy.

Approach: We adapted and extended the RAKI method by incorporating the FID dimension, via a 3D, complex-valued convolutional network, for MRSI reconstruction.

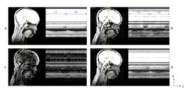
Results: Our method effectively reconstructed data for different undersampling designs in in vivo MRSI, leading to improved subsequent spatiospectral processing results.

Impact: We presented a self-supervised learning-based (k,t)-space interpolation method, (k,t)-RAKI, that is useful for further accelerating MRSI acquisition, in combination with subspace methods.

1083 Pitch: 15:45

Poster: 16:45

Screen 19



Spatiotemporal atlas driven reconstruction of dynamic speech imaging

Riwei Jin[1], Fangxu Xing[2], Imani Gilbert[3], Jamie Perry[3], Jonghye Woo[2], Ryan Shosted[1], Zhi-Pei Liang[1], and Brad Sutton[1]

[1]University of Illinois Urbana-Champaign, Champaign, IL, United States, [2]Massachusetts General Hospital/Harvard Medical School, Boston, MA, United States, [3]East Carolina University, Greenville, NC, United States

Keywords: Image Reconstruction, Image Reconstruction, Atlas, speech imaging

Motivation: Individuals across a population typically exhibit similar articulatory movements when performing speech tasks with specific speech samples. From an imaging experiment, we are interested in representing how an individual's speech behavior is different from the 'standard' motion, which assists the preoperative planning of velopharyngeal surgery.

Goal(s): We expected to visualize velopharyngeal variations between individual subjects and the average population.

Approach: We have integrated an atlas into a low-rank residual reconstruction framework to capture the distinctive motion variations unique to each subject.

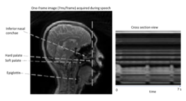
Results: We demonstrated the ability of the method to visualize velopharyngeal variations as well as enhancing the quality of the reconstruction process.

Impact: By applying a spatio-temporal atlas-driven reconstruction method, we were able to visualize and analysis velopharyngeal variations between individuals and the average population which will specifically benefit the surgical planning of individual cleft palate patients.

1084 Pitch: 15:45

Poster: 16:45

Screen 20



Self-navigated Subspace Reconstruction for Real-time MRI Speech Tracking

Peng Cao[1], Wenting Jiang[1], Changhe Chen[2], Yiang Wang[1], and Jonathan Havenhill[2]

[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, China, [2]Department of Linguistics, The University of Hong Kong, Hong Kong, China

Keywords: Image Reconstruction, Motion Correction

Motivation: Real-time MRI offers a continuous and dynamic view of the object being imaged. Researchers have applied real-time MRI to speech tracking, which allows for the visualization of the vocal tract during speech production.

Goal(s): In this study, we propose applying self-navigated subspace reconstruction to real-time MRI for speech tracking.

Approach: During reconstruction, 1000 frames were compressed to a few principal components, and iterative low-rank approximation was performed on compressed k-space, greatly reducing computation costs.

Results: The proposed method allows for the joint reconstruction of all time frames and provides the dynamic motion pattern of the vocal tract at a high frame rate.

Impact: Our study presented a subspace reconstruction technique that does not require a navigator echo, which can be used for real-time MRI, particularly in speech tracking applications.

Power Pitch

Pitch: From One Proton to Another: CEST & MT

Power Pitch Theatre 2

Wednesday
Pitches: 15:45 - 16:45
Posters: 16:45 - 17:45

Moderators: Nirbhay Yadav & Andreea Hertanu

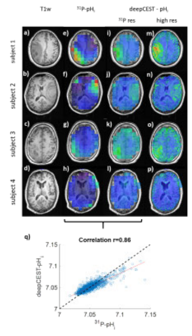
(no CME credit)

1085 Pitch: 15:45 Poster: 16:45 Screen 21

<u>Non-invasive high-resolution in vivo pH mapping in brain tumors by 31P-informed deepCEST MRI</u>

Jan-Rüdiger Schüre[1], Junaid Rajput[1], Eike Steidl[2], Manoj Shrestha[3], Ralf Deichmann[3], Elke Hattingen[2], Moritz Fabian[1], Andreas Maier[4], Armin Nagel[5], and Moritz Zaiss[1,4,6]

[1]Institute of Neuroradiology, Erlangen, Germany, [2]Institute of Neuroradiology, Frankfurt am Main, Germany, [3]Brain Imaging Center, Frankfurt am Main, Germany, [4]Department Artificial Intelligence in Biomedical Engineering, Erlangen, Germany, [5]Institute of Radiology, Erlangen, Germany, [6]Max-Planck Institute for Biological Cybernetics, Tübingen, Germany



Keywords: CEST / APT / NOE, CEST & MT, Cancer, pH, CEST, 31P, Neuronal Network

Motivation: The pH value is an important biomarker for many diseases. MRI-based 3D pH mapping for clinical routine would be an enormous benefit for diagnostics.

Goal(s): Prediction of intracellular ^{31}P-pH$_i$ maps from ^{1}H APTw-CEST MRI data using a voxel-wise neural network, aiming to improve brain tumor imaging.

Approach: Fifteen glioblastoma patients underwent 3T MRI with both APTw-CEST and ^{31}P-MRS. A neural network trained on 11 patients data to correlate APTw-CEST features with ^{31}P-derived pH$_i$ values, tested on 4 additional patients.

Results: The neural network's pH$_i$ predictions closely matched ^{31}P-pH$_i$ maps, showing potential for high-resolution, non-invasive pH$_i$ mapping in brain tumors.

Impact: High resolution pH imaging for better diagnosis of diseases (inflammation, stroke, tumor) and therapy monitoring in clinical routine.

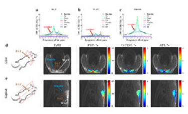
1086 Pitch: 15:45 Poster: 16:45 Screen 22

MERIT AWARD SUMMA CUM LAUDE

<u>Non-invasive mapping of brown adipose tissue activity with MRI</u>

Zimeng Cai[1,2], Qiaoling Zhong[3], Yanqiu Feng[4,5,6], Zhigang Wu[7], Changhong Liang[1,2], Chong Wee Liew[8], Lawrence Kazak[9,10], Aaron M. Cypess[11], Zaiyi Liu[1,2], and Kejia Cai[12,13]

[1]Department of Radiology, Guangdong Provincial People's Hospital (Guangdong Academy of Medical Sciences), Southern Medical University, Guangzhou, China, [2]Guangdong Provincial Key Laboratory of Artificial Intelligence in Medical Image Analysis and Application, Guangzhou, China, [3]Department of Radiology, Guangzhou Women and Children's Medical Center, Guangzhou Medical University, Guangdong Provincial Clinical Research Center for Child Health, Guangzhou, China, [4]School of Biomedical Engineering, Southern Medical University, Guangzhou, China, [5]Guangdong Provincial Key Laboratory of Medical Image Processing & Guangdong Province Engineering Laboratory for Medical Imaging and Diagnostic Technology, Southern Medical University, Guangzhou, China, [6]Guangdong-Hong Kong-Macao Greater Bay Area Center for Brain Science and Brain-Inspired Intelligence & Key Laboratory of Mental Health of the Ministry of Education, Southern Medical University, Guangzhou, China, [7]Philips Healthcare (Shenzhen) Ltd, Shenzhen, China, [8]Physiology and Biophysics Department, University of Illinois at Chicago, Chicago, IL, United States, [9]Rosalind & Morris Goodman Cancer Institute, McGill University, Montreal, QC, Canada, [10]Department of Biochemistry, McGill University, Montreal, QC, Canada, [11]Diabetes, Endocrinology, and Obesity Branch, Intramural Research Program, National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), Bethesda, MD, United States, [12]Radiology Department, University of Illinois at Chicago, Chicago, IL, United States, [13]Biomedical Engineering Department, University of llinois at Chicago, Chicago, IL, United States



Keywords: CEST / APT / NOE, Metabolism

Motivation: Through non-shivering thermogenesis, brown adipose tissue (BAT) plays a critical and beneficial role in obesity and metabolic diseases.

Goal(s): In this study, we developed non-invasive creatine CEST (CrCEST) MRI of adipose tissues for mapping BAT activity in both rodents and humans given to creatine's important role in bioenergetics.

Approach: We observed by CrCEST MRI that the changes in BAT activity in rats and human after drug administration and/or cold exposure were in good agreement with traditional ^{18}F-FDG PET/CT imaging.

Results: The results of this study demonstrated CrCEST MRI as an endogenous, non-invasive, and radiation-free method for *in vivo* mapping of BAT activity.

Impact: In this study, endogenous CrCEST MRI of adipose tissues was developed and found to serve as an imaging biomarker for BAT activity, the diagnosis of metabolic diseases, and the evaluation of new therapeutic strategies in a longitudinal and non-invasive means.

1087

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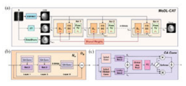
Screen 23



Accelerated CEST Imaging with Deep Learning Priors and Synthetic Brain Tumor Datasets

Yuyan Wang[1], Jianping Xu[1], Zhechuan Dai[1], Yi-Cheng Hsu[2], and Yi Zhang[1]

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Keywords: CEST / APT / NOE, Machine Learning/Artificial Intelligence, Synthetic Datasets

Motivation: The clinical application of CEST MRI is constrained by its relatively long scan time.

Goal(s): We aim to develop a deep learning reconstruction method for accelerating CEST imaging in the absence of true experimental data.

Approach: Here, we propose a model-based deep learning framework, in conjunction with the Channel-wise Attention mechanism and Total variation regularization, dubbed as MoDL-CAT. Moreover, we propose a new workflow to synthesize CEST data from the BraTS and fastMRI repositories.

Results: We demonstrate that the BraTS-CEST dataset can improve the performance of all deep learning networks tested, and the MoDL-CAT method achieves superior reconstruction quality to the state-of-the-art methods.

Impact: The proposed deep learning framework with channel-wise attention may offer a better prior for reconstruction. And our novel workflow to synthesize high-quality brain tumor CEST datasets might help researchers with limited data to explore various methods for accelerating CEST imaging.

1088

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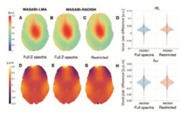
Screen 24



Rapid and simplified post-processing for B0 and B1 mapping with WASABI-RADISH in the application of CEST at 7T

Mara Quach[1,2], Myrte Strik[2,3,4], Rebecca Glarin[2], Bradford A Moffat[2], David K Wright[5], and Leigh A Johnston[1,2]

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Keywords: CEST / APT / NOE, CEST & MT, B1, B0, WASABI, data processing, UHF, 7T, tools

Motivation: WASABI provides high fidelity B_0 and B_1 maps necessary for CEST correction yet suffers from prolonged post-processing incompatible with clinical use.

Goal(s): Our goal was to design an optimisation-free method to expedite map estimations.

Approach: A direct relationship was derived between B_0 and B_1 and information in WASABI Z-spectra.

Results: The proposed approach accelerated post-processing by a factor of 80, with improved estimation in brain regions that are noisy and/or have unpredictable initial magnetisation.

Impact: Improvement in speed and accuracy provided by RADISH has the ability to make WASABI, and quantitative CEST at ultra-high-field in general, more reliable and clinically feasible.

1089

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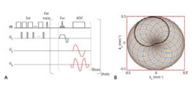
Screen 25



Fast, motion-robust CEST imaging with inherent B0 correction using rosette trajectories

Sultan Zaman Mahmud[1], Munendra Singh[1], Peter van Zijl[1], and Hye-Young Heo[1]

[1]Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

Keywords: CEST / APT / NOE, CEST & MT

Motivation: CEST-MRI typically requires a long scan time and an additional B_0 map scan for inhomogeneity correction.

Goal(s): To implement a rosette readout for fast CEST imaging with improved robustness to bulk-motion and inherent correction of B_0 inhomogeneity.

Approach: Rosette trajectories which sample more densely near the k-space center provided faster and more motion-robust CEST imaging than Cartesian trajectories. B_0 inhomogeneities were estimated using the phase difference between two images from two halves of the rosette lobe and corrected subsequently.

Results: Rosette trajectories significantly reduced the CEST imaging time. No extra scans were needed for B_0 correction due to the inherent B_0 mapping capability.

Impact: Fast, motion-robust, and inherent B_0-corrected CEST imaging with rosette trajectories can help improve patient comfort and compliance. The work is expected to significantly accelerate the translation of CEST-MRI into a robust clinically viable approach.

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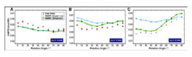
Screen 26



Orientation Dependence of Magnetization Transfer and “Inhomogeneous Magnetization Transfer” in Spinal Cord

Niklas Wallstein[1], André Pampel[1], Carsten Jäger[2,3], Roland Müller[1], Jens Stieler[3], Sven Martin[3], Markus Morawski[2,3], and Harald E. Möller[1,4]

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Keywords: Magnetization Transfer, Magnetization transfer, Inhomogeneous Magnetization Transfer, Orientation Dependence, Spinal Cord

Motivation: Magnetization transfer (MT) and inhomogeneous MT (ihMT) are assumed to report on myelin content. Recently, anisotropy of MT and ihMT have been demonstrated in model systems and in white matter.

Goal(s): Our goal was to quantify orientation effects in (ih)MT, as they closely relate to the microstructure and serve to confirm assumptions about the relaxation mechanism.

Approach: Comprehensive (ih)MT investigations were performed in fixed spinal cord with variation of the fiber-to-field angle (θ_{FB}).

Results: Unambiguous orientation dependence was observed for (ih)MT. The variation depends strongly on the offset frequency, which was quantitatively predicted in simulations of the BSBM with a realistic fiber model.

Impact: This study investigates the orientation dependency of magnetization transfer and related model parameters. Some subtle orientation effects are observed for the first time and are quantitatively explained by using a reasonable model for the RF saturation lineshape.

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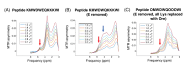
Screen 27



Large-shift, Rapid Exchange Endogenous CEST Contrast for Reporter Gene Product Design

David Edward Korenchan[1], Nicolas Scalzitti[2], Michael T McMahon[3], Assaf Gilad[2], and Christian T Farrar[1]

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Keywords: CEST / APT / NOE, CEST & MT

Motivation: Endogenous CEST contrast from reporter gene products would benefit from exchangeable protons resonating above 3.5 ppm and exchanging rapidly.

Goal(s): We sought to characterize high-shift CEST contrast in tryptophan-enriched peptide sequences to design a highly specific and selective reporter gene protein product.

Approach: We performed CEST z-spectroscopy and QUESP analysis on several tryptophan-containing peptide sequences with variations on a WDWEQ motif.

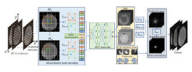
Results: We identified a CEST z-peak at 5.5 ppm exchanging at 250-350 s^{-1}. Surprisingly, we also discovered a new fast-exchanging (k_{sw} ~ 1800 s^{-1}) CEST resonance at 4.4 ppm in one peptide. Both improve our ability to generate unique CEST contrast.

Impact: Developing selective and specific MRI-detectable CEST contrast will greatly benefit noninvasive assessment of viral and cell based therapies. Our work in high-shift CEST contrast shows great potential to improve our ability to reliably monitor these therapies.

1092 Pitch: 15:45 Poster: 16:45 Screen 28

[Highly Accelerated CEST Imaging with Stack-of-stars Acquisition using Unsupervised Implicit Neural Representation Networks]

Bei Liu[1], Huajun She[1], and Yiping Du[1]



[1]*Shanghai Jiao Tong University, Shanghai, China*

Keywords: CEST / APT / NOE, CEST & MT

Motivation: Reduction of scan time in CEST imaging is clinically meaningful.

Goal(s): Our goal is to develop an undersampled reconstruction algorithm to help vastly reduce the acquisition time.

Approach: A novel unsupervised deep-learning based algorithm is proposed to accelerate steady-state pulsed CEST imaging with golden-angle stack-of-stars trajectory using mixed-feature hash encoding implicit neural representation. Additionally, Imaging quality is further improved using the explicit prior knowledge of weighted joint sparsity in subtle structural features of CEST image domain. The low rankness and sparsity in the Z-spectra domain are used to reduce acquisition time.

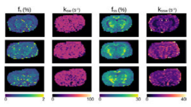
Results: It is possible to achieve a 30-fold acceleration for CEST imaging.

Impact: An unsupervised deep-learning algorithm is proposed to accelerate steady-state pulsed CEST imaging with golden-angle stack-of-stars trajectory using mixed-feature hash encoding implicit neural representation and weighted joint sparsity. It can vastly reduce the acquisition time and has potential for clinical applications.

1093 Pitch: 15:45 Poster: 16:45 Screen 29

[Magnetic Resonance Fingerprinting of the Chemical Exchange Relayed Nuclear Overhauser Effect In Vivo (rNOE-MRF)]

Inbal Power[1], Michal Rivlin[2], Gil Navon[2], and Or Perlman[1,3]



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Keywords: CEST / APT / NOE, CEST & MT

Motivation: Despite its demonstrated ability to provide biological insights into various pathologies, relayed nuclear Overhauser effect (rNOE) imaging is lengthy and biased by water T_1 and semisolid MT contrast.

Goal(s): To develop a rapid rNOE quantification MR-Fingerprinting (MRF) method and validate its performance in-vivo.

Approach: An rNOE-MRF acquisition protocol was designed and employed at 7T for imaging three in-vitro tissue types and wild-type mice (n=7). Quantitative glycogen, rNOE, and semisolid MT maps were simultaneously reconstructed.

Results: In-vitro rNOE exchange parameter maps were highly correlated with ground truth (r>0.99, p<0.01, NRMSE<7%). The rNOE and MT quantitative trends in mice were in agreement with previous literature.

Impact: A quantitative molecular MR-Fingerprinting method was developed, allowing for the simultaneous extraction of rNOE and semisolid MT proton-exchange parameter maps. These in-vivo, bias-dismantled maps are expected to aid in the diagnosis and characterization of cancer, stroke, and spinal cord injury.

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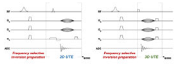
Screen 30



Frequency-selective inversion nulling ultra-short echo time (FINUTE) MRI for direct detection of lipids of the myelin bilayer

Anshuman Swain[1], Narayan Datt Soni[2], Neil Wilson[2], and Ravinder Reddy[2]

[1]Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States, [2]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

Keywords: CEST / APT / NOE, New Signal Preparation Schemes, Short T2, Lipids, Myelin

Motivation: Recent studies have shown the effects of lipid dyshomeostasis and demyelination in the pathology of neurodegenerative diseases, especially early-onset Alzheimer's disease. Consequently, imaging methods to monitor these changes are necessary.

Goal(s): This study uses a novel sequence, termed FINUTE, to image short T_2 lipids primarily associated with the myelin bilayer.

Approach: Simulations and experiments on ex-vivo spinal cord specimens are performed for validation of methodology and applied in-vivo to assess changes in myelination in a mouse model of AD.

Results: Results demonstrate FINUTE's sensitivity to myelin lipids, with statistically significant white matter(corpus callosum) and visually-apparent gray matter(hippocampus) changes present in AD animals.

Impact: FINUTE presents a non-invasive MR-imaging technique that is sensitive to lipids primarily in the myelin bilayer as well as in gray matter, thus providing a method for assessing myelination and lipid dyshomeostasis in neurodegenerative diseases such as AD.

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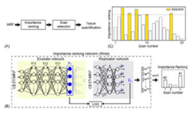
Screen 31



Optimization of sparse saturation transfer MR fingerprinting (ST-MRF) by ranking the importance of saturation transfer contrast features

Munendra Singh[1], Sultan Zaman Mahmud[1], Peter van Zjil[1], and Hye-Young Heo[1]

[1]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States

Keywords: CEST / APT / NOE, CEST & MT

Motivation: Optimizing ST-MRF sequence design is critical to accelerate image acquisition and improve reconstruction accuracy.

Goal(s): To develop a deep-learning framework that can optimize MRF acquisition for tissue parameter determination with a minimal number of scan parameter settings.

Approach: An interpretable neural network was designed to optimize MRF sequences by ranking the importance of saturation contrast features and evaluated using numerical phantoms and *in vivo* experiments at 3T.

Results: Importance-ranking network-based sequence optimization demonstrated its ability to improve the choice of scan parameter values for quantification of tissue parameters. Sequence optimization achieved 1.7-fold acquisition acceleration without compromising the fidelity of the tissue parameter quantification.

Impact: Ranking the importance of saturation transfer contrast features facilitates choosing the best combination of sequence parameters for tissue quantification with fingerprinting (ST-MRF). An interpretable network based on importance ranking can significantly accelerate data acquisition for ST-MRF and conventional Z-spectral acquisition.

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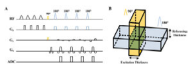
Screen 32



High-Resolution Reduced FOV Renal Chemical Exchange Saturation Transfer MRI Using orthogonal RF pulses

Qianqian Zhang[1,2], Zelong Chen[3], Zhigang Wu[4], Kan Deng[5], Quan Tao[2,6], Wenyan Zhang[1,2], Yizhe Zhang[1,2], Yikai Xu[3], and Yanqiu Feng[1,2]

[1]School of Biomedical Engineering, Southern Medical University, Guangzhou, China, [2]Guangdong Provincial Key Laboratory of Medical Image Processing & Guangdong Province Engineering Laboratory for Medical Imaging and Diagnostic Technology, Southern Medical University, Guangzhou, China, [3]Medical Imaging Center, Nanfang Hospital, Southern Medical University, Guangzhou, China, [4]Philips Healthcare, Shenzhen, China, [5]Philips Healthcare, Guangzhou, China, [6]Department of Rehabilitation, Zhujiang Hospital, Southern Medical University, Guangzhou, China

Keywords: CEST / APT / NOE, CEST & MT

Motivation: Long scanning time and low resolution limit the chemical exchange saturation transfer (CEST) clinical translation.

Goal(s): We aimed to develop a high-resolution renal reduced field of view CEST (rCEST) technique to reduce scanning time.

Approach: The rFOV based on orthogonal RF pulses in combination with conventional CEST module was performed on a volunteer and compared this technique with full-size FOV CEST (fCEST).

Results: Compared to fCEST, rCEST has shorter scanning time, higher image quality, and better saturation efficiency at the same image resolution.

Impact: The rCEST technique may have potential for clinical applications requiring high resolution and metabolic renal CEST-MR image.

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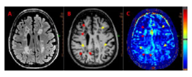
Screen 33



Amide proton transfer weighted signal of multiple sclerosis lesions and normal appearing white matter

Ibrahim Khormi[1,2,3], Oun Al-iedani[2,4], Stefano Casagranda[5], Christos Papageorgakis[5], Abdulaziz Alshehri[1,2,6], Rodney Lea[2], Patrick Liebig[7], Saadallah Ramadan[1,2], and Jeannette Lechner-Scott[2,8,9]

[1]School of Health Sciences, University of Newcastle, Callaghan, Australia, [2]Hunter Medical Research Institute, New Lambton Heights, Australia, [3]College of Applied Medical Sciences, University of Jeddah, Jeddah, Saudi Arabia, [4]School of Biomedical Sciences and Pharmacy, University of Newcastle, Callaghan, Australia, [5]Department of R&D Advanced Applications, Olea Medical, La Ciotat, France, [6]Department of Radiology, King Fahd Hospital of the University, Imam Abdulrahman Bin Faisal University, Al Khobar, Saudi Arabia, [7]Siemens Healthineers, Erlangen, Germany, [8]School of Medicine and Public Health, University of Newcastle, New Lambton Heights, Australia, [9]Department of Neurology, John Hunter Hospital, New Lambton Heights, Australia

Keywords: CEST / APT / NOE, Multiple Sclerosis

Motivation: Monitoring disease progression in people with relapsing-remitting multiple sclerosis (pw-RRMS) presents a substantial clinical challenge. Conventional MRI often fails to provide molecular biomarkers for pathophysiological changes like myelin protein accumulation indicative of demyelination.

Goal(s): The study aimed to validate whether amide proton transfer weighted (APTw) imaging could be a sensitive molecular marker for detecting demyelination in MS lesions.

Approach: We conducted APTw imaging at 3T on 24 pw-RRMS, evaluating the signal intensity within MS lesions compared to contralateral normal-appearing white matter (cNAWM) regions.

Results: The investigation revealed a statistically significant increase in APTw signal intensity in MS lesions compared to cNAWM regions.

Impact: Elevated APTw signal intensity could serve as a non-invasive molecular biomarker for demyelination, potentially aiding in the more accurate monitoring of MS disease progression and treatment efficacy.

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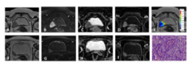

Assessment of neoadjuvant immunochemotherapeutic response for bladder carcinoma using amide proton transfer weighted MRI: a feasibility study

Lingmin Kong[1], Qian Cai[1], Yanling Chen[1], Wenxin Cao[1], Bei Weng[1], Yan Guo[1], and Huanjun Wang[1]

[1]*The First Affiliated Hospital, Sun Yat-Sen University, Guangzhou, China*

Keywords: CEST / APT / NOE, Bladder

Motivation: To accurately predict bladder cancer patient neoadjuvant treatment responses is essential and urgent.

Goal(s): To investigate the feasibility of amide proton transfer weighted (APTw) and diffusion weighted MRI in evaluating the response of neoadjuvant therapy for bladder cancer.

Approach: Histogram analysis features were extracted from pre- and post-treatment APTw and apparent diffusion coefficient (ADC) map.

Results: Several imaging biomarkers derived from pretreatment imaging were statistical significant between pathological complete response (pCR, no residual tumor) and non-pCR group ($P < 0.05$ for all). For the pCR group, APTw values markedly decreased while ADC values noticeably increased at post-treatment MRI ($P < 0.05$ for all).

Impact: This work establishes that APTw MRI holds promise to evaluate bladder cancer tumor responses to neoadjuvant immunochemotherapy and may be used to guide personalized precision therapy in future.

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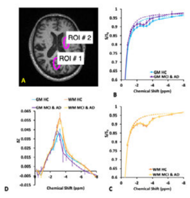


PET-MR compatible CEST method for imaging of Alzheimer's Disease.

Rodolphe Leforestier[1], Ding Xia[1], Li Feng[2], Carolina Ferreira-Atuesta[3,4], Ziwei Xu[4], Trey Hedden[4], and Xiang Xu[1]

[1]*Biomedical Engineering and Imaging Institute, Icahn School of Medicine at Mount Sinai, New-York, NY, United States,* [2]*Center for Advanced Imaging Innovation and Research (CAI2R), New York University Grossman School of Medicine, New-York, NY, United States,* [3]*Department of Neurology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States,* [4]*Department of Neurology, Icahn School of Medicine at Mount Sinai, New-York, NY, United States*

Keywords: CEST / APT / NOE, CEST & MT

Motivation: Current methods of assessing Alzheimer's disease, such as PET scans, are expensive, involve exposure to radiation and have limited resolution.

Goal(s): We aim to demonstrate the applicability a novel CEST MRI method to measure the relayed Nuclear Overhauser effect, which may be sensitive to amyloid-β aggregates.

Approach: We have developed and tested a radially sampled CEST sequence (ssGraspCEST) that can be acquired on hybrid PET-MRI systems.

Results: MCI and AD patients appeared to have narrower distributions of LD_{NOE} and ΔST(-3.6) and higher values. However, due to the limited sample size at this time, no significant differences were observed between the two groups.

Impact: We demonstrated the implementation of a fast, motion-robust CEST method, fully compatible with hybrid PET-MRI systems and particularly suitable for imaging elderly participants who cannot hold still during the scan, which may be useful in future for detecting pathological aggregates.

1100 Pitch: 15:45

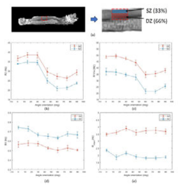
Poster: 16:45

Screen 36

Orientation independent quantification of macromolecular proton fraction in tissues with suppression of residual dipolar coupling

Zijian Gao[1], Ziqiang Yu[1], Ziqin Zhou[1,2], Jian Hou[1], Baiyan Jiang[1,3], Michael Tim-yun ONG [4], and Weitian Chen[1]

[1]Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong, Hong Kong, [2]MR Collaboration, Siemens Healthineers Ltd., Hong Kong, Hong Kong, Hong Kong, [3]Illuminatio Medical Technology Limited, Hong Kong, Hong Kong, Hong Kong, [4]Department of Orthopaedics and Traumatology, The Chinese University of Hong Kong, Hong Kong, Hong Kong



Keywords: Magnetization Transfer, Quantitative Imaging, Macromolecular proton fraction

Motivation: The residual dipolar coupling (RDC) can lead to the orientation-dependent measurements in ordered tissues in MRI, potentially confounding their clinical applications.

Goal(s): We demonstrate the potential confounding effect from tissue orientation in quantitative magnetization transfer can be suppressed by using a new technique Macromolecular Proton Fraction Mapping based on Spin-Lock (MPFSL).

Approach: Applying MPFSL, we can adjust both the resonance frequency offset and the amplitude of spin-lock radiofrequency pulse to achieve a strong effective spin-lock field to suppress RDC, eliminating orientation-dependency of MPF measurement. Human knee specimen experiments conducted verified this finding.

Results: The MPF measured using MPFSL shows insensitivity to tissue orientations.

Impact: Spin-lock based quantitative magnetization transfer imaging can achieve orientation-independent quantification, thus having potential applications in characterization of highly-ordered tissues such as cartilage and myelin.

1101 Pitch: 15:45

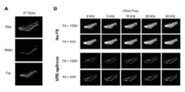
Poster: 16:45

Screen 37

Fat-suppressed Ultrashort Echo Time Quantitative Magnetization Transfer (UTE-qMT) MRI via Single-point Dixon Method

Soo Hyun Shin[1], Hyungseok Jang[1], Arya Suprana[1,2], Eric Y. Chang[1,3], Yajun Ma[1], and Jiang Du[1,2,3]

[1]Department of Radiology, University of California, San Diego, La Jolla, CA, United States, [2]Department of Bioengineering, University of California, San Diego, La Jolla, CA, United States, [3]Radiology Service, VA San Diego Healthcare System, La Jolla, CA, United States



Keywords: Fat & Fat/Water Separation, Fat

Motivation: UTE-qMT imaging has shown potential in probing the molecular composition and microenvironment of short-T_2 tissues. Yet fat signals and chemical shift artifacts interfere with morphological contrast and UTE-qMT measurements.

Goal(s): To establish a fat suppression method for accurate UTE-qMT imaging.

Approach: We adopted the UTE-single point Dixon (UTE-spDixon) method for suppressing fat signals in a series of MT-weighted UTE images of short-T_2 tissues.

Results: UTE-spDixon successfully separates fat from water without short-T_2 signal attenuation and compromising qMT measurement.

Impact: The fat/water-separated UTE-qMT method shown in this study will improve the accuracy of quantifying molecular compositions of short-T_2 tissues. This fat/water separation method also has the potential to apply to other UTE-based quantitative MR techniques.

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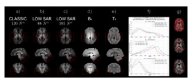
Screen 38



<u>Exploration of a low-SAR ihMT-RAGE approach for human whole brain imaging at 7T</u>

Timothy Anderson[1,2], Lucas Soustelle[1,2], Thomas Troalen[3], Gopal Varma[4], Evgenios N. Kornaropoulos[1,2], Maxime Guye[1,2], Jean-Philippe Ranjeva[1,2], David C. Alsop[4], Guillaume Duhamel[1,2], and Olivier M. Girard[1,2]

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Keywords: Magnetization Transfer, Pulse Sequence Design, qMRI ihMT Neuro Brain

Motivation: Inhomogeneous Magnetization Transfer (ihMT) is a recent MRI technique that has raised great interest for myelin imaging. Several ihMT protocols have been proposed for whole brain imaging at clinical field strengths. However, ultra-high field (UHF, 7T) translation remains challenging.

Goal(s): In this work we explore ways to perform ihMT at UHF for clinical applications.

Approach: A low-SAR ihMT-RAGE sequence is proposed by shortening the ihMT preparation and enabling partial Fourier MT saturation.

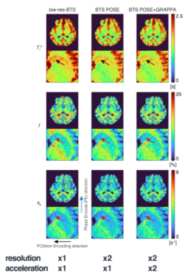
Results: This original sequence addresses SAR limitations within relatively short scan times, allowing for whole brain 1.2mm isotropic resolution (resp. 1mm) in 12 minutes (resp. 16 min) at 7T.

Impact: Ultra-high field ihMT enables high resolution (1mm iso) myelin specific imaging, opening new perspectives for neuroscience and clinical research. Future developments, such as reduced FOV and compressed sensing sequences could bring scan times further down to 5-10 minutes.

1103 Pitch: 15:45

Poster: 16:45

Screen 39



<u>BTS POSE: Rapid High Resolution 3D Quantitative MT Imaging using Novel Position Encoding and Parallel Imaging</u>

Albert Jang[1] and Fang Liu[1]

[1]Martinos Center for Biomedical Imaging, Harvard Medical School, Charlestown, MA, United States

Keywords: Magnetization Transfer, Magnetization transfer

Motivation: Current quantitative MT (qMT) methods have low resolution, limiting their ability to assess tissue microstructure.

Goal(s): Introduce a new qMT approach that achieves 3D isotropic high-resolution qMT within a clinically feasible scan time.

Approach: BTS POSE applies unique subvoxel-shifts along the acquisition parameter dimension, combined with the BTS MT signal model, to generate MT parameter maps with enhanced resolution.

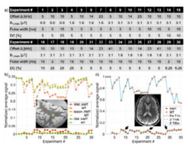
Results: in-vivo results show that BTS POSE 1) enhances the image resolution at no cost of additional scan time, 2) can be combined with parallel imaging to achieve further acqusition acceleration, and 3) generates quantitative maps corresponding well with literature values.

Impact: BTS POSE uses position encoding to generate 3D MT parameter maps with enhanced resolution. This enables microstructure assessment of tissues such as myelin, an important biomarker for neurodegenerative diseases.

1104 Pitch: 15:45

Poster: 16:45

Screen 40



Refinement of the model and types of data for quantitative Magnetization Transfer (qMT) in brain tissues

Gopal Varma[1], Aaron K Grant[1], Lucas Soustelle[2], Olivier M Girard[2], Guillaume Duhamel[2], and David C Alsop[1]

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Keywords: Magnetization Transfer, Magnetization transfer, qMT, ihMT, brain microstructure

Motivation: To improve the accuracy of quantitative Magnetization Transfer (qMT) for interrogation of brain microstructure.

Goal(s): To determine: i) the model for qMT that best describes the signal from MT and inhomogeneous MT (ihMT) experiments, and ii) the MT preparations that contribute useful data.

Approach: We tested accuracies of the models based on fit quality in-vivo and ex-vivo, comparing ex-vivo qMT at physiological and room temperatures. Data were retrospectively reduced to test the importance of types of MT preparations.

Results: We recommend a model with two bound-pool T2 values and use of different MT pulse widths and duty cycles as a result.

Impact: Our results will impact the model and data acquired for quantitative Magnetization Transfer (qMT) of brain tissues. Use of a two bound-pool model with distinct T2 values and data inputs with variations in MT pulse width and DC is recommended.

Power Pitch

Pitch: Clinical Connectivity

Power Pitch Theatre 3

Wednesday
Pitches: 15:45 - 16:45
Posters: 16:45 - 17:45

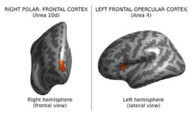
Moderators: Zhaohua Ding & Anouk Schrantee

(no CME credit)

1105 Pitch: 15:45

Poster: 16:45

Screen 41



Aberrant activations associated with developmental dyslexia and READ1 deletion induced by visual/attentive tasks

Alice Giubergia[1,2], Sara Mascheretti[3,4], Filippo Arrigoni[5], Alessio Toraldo[3,6], Chiara Andreola[7], Martina Villa[8,9,10], Valentina Lampis[3,4], Roberto Giorda[11], Marco Villa[11], and Denis Peruzzo[1]

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Keywords: Task/Intervention Based fMRI, fMRI (task based)

Motivation: Developmental Dyslexia (DD) is a complex and heritable neurodevelopmental disorder with heterogeneous genotype-phenotype pathways.

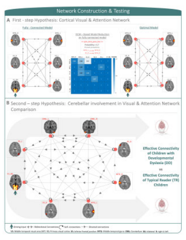
Goal(s): Utilise fMRI as a bridge between genetic factors (DD-candidate risk genes) and behavioral traits (proficiency in reading skills).

Approach: A GLM was used to test for relationships between reading proficiency, genetic mutation, and neural activations of two visual-attentive tasks.

Results: A genetic vulnerability to alterations in neural activation was found in the ventral attentive and salient networks during reading-related stimuli in subjects with poor reading proficiency.

Impact: Functional MRI has shown to be a valuable mediator linking genotype to phenotype, possibly leading to the optimization of criteria to diagnose Developmental Dyslexia and the early identification of children with a genetically driven susceptibility.

1106 Pitch: 15:45
Poster: 16:45
Screen 42



Cortico-cerebellar effective connectivity of visual attention areas is altered in developmental dyslexia compared to typical readers

Gökçe Korkmaz[1], Roberta Maria Lorenzi[1], Sara Mascheretti[1,2], Denis Peruzzo[3], Filippo Arrigoni[4], Egidio D'Angelo[1,5], Fulvia Palesi[1,5], and Claudia A.M. Gandini Wheeler-Kingshott[1,5,6]

[1]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, [2]Child Psychopathology Unit, Scientific Institute, IRCCS Eugenio Medea, Bosisio Parini, Italy, [3]Neuroimaging Unit, Scientific Institute, IRCCS Eugenio Medea, Bosisio Parini, Italy, [4]Pediatric Radiology and Neuroradiology Department, Children's Hospital V. Buzzi, Milan, Italy, [5]Digital Neuroscience Centre, IRCCS Mondino Foundation, Pavia, Italy, [6]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom

Keywords: Functional Connectivity, Brain Connectivity, Dyslexia, Dynamic Causal Modeling

Motivation: Alterations in functional connectivity between regions involved in reading and visuo-attention networks have been associated with developmental dyslexia. However, the causal relationship between regional activity remains unknown.

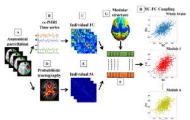
Goal(s): We aimed to investigate the causal relationship between regions of the visuo-attention network in developmental dyslexia and typical readers during a coherent motion detection task.

Approach: Using Dynamic Causal Modeling, the causal connectivity between regions in the cortex and cerebellum was estimated to understand aberrant network function.

Results: Children with developmental dyslexia showed remarkable differences in patterns of excitatory and inhibitory communication between cerebellum and visuo-attention regions compared to typical reader children.

Impact: Dynamic Causal Modeling can evaluate cortico-cerebellar causal relationship (i.e., effective connectivity) in healthy subjects and in neurodevelopmental conditions such as developmental dyslexia. New evidence points toward a critical role of the cerebellum in reading impairment, with potential consequences for intervention.

1107 Pitch: 15:45
Poster: 16:45
Screen 43



Aberrant brain structural–functional connectivity coupling related to cognitive impairment in different cerebral small vessel disease burden

Xinyue Zhang[1], Changhu Liang[1], Mengmeng Feng[2], Haotian Xin[2], Yian Gao[1], Chaofan Sui[1], Na Wang[1], Nan Zhang[1], Hongwei Wen[3], and Lingfei Guo[1]

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Keywords: Functional Connectivity, Aging

Motivation: The impact of different cerebral small vessel disease (CSVD) burden on brain structural and functional connectivity coupling and their correlation with neurocognitive outcomes remain largely unknown.

Goal(s): To explore the alterations of structural and functional connection network (SC-FC) coupling in the whole brain and different functional modules of patients with different CSVD burden compared with healthy controls.

Approach: Diffusion tensor imaging (DTI) and Resting-state blood-oxygen-level-dependent (BOLD) fMRI techniques were used to analyze structural and functional brain connections.

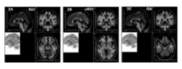
Results: Severe CSVD burden patients exhibited significantly decreased whole-brain SC-FC coupling, reduced modular SC-FC coupling and associated with impairment of cognitive outcomes.

Impact: SC-FC coupling might provide a more sensitive neuroimaging biomarker of CSVD burden as well as new insights into the pathophysiologic mechanisms of the clinical development of CSVD.

1108 Pitch: 15:45

Poster: 16:45

Screen 44



Diffusion tractography and functional connectivity profiles of the dorsal raphe nucleus in Parkinson’s Disease with sleep symptoms

Wei-Jing Hsu[1,2], Srijan Bhasin[1,2,3], Poh Choo Seow[2], Thomas Welton[1,4], Septian Hartono[1,2,4], Celeste Yan Teng Chen[4], Weiling Lee[2], Wilson Wong[2], Louis Chew Seng Tan[1,4], Eng King Tan[1,4], and Ling Ling Chan[1,2,4]

[1]DukeNUS Medical School, Singapore, Singapore, [2]Singapore General Hospital, Singapore, Singapore, [3]Duke University School of Medicine, Durham, NC, United States, [4]National Neuroscience Institute, Singapore, Singapore

Keywords: Functional Connectivity, fMRI (resting state), Parkinson's disease, Dorsal Raphe Nucleus, Sleep disturbance, correlational tractography

Motivation: The role of the dorsal raphe nucleus (DRN) in sleep related pathologies in Parkinson’s disease (PD) remains under investigated.

Goal(s): To characterize functional connectivity patterns and correlational structural tractography changes specific to the DRN in PD and sleep-related symptoms.

Approach: Resting-state functional MRI and diffusion spectrum MRI metrics were compared across PD patients and healthy controls experiencing severe sleep disturbances.

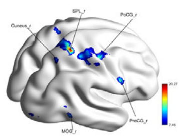
Results: We found changes in functional connectivity profiles of the DRN and findings suggesting axonal damage that showed stronger correlation with sleep symptoms in healthy controls compared to patients, implying potentially distinct pathophysiological mechanisms in symptom development.

Impact: Clarifying involvement of the dorsal raphe nucleus and serotonergic pathways in the pathogenesis of sleep symptoms in Parkinson’s Disease may contribute to development of novel therapies targeted toward specific dysfunctional pathways involved in this quality-of-life disturbing condition.

1109 Pitch: 15:45

Poster: 16:45

Screen 45



Instant modulatory effects of transcutaneous vagus nerve stimulation in patients with Parkinson disease.

Chengwei Fu[1], Yue Zhang[2,3], Kan Deng[4], Xiance Zhao[5], and Bo Liu[2,3]

[1]Department of Rehabilitation, Sir Run Run Shaw Hospital,School of Medicine, Zhejiang University, Hangzhou, China, [2]the Second Affiliated Hospital of Guangzhou University of Chinese Medicine, Guangzhou, China, [3]Guangzhou University of Chinese Medicine, Guangzhou, China, [4]Philips Healthcare, Guangzhou, China, [5]Philips Healthcare, Shanghai, China

Keywords: fMRI Analysis, fMRI (resting state), ALFF, taVNS

Motivation: A growing body of evidence suggests that taVNS may improve the motor function of PD patients whereas little is known about the neuropathologic mechanism.

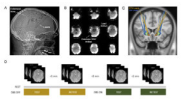
Goal(s): To explore the potential mechanism of taVNS in treating PD by rs-fMRI.

Approach: Fifty patients with PD underwent three times fMRI scanning. And the difference in ALFF among the baeline state,real taVNS and sham taVNS state were investigated.

Results: Compared with baseline and sham taVNS state, the ALFF value showed a significant decrease in 5 clusters. Pearson correlation analysis indicated ALFF of SPL_r in real taVNS condition was negatively correlated with the total UPDRS score, UPDRS-IIIscore and PDQ.

Impact: The taVNS may produce treatment effects by modulating the abnormal ALFF of sensorimotor network,salience network and visual network. This may shed light on the neural mechanisms underlying taVNS treatment of PD.

1110 Pitch: 15:45 Poster: 16:45 Screen 46



Functional MRI test-retest reliability during deep brain stimulation in Parkinson's disease

Skyler Deutsch[1], Katelyn Vu[1], Andrea Fuentes [2], Sarah Wang [3], Alastair Martin[1], Jill L. Ostrem[3], Philip A. Starr[4], Doris D. Wang[4], Ian O. Bledsoe[3], and Melanie A. Morrison [1]

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Keywords: Task/Intervention Based fMRI, fMRI, Deep Brain Stimulation (DBS); Neuromodulation; Reliability; Reproducibility; Test-retest

Motivation: fMRI studies are advancing DBS biomarker development, but data reproducibility is unclear.

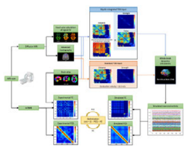
Goal(s): To evaluate resting-state fMRI reliability in 16 patients with DBS for Parkinson's disease.

Approach: fMRI was repeated for DBS-ON and DBS-OFF conditions. Test-retest connectomes were correlated to measure reproducibility and compared across DBS conditions and clinical parameters. Signal reproducibility around the leads was also explored.

Results: Stimulation reduced reproducibility around the leads and across multiple networks, differing by brain target. Patients with less tremor and/or more rigidity and bradykinesia, and relative lower symptom and brain response to DBS had more reproducible functional connectivity.

Impact: The results enhance our understanding of the reliability of resting-state fMRI derivatives in the presence of DBS leads and during stimulation. Realizing the reliability of these data is critical to clinical translation of fMRI-based biomarkers to improve the DBS strategy.

1111 Pitch: 15:45 Poster: 16:45 Screen 47



Integration of myelin-sensitive biophysical features in virtual brain models: towards healthy and pathological Brain Digital Twins

Eleonora Lupi[1], Anita Monteverdi[2], Marta Gaviraghi[1], Elena Grosso[1], Alessandro Marinelli[1], Marco Battiston[3], Francesco Grussu[3,4], Baris Kanber[3,5], Ferran Prados Carrasco[3,5,6], Antonio Ricciardi[3], Nicolò Rolandi[1,3,7], Rebecca S Samson[3], Madiha Shatila[3], Jed Wingrove[3], Marios C Yiannakas[3], Claudia Casellato[1,2], Egidio D'Angelo[1,2], Claudia A. M. Gandini Wheeler-Kingshott[1,2,3], and Fulvia Palesi[1,2]

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Keywords: Functional Connectivity, Brain Connectivity, Brain modeling, The Virtual Brain, conduction velocity

Motivation: The Virtual Brain (TVB) is a neuroinformatic platform used to perform brain dynamic simulations integrating subject-specific imaging data. In standard TVB the input conduction velocity is fixed, making it insensitive to local effective measures of myelin content.

Goal(s): Here we parameterized signal conduction velocity for TVB simulations.

Approach: Considering myelin role in efficient neural conduction, myelin measures were integrated into TVB.

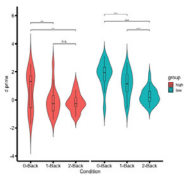
Results: Making TVB sensitive to myelin content highlights variations in simulation outcomes with potential improvements in capturing spatiotemporal dynamics of brain activity. This advancement opens perspectives for realizing more accurate subject-specific simulations, representing a new step towards brain digital twinning.

Impact: Brain Digital Twin technologies will transform personalized medicine, providing a better understanding of pathophysiological underpinnings of diseases. Our study demonstrates how simulating brain activity with The Virtual Brain model improves when integrating subject-specific neural conduction values, calculated from myelin measures.

1112 Pitch: 15:45

Poster: 16:45

Screen 48



The Association of Brain Functional Network Segregation with Working Memory and Negative Symptoms in Schizophrenia

Siwei Liu[1], Bing Cai Kok[1], Gurpreet Rekhi[2], Mei San Ang[2], Jia Ming Lau[1], Jia Nee Foo[3], Raymond C.K. Chan[4,5], Jimmy Lee[2,3], and Juan Helen Zhou[1,6,7]

[1]Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, [2]Research Division, Institute of Mental Health, Singapore, Singapore, [3]Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, Singapore, [4]Neuropsychology and Applied Cognitive Neuroscience Laboratory, CAS Key Laboratory of Mental Health, Institute of Psychology, Beijing, China, [5]Department of Psychology, University of Chinese Academy of Sciences, Beijing, China, [6]Department of Electrical and Computer Engineering, National University of Singapore, Singapore, Singapore, [7]Integrative Sciences and Engineering Programme, National University of Singapore, Singapore, Singapore

Keywords: Functional Connectivity, Brain Connectivity, Schizophrenia, negative symptom, network segregation

Motivation: Empirical findings suggest that negative symptoms of schizophrenia could be improved by cognitive training regime.

Goal(s): This study seeks to (1) understand how brain network architecture supporting task performance may be related to negative symptoms and (2) whether better task performance could be linked to differences in intrinsic functional network architecture.

Approach: Schizophrenia patients underwent resting state and dual-modality N-back task fMRI scans. Network segregation was summarised using the system segregation index for each network.

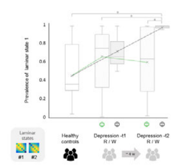
Results: Functional network segregation during both rest and task was associated with negative symptom severity and task performance.

Impact: The current study highlighted the common ground of altered network segregation between negative symptoms and task performance in schizophrenia and encouraged future study on improving negative symptoms and network communication through cognitive training interventions.

1113 Pitch: 15:45

Poster: 16:45

Screen 49



Altered dynamics of global cortical depth connectivity in depression

Patricia Pais-Roldán[1], Shukti Ramkiran[1,2], Seong Dae Yun[1], Ravichandran Rajkumar[1,2,3], Jana Hagen[2], Areej Al Okla[1], Tanja Veselinovic[1,2], Gereon Schnellbächer[2], Irene Neuner*[1,2,3], and N. Jon Shah*[1,3,4,5]

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Keywords: fMRI Analysis, fMRI (resting state), Laminar connectivity, depression

Motivation: A previous own study in healthy volunteers indicated that global laminar connectivity is highly dynamic, suggesting that it could be sensitive to altered brain conditions.

Goal(s): Does global laminar connectivity change in depression?

Approach: We acquired high-resolution fMRI data from patients before and after treatment and conducted a dynamic connectivity analysis focused on cortical depth.

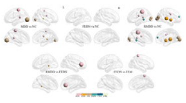
Results: The prevalence of the depth-connectivity states co-evolved with the psychometric scores of patients.

Impact: The presented results may motivate other researchers working on laminar fMRI to average across ROIs and evaluate the effect of diverse brain conditions on the global component of depth-dependent connectivity, whose potential relevance is suggested by our preliminary studies.

1114 Pitch: 15:45

Poster: 16:45

Screen 50



Decreased global signal topography in recurrent major depressive disorder

Huaijin Gao[1], Rui Qian[1], Wen Zhu[1], Chengjiaao Liao[1], Dan Wu[1], and Zhiyong Zhao[1]

[1]Key Laboratory for Biomedical Engineering of Ministry of Education , Department of Biomedical Engineering, College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China

Keywords: Functional Connectivity, fMRI (resting state), Major depressive disorder; Global signal topography

Motivation: Global signal (GS) distribution changes remain unclear in major depressive disorder (MDD).

Goal(s): This study aimed to explore abnormal GS topography in MDD, and its underlying structural mechanism and relationship with clinical assessments.

Approach: We used resting-state fMRI and T1-weighted data from the REST-meta-MDD consortium, and calculated the GS correlation (GSCORR) and gray matter volume (GMV).

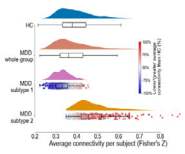
Results: We found decreased GS topography in sensorimotor networks in recurrent MDD, and altered GMV-GSCORR coupling in cingulo-opercular and frontoparietal/occipital networks in first-episode and recurrent MDD, respectively. The alterations of GS topography in temporal lobe and cerebellum correlated with HAMD/HAMA scores, which were partially mediated by GMV.

Impact: Our findings demonstrated that first-episode and recurrent MDD showed different alterations in GS topography, which were associated with cortical GMV and clinical symptoms of patients, contributing to the understanding of relationship between global and local neuronal activities in MDD.

1115 Pitch: 15:45

Poster: 16:45

Screen 51



Two functional connectivity based subtypes of MDD and related biological mechanisms

Qian Li[1], Haoran Li[1], Yaxuan Wang[1], Fenghua Long[1], Yufei Chen[1], Yitian Wang[1], Qiyong Gong[1], and Fei Li[1]

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Keywords: fMRI Analysis, fMRI (resting state), MR value; major depressive disorder; subtypying; genetic mechanisms; neurotransmitter; cognition

Motivation: There's a large clinical heterogeneity presented in MDD and inconsistent MRI evidence on abnormal functional connectivity (FC) in MDD, let alone the unclear biological mechanisms underlying the neuroimaging alterations.

Goal(s): To identify FC based subtypes of MDD and their genetic mechanisms and neurotransmission patterns.

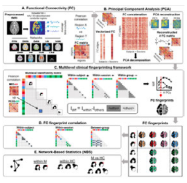
Approach: Consensus clustering of FC was applied to subtyping MDD. Correlation analyses were used to explore the underlying biological mechanisms of FC alterations in each subtype.

Results: Two stable neurophysiological MDD subtypes were found. While the two subtypes were indistinguishable by clinical symptoms, FC alterations of each subtype had distinct spatial correlations with cognition, gene, and neurotransmission profiles.

Impact: Our findings suggested the presence of two neuroimaging subtypes in MDD and the two subtypes can be characterized by different genetic mechanisms, neurotransmitter receptor/transporter profiles, and cognition types, providing new clues to understand the pathophysiology of MDD.

1116 Pitch: 15:45 Poster: 16:45 Screen 52

MERIT AWARD MAGNA CUM LAUDE



Multilevel clinical connectome fingerprinting: uncovering functional connectivity changes across the migraine cycle

Inês Esteves[1], Ana R. Fouto[1], Amparo Ruiz-Tagle[1], Gina Caetano[1], Rita G. Nunes[1], Nuno A. Silva[2], Pedro Vilela[3], Raquel Gil-Gouveia[4], Isabel Pavão Martins[5], César Caballero-Gaudes[6], and Patrícia Figueiredo[1]

[1]ISR-Lisboa/LARSyS and Department of Bioengineering, Instituto Superior Técnico – Universidade de Lisboa, Lisboa, Portugal, [2]Learning Health, Hospital da Luz, Lisboa, Portugal, [3]Neurology Department, Hospital da Luz, Lisboa, Portugal, [4]Center for Interdisciplinary Research in Health, Universidade Católica Portuguesa, Lisboa, Portugal, [5]Centro de Estudos Egas Moniz e Instituto de Medicina Molecular João Lobo Antunes, Faculdade de Medicina da Universidade de Lisboa (FMUL), Lisboa, Portugal, [6]Basque Center on Cognition, Brain and Language, Donostia, Spain

Keywords: Functional Connectivity, Brain, Migraine, Longitudinal, Multilevel Clinical Connectome Fingerprinting

Motivation: Case-control fMRI studies spanning the entire migraine cycle are lacking, precluding a complete assessment of brain functional connectivity in migraine. Such studies are essential for understanding the inherent changes in the brain of migraine patients as well as transient changes along the cycle.

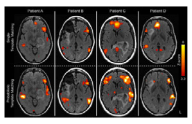
Goal(s): Our goal was to determine the influence of the migraine cycle on individual functional connectome fingerprints.

Approach: Functional connectivity (FC) was longitudinally studied for migraine patients (across the four different cycle phases) and matched healthy controls.

Results: We observed greater heterogeneity in FC patterns of migraine patients and significant changes in FC across the cycle compared to controls.

Impact: This work represents the first case-control fMRI longitudinal study across the whole migraine cycle. Building upon clinical connectome fingerprinting, applied for the first time to migraine, it tackles a major cause of disability worldwide, contributing to developing connectome-based disease biomarkers.

1117 Pitch: 15:45 Poster: 16:45 Screen 53



Probabilistic Template Matching for Detection of Language Network with resting-state fMRI in Patients with Brain Tumors

Jian Ming Teo[1,2], Vinodh A. Kumar[3], Jina Lee[3], Rami W. Eldaya[3], Ping Hou[1], Kyle R. Noll[4], Sherise D. Ferguson[5], Sujit S. Prabhu[5], Max Wintermark[5], and Ho-Ling Liu[1]

[1]Department of Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Medical Physics, The University of Texas MD Anderson Cancer Center UTHealth Graduate School of Biomedical Sciences, Houston, TX, United States, [3]Deparment of Neuroradiology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [4]Neuro-Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [5]Department of Neurosurgery, The University of Texas MD Anderson Cancer Center, Houston, TX, United States

Keywords: fMRI Analysis, fMRI (resting state), Language Function

Motivation: Automated detection of resting-state language network with independent components analysis (ICA) of brain tumor patients is challenging.

Goal(s): Develop an algorithm to detect the language network with ICA guided by a probabilistic overlap map (POM).

Approach: POM was generated from sentence completion presurgical fMRI of 283 patients. Probabilistic template matching performs a direct search over probability thresholds and component numbers. Independent dataset of 28 patients was used for testing in comparison to an existing method.

Results: Recommended ICA components from our algorithm agreed better with tb-fMRI language localizations, demonstrating significantly higher Dice coefficients and Pearson correlation scores in left hemisphere primary language areas.

Impact: The proposed method can improve the accuracy of automated detection of rs-fMRI language network. This may benefit presurgical evaluation for patients whose tumors are adjacent to language areas but have limited tb-fMRI.

1118 Pitch: 15:45
Poster: 16:45
Screen 54

Longitudinal resting-state network changes in treatment-resistant OCD patients following MR-guided Focused Ultrasound Capsulotomy

Conrad P Rockel[1,2], Darren L Clark[1,2], Samuel Pichardo[1,2], Fady M Girgis[2,3], Beverly L Adams[4], Zelma HT Kiss[1,2,3], and G Bruce Pike[1,2]

[1]Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, [2]Radiology and Clinical Neurosciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, [3]Dept of Surgery, University of Calgary, Calgary, AB, Canada, [4]Dept of Psychiatry, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada

Keywords: Task/Intervention Based fMRI, fMRI (resting state), Obsessive compulsive disorder, Focused Ultrasound, Surgery

Motivation: MR-guided focused ultrasound capsulotomy is a surgical procedure to treat intractable OCD. While demonstrating clinical success, the mechanisms of symptom decrease are poorly understood.

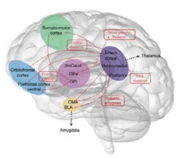
Goal(s): This study sought to explore how intrinsic brain networks change following surgery.

Approach: Seed-based resting state fMRI was used to analyze intrinsic networks in a group of 6 OCD patients prior to and following surgery, along with a matched control group.

Results: Prior to surgery, OCD patients showed greater connectivity within internally-focused networks, and less connectivity in those involved in external cognition. One year following surgery, these connectivity differences were substantially reduced relative to controls.

Impact: This study will appeal to neuroscientists interested in resting-state networks involved with OCD, as well as in how these networks change following a MRgFUS surgical procedure which produced substantial clinical improvement.

1119 Pitch: 15:45
Poster: 16:45
Screen 55



Disrupted functional connectivity architectures of neural circuits in obsessive-compulsive disorder

Lingxiao Cao[1], Hailong Li[1], Jiaxin Jiang[2], Bin Li[2], Shuangwei Chai[1], Huan Zhou[1], Qiyong Gong[1], and Xiaoqi Huang[1]

[1]Department of Radiology and Huaxi MR Research Center (HMRRC), Functional and Molecular Imaging Key Laboratory of Sichuan Province, Frontiers Science Center for Disease-related Molecular Network, West China Hospital, Sichuan University, Chengdu, China, [2]Mental Health Center, West China Hospital of Sichuan University, Sichuan Clinical Medical Research Center for Mental Disorders, Chengdu, China

Keywords: Functional Connectivity, Brain Connectivity

Motivation: The mechanistic understanding of dysfunctional neural circuits involved in obsessive-compulsive disorder (OCD) is incomplete.

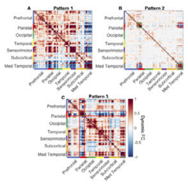
Goal(s): To replicate previous findings in an independent data set and replenish mechanisms of changes in functional connectivity architectures within neurocircuitry of OCD using resting-state fMRI.

Approach: Network-based statistical analysis on a brain network incorporating functionally parcellated regions of interest defined by clustering technique was used.

Results: Hyperconnectivity were detected in the fronto-pallidal, fronto-thalamic, basal ganglia-thalamic, intra-thalamic, and thalamo-amygdala connections in OCD patients compared with healthy controls.

Impact: We depict the neurocircuitry model of OCD pathophysiology through the functional network connectivity perspective and extend it by providing the importance of intra-thalamic and thalamo-amygdala connections in OCD. These findings add mechanistic insights to the dysfunctional neural circuits in OCD.

1120 Pitch: 15:45
Poster: 16:45
Screen 56



<u>Single-timepoint dynamic functional connectivity patterns in temporal lobe epilepsy</u>

Lucas E Sainburg[1,2], Baxter P Rogers[1,2], Catie Chang[1,2,3], Dario J Englot[1,2,3,4], and Victoria L Morgan[1,2,4]

[1]Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Department of Electrical and Computer Engineering, Vanderbilt University, Nashville, TN, United States, [4]Department of Neurological Surgery, Vanderbilt University Medical Center, Nashville, TN, United States

Keywords: Functional Connectivity, fMRI (resting state), Epilepsy, Functional Connectivity

Motivation: Epileptic tissue generates interictal spikes between seizures, which are used to localize the epileptic focus clinically.

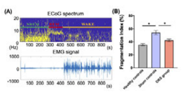
Goal(s): We aimed to detect dynamic functional connectivity (FC) patterns in resting-state fMRI data that may be related to interictal spikes.

Approach: We detected whole-brain dynamic FC patterns at timepoints that had FC characteristics similar to epileptic spikes in both healthy controls and patients with temporal lobe epilepsy (TLE).

Results: We found three dynamic FC patterns, one of which occurred more in TLE than in controls and the occurrence of which was related to clinical measures of epilepsy severity.

Impact: These results suggest the potential clinical utility of fMRI-based dynamic FC to detect interictal spikes. Future studies can evaluate the correspondence of these dynamic FC patterns to interictal spikes using simultaneous electrophysiology and fMRI.

1121 Pitch: 15:45
Poster: 16:45
Screen 57



<u>Investigating the Effect of Central Thalamic Deep Brain Stimulation on Sleep in Alzheimer’s Disease Model</u>

Ching-Wen Chang[1,2], Mu-Hua Wang[1], Yi-Chen Lin[1], Chih-Yu Wang[1], Ssu-Ju Li[1], Ting-Chieh Chen[1], Yao-Wen Liang[1], Ching-Te Chen[3], You-Yin Chen[1], and Sheng-Huang Lin[4,5]

[1]National Yang Ming Chiao Tung University, Taipei City, Taiwan, [2]Biomedical Translation Research Center, Academia Sinica, Taipei City, Taiwan, [3]Abbott Neuromodulation, Austin, TX, United States, [4]Department of Neurology, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Hualien, Taiwan, [5]Department of Neurology, Tzu Chi University, Hualien, Taiwan

Keywords: Functional Connectivity, Alzheimer's Disease, intermittent theta-burst stimulation (iTBS)

Motivation: In Alzheimer's disease (AD), the neuropsychiatric inventory is strongly affected by sleep disorders, and vice versa. Central thalamic deep brain stimulation (CT-iTBS) has improved memory and altered the hypothalamic function which may impact the orexinergic system and sleep.

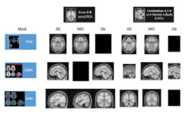
Goal(s): Investigating the therapeutic effect of CT-iTBS on sleep, orexinergic system, and cognitive function in AD.

Approach: Applied functional magnetic resonance imaging, electrocorticogram-electromyogram, behavioral tasks, and ELISA to assess the impact of CT-iTBS in 3xTgAD mouse model.

Results: CT-iTBS significantly improved sleep fragmentation, functional connectivity, cognitive function, and orexin receptors and concentrations in 3xTgAD mice.

Impact: We discovered that CT-iTBS may play an important role in modulating sleep, the orexinergic system, and cognitive function in AD. Improved outcomes pave the future direction of treating sleep disorders in Alzheimer's disease.

1122 Pitch: 15:45
Poster: 16:45
Screen 58



Hyperactive Cerebellum in Alzheimer's Disease

Rommy Elyan[1], Biyar Ahmed[1], and Prasanna Karunanayaka[1]

[1]*Pennsylvania State University College of Medicine, Hershey, PA, United States*

Keywords: Functional Connectivity, Alzheimer's Disease

Motivation: Cerebellar involvement in Alzheimer's disease (AD) has not been studied to the extent that cortical neuropathological changes have been. Historical and recent histopathological literature demonstrates cerebellar AD pathology while functional investigations have demonstrated disrupted intrinsic cortical – cerebellar connectivity in AD.

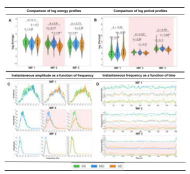
Goal(s): Investigate metabolic activity and functional connectivity of the cerebellum with the default mode network, dorsal attention network, and primary olfactory cortex.

Approach: Characterizing the cerebellum's metabolic activity using 18F-fluorodeoxyglucose positron data from the Alzheimer's Disease Neuroimaging Initiative.

Results: In contrast to known parietal and temporal lobe FDG hypo-metabolism in AD, significant FDG hyper-metabolism was found in the cerebellum.

Impact: Results show that resting state functional connectivity of cerebellar regions (that show hyper FDG metabolic activity) is impaired across brain-wide networks. Future work focusing on inhibitory control of the cerebellum as a potential pathway of AD pathogenesis is warranted.

1123 Pitch: 15:45
Poster: 16:45
Screen 59



Analysis of time varying energy period profiles using Hilbert Huang Transform in resting state fMRI for Alzheimer's disease

Pavithran Pattiam Giriprakash[1], Filippo Cieri[1], Zhengshi Yang[1], Xiaowei Zhuang[1], and Dietmar Cordes[1]

[1]*Lou Ruvo Center for Brain Health, Cleveland Clinic, Las Vegas, NV, United States*

Keywords: fMRI Analysis, Alzheimer's Disease, Resting state fMRI, Empirical Mode Decomposition, Time frequency analysis

Motivation: The time frequency analysis of brain networks in resting state fMRI has largely been based on linear decompositions.

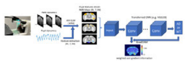
Goal(s): The primary goal of this study is to analyze the temporal dynamics of these networks using an adaptive nonlinear approach devoid of any apriori assumptions or basis functions.

Approach: Empirical Mode Decomposition (EMD), a data driven technique is utilized to investigate the energy period relationship differences in brain networks across cognitively normal (CN), mild cognitive impairment (MCI) and Alzheimer's disease (AD).

Results: The AD group operates at a higher frequency with reduced energy in typical resting state networks compared to both CN and MCI.

Impact: The time varying energy and period profiles obtained from EMD could serve as a potential neuromarker for disease progression from MCI to AD, resulting in timely and early clinical intervention.

1124 Pitch: 15:45 Poster: 16:45 Screen 60



<u>Pupil-fMRI correlation-based Explainable AI to classify Alzheimer’s Disease</u>

Xiaochen Liu[1], William Xu[1], David Hike[1], Zeping Xie[1,2], Andy Liu[1,3], Sangcheon Choi[1], Biyue Zhu[1], Chongzhao Ran[1], Yuanyuan Jiang[1], and Xin Yu[1]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States, [2]School of Traditional Medicine, Southern Medical University, Guangzhou, China, [3]Department of Neuroscience, Boston University, Boston, MA, United States

Keywords: Task/Intervention Based fMRI, Alzheimer's Disease, pupil dynamics

Motivation: The pupil-fMRI correlation analysis reveals that erroneous pupillary light responses in AD mice are highly correlated to specific neuromodulatory systems.

Goal(s): This study applied an explainable AI method with a pre-trained deep convolutional neural network to process pupil-fMRI interactive measurements of awake mice to verify AD biomarkers.

Approach: Using the GradCAM method, we produced the saliency heatmap, which can be used to verify the underlying responsible functional nuclei for classification that could be impaired due to AD degeneration.

Results: This study applied a novel GradCAM-based machine learning scheme to elucidate AD-specific pupillary responses based on impaired neuromodulatory dysfunction as a non-invasive AD biomarker.

Impact: The GradCAM-based saliency map obtained with an XAI method could be used to verify the statistical differential maps of PLR-based fMRI correlation between AD and WT mice, providing a novel non-invasive AD bioimaging marker.

Member-Initiated Session

Everything You Always Wanted To Know About the Annual Meeting Program Committee & from Academic Journal Editors & How You Can Be Part of It

Room 325-326 Wednesday 15:45 - 17:45

(no CME credit)

15:45 What Is the AMPC?

Margaret Hall-Craggs

University College London (UCL)

15:58 How Is the Annual Meeting Program Planned?

Brian Hargreaves

University of Stanford

16:11 The Challenges of the Chair from Experience

Nivedita Agarwal

IRCCS Eugenio Medea

16:24 What Will Be New in Honolulu?

Kei Yamada

Kyoto Prefectural Univ. of Medicine

16:37 Presenting MRM & How Does an Editor Work/Operate?

Peter Jezzard

University of Oxford

16:50 Presenting JMRI & How Does an Editor Work/Operate?

Mark Schweitzer

Wayne State University

17:03 Tips for Authors

Pegah Khosravi

New York City College of Technology

17:16 Tips for Reviewers

Mary McDougall

Texas A&M University

17:29 Panel Discussion

Thursday, 09 May 2024

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Sunrise Course

Cardiology for Physicists: Congenital Heart Disease

Organizers: Michael Atalay, Teresa Correia, Tarique Hussain, Christopher Nguyen, Hajime Sakuma, Andrew Scott, Tobias Wech

Hall 606 | Thursday 7:00 - 8:00 | *Moderators:* Anastasia Fotaki

7:00 Appropriate Use of CMR in Adults with Congenital Heart Disease
Tarinee Tangcharoen

7:30 CMR Assessment of Patients with Fontan Physiology
Sanja Dzelebdzic

Sunrise Course

Absolute Beginner's Guide to Susceptibility Imaging

Organizers: Sune Jespersen, Sila Kurugol, Shaihan Malik, Henrik Odéen, Yasuhiko Tachibana, Cristian Tejos, Richard Thompson

Nicoll 2 | Thursday 7:00 - 8:00 | *Moderators:* Beata Bachrata & Ferdinand Schweser

7:00 Qualitative Susceptibility Imaging
Kohsuke Kudo

7:30 Quantitative Susceptibility Imaging
Sina Straub

Sunrise Course

Response Assessment to Immuno- & Targeted Therapies

Organizers: Nandita DeSouza, Sonal Krishan

Nicoll 3 | Thursday 7:00 - 8:00 | *Moderators:* Fernando Arias-Mendoza & Mary McLean

7:00 Monitoring Response to Targeted & Immunotherapy: iRECIST, DWI & More
Natalie Serkova

7:30 Translation of Quantitative MRI Biomarkers for Assessing Treatment Response: Lessons Learned with MR Elastography
Richard Ehman

Sunrise Course

Unlocking Productivity & Impact in Teaching & Publishing IV

Organizers: Agah Karakuzu, Shin-Lei Peng

Room 325-326 | Thursday 7:00 - 8:00 | *Moderators:* Karin Shmueli & Binu Thomas

7:00 Open Source in Lab Management
Julien Cohen-Adad

7:30 Large Language Models (LLMs) in Research
Efrat Shimron

Sunrise Course

All About Head & Neck: MRI in Surgical Oncology

Organizers: Wei-Tang Chang, Seena Dehkharghani, Xiao-Qi (Juliana) Huang

Room 331-332 | Thursday 7:00 - 8:00 | *Moderators:* Puneet Bagga & Shanshan Jiang

7:00 Overview of Advanced Imaging for Head & Neck Cancer: Exemplary Application for Parotid Tumor Diagnosis
Jingwen Yao

7:30 Advanced Imaging Techniques for Head/Neck Oncology
Stefan Posse

Sunrise Course
Quantification & Analysis: Perfusion
Organizers: HyungJoon Cho, Rita Nunes, Khin Tha, Mingming Wu

Room 334-336 | Thursday 7:00 - 8:00 | *Moderators:* Alex T. L. Leong

7:00 Perfusion: Technical
Yolanda Ohene

7:30 Clinical Application of Perfusion MR Imaging
Won-Jin Moon

Sunrise Course
Open-Source Pipelines for MSK Applications
Organizers: Feliks Kogan, Fang Liu

Summit 1 | Thursday 7:00 - 8:00 | *Moderators:* Albert Jang & Rianne van der Heijden

7:00 Open-Source Muscle Analysis
Francesco Santini

7:20 Deep Learning Open-Source Framework for MSK MRI
Arjun Desai

7:40 Open-Source Challenges & Opportunities
Mark Chiew

Sunrise Course
Surprising Aspects of MRI Physics: The Steady-State & Fast Spin Echo Beasts & Their Beauty
Organizers: Brian Hargreaves, Shaoying Huang, Rita Schmidt, Rolf Schulte, Ramesh Venkatesan, Andrew Webb

Summit 2 | Thursday 7:00 - 8:00 | *Moderators:* Congbo Cai & Ruixi Zhou

7:00 Transition Bands in Balanced SSFP: From Artifacts to Refined Method for fMRI Contrast
Rahel Heule

7:30 Spin-Echo Trains: Surprises & Facts
David Alsop

Other
Junior Fellows Shark Tank

Room 325-326 | Thursday 8:15 - 10:15

(no CME credit)

Weekday Course
Contrast Agents
Organizers: Shaihan Malik, Henrik Odéen, Nadya Pyatigorskaya, Cristian Tejos

Summit 1 | Thursday 8:15 - 10:15 | *Moderators:* Scott Swanson

8:15 Relaxation-Based Agents: The Basics

Zheng-Rong Lu[1]

[1]*Case Western Reserve University, Cleveland, OH, United States*

Keywords: Contrast mechanisms: Contrast agents, Contrast mechanisms: Molecular imaging

MR images are generated based on the magnetic properties of water protons, particularly their relaxation rates, in the body. Paramagnetic substances are often used to alter the relaxation rate of protons in tissues or around biomolecules of interest, creating enhanced MR signal contrast over surrounding tissues for anatomical or molecular imaging. This presentation discusses the basic principles, including relaxivities, contrast enhancement, structure and chelation stability, and molecular imaging of relaxation-based contrast agents. Approaches for designing contrast agents with high relaxivities and clinically translatable targeted contrast agents for Magnetic Resonance Molecular Imaging (MRMI) will also be discussed.

8:45 Gd-Based Contrast: Amazingly Safe & Yet So Many Issues

Martin Prince[1]

[1]*Cornell & Columbia Universities, United States*

9:15 MRI Contrast Without Contrast

Meng Law[1]

[1]*Alfred Hospital, Melbourne, Australia*

9:45 Non-Relaxation-Based Contrast Agents

Kannie WY Chan[1,2]

[1]*Department of Biomedical Engineering, Hong Kong Centre for Cerebro-cardiovascular Health Engineering, City University of Hong Kong, Hong Kong, Hong Kong,* [2]*Russell H Morgan Department of Radiology and Radiological Science, Johns Hopkins University, School of Medicine, Baltimore, MD, United States*

Keywords: Contrast mechanisms: CEST & MT, Neuro: Brain

Imaging exchangeable protons of molecules using CEST MRI has significant potential for disease diagnosis and treatment evaluation. This technique, first introduced by Wand and Balaban in 2000, involves saturating these protons, enabling the detection of water signal saturation. The exchange process, influenced by local environmental factors like temperature and pH, allows for the imaging of intriguing in vivo events, such as those within tumors and stroke lesions. This presentation will explore the principles of CEST MRI and exchange-based contrast agents, focusing on their role in detecting neuropathology across various disease stages.

Oral

Imaging Brain Anatomy & Physiology

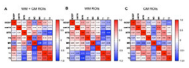
Hall 606 Thursday 8:15 - 10:15 *Moderators:* Cristina Cudalbu

8:15 Introduction

Cornelius Faber

University Hospital Muenster, Germany

1125 8:27 Towards a multi-parametric MRI-based myelin marker in the developing mouse brain



Choong Heon Lee[1], Jennifer A Minteer[2], Zifei Liang[1], Yongsoo Kim[2], and Jiangyang Zhang[1]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Department of Neural and Behavioral Sciences, Penn State University, Hershey, PA, United States

Keywords: Biomarkers, Neuro

Motivation: Although several myelin markers have been introduced using MRI, their ability to accurately detect myelin has been limited in sensitivity and specificity.

Goal(s): MP-MRI shows promise in improving myelin mapping, but validating its effectiveness remains a challenge. Our aim is to create a MP-MRI indicator and verify its accuracy through 3D myelin histology.

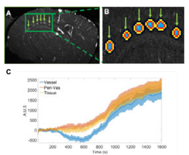
Approach: We compared myelin histology in MOBP-eGFP mouse brains, which exhibit enhanced myelination with various MRI markers in the same subjects.

Results: We observed varying degrees of correlation between MRI markers and MOBP signals in different brain regions. Employing PLSR analysis revealed that MP-MRI has potential to enhance myelin mapping.

Impact: The integration of multiple MRI markers in multiparametric MRI has the potential to improve our capacity for mapping myelin in the brain. A direct biomarker of myelin would be highly impactful for management of patients with MS and de/dysmyelinating disorders.

1126 8:39 Mapping glymphatic solute transportation through the perivascular space of hippocampal arterioles with 14 Tesla MRI

MERIT AWARD
SUMMA CUM LAUDE



Xiaoqing Alice Zhou[1,2], Weitao Man[1,2], Xiaochen Liu[1,2], Yuanyuan Jiang[1,2], David Hike[1,2], Lidia Gomez Cid[1,2], Sangcheon Choi[1,2], Changrun Lin[1,2], and Xin Yu[1,2]

[1]A.A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States

Keywords: Small Animals, Vessels, Glymphatic

Motivation: The perivascular space (PVS) plays a crucial role in facilitating the clearance of waste products and the exchange of cerebrospinal fluid and interstitial fluid in the central nervous system.

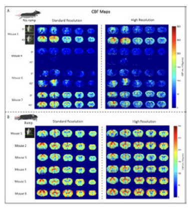
Goal(s): However, the limited depth penetration of current imaging methods impedes the study of glymphatic dynamics in deep brain regions.

Approach: In this study, we introduced an ultra-high-resolution dynamic contrast-enhanced MRI mapping approach based on single-vessel multi-gradient-echo methods.

Results: This technique allowed the differentiation of penetrating arterioles and venules from adjacent parenchymal tissue voxels and enabled the detection of Gd-enhanced signals coupled to PVS of penetrating arterioles in the deep cortex and hippocampus.

Impact: The study revealed significant PVS-specific Gd signal enhancements, shedding light on glymphatic function in deep brain regions. These findings advance our understanding of brain-wide glymphatic dynamics and impaired waste clearance, warranting further exploration of their clinical relevance and therapeutic applications.

1127 8:51



High resolution pCASL mapping of perfusion in the mouse brain
Sara Pires Monteiro[1,2], Lydiane Hirschler[3], Emmanuel L. Barbier[4], Patrícia Figueiredo[2], and Noam Shemesh[1]

[1]Champalimaud Research, Champalimaud Foundation, Lisbon, Portugal, [2]Institute for Systems and Robotics - Lisboa and Department of Bioengineering, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal, [3]C.J. Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands, [4]Université Grenoble Alpes, Inserm, Grenoble Institut des Neurosciences, Grenoble, France

Keywords: Biology, Models, Methods, Perfusion, Arterial Spin Labelling

Motivation: pCASL perfusion mapping has many potential applications in preclinical imaging, but its use is still challenging particularly in mice and at higher fields due to limited sensitivity and constraints on labelling arising from the mouse’s anatomy.

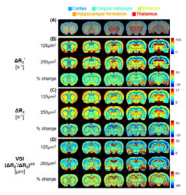
Goal(s): Here, we set to push the spatial resolution limitations of pCASL in mice by over an order of magnitude.

Approach: For this, we leverage SNR increases provided by cryogenic coils and develop a novel experimental setup optimizing and stabilizing the positioning of the mice.

Results: We then show x11 higher spatial resolution CBF maps compared to the previous state-of-the-art and higher stability and reproducibility of findings.

Impact: We developed a setup optimizing carotid positioning for mice, thereby enabling efficient pCASL labeling. When combined with a cryogenic coil, perfusion images of the mouse brain were enhanced x11 in spatial resolution and were highly reproducible compared to current state-of-the-art.

1128 9:03



The resolution dependence of MRI vessel size index varies across brain regions.
Dongkyu Lee[1], Yelim Gong[1], Sohyun Han[2], and HyungJoon Cho[1]

[1]Biomedical Engineering, Ulsan National Institute of Science and Technology, Ulsan, Korea, Republic of, [2]Korea Basic Science Institute, Cheongju, Korea, Republic of

Keywords: Perfusion, Vessels, vessel size index, VSI, resolution dependence

Motivation: Vessel size index (VSI) MRI of the rodent brain is measured at various in-plane resolutions, but the resolution dependence of VSI has not yet been explored.

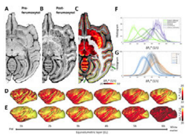
Goal(s): Here, we investigated the differences in rat brain VSI at mostly measured in-plane resolutions of 125μm^2 and 250μm^2.

Approach: Resolution-dependent differences in VSI across brain regions were investigated in in-vivo rat experiments via a steady-state susceptibility contrast method by injection of monocrystalline iron oxide nanoparticles and validated through Monte Carlo simulations.

Results: In the white matter and hippocampus regions, the VSI was measured to be 12% larger as the resolution was lowered from 125μm^2 to 250μm^2.

Impact: Because the resolution dependence of VSI quantification varies across brain regions depending on the vascular configuration within MRI voxels, caution is required when comparing and analyzing brain VSI MRI obtained at different resolutions.

1129 9:15



Charting vascular network architecture in primate brain using ferumoxytol-weighted laminar MRI

Joonas A. Autio[1], Ikko Kimura[1], Takayuki Ose[1], Yuki Matsumoto[1], Masahiro Ohno[1], Yuta Urushibata[2], Takuro Ikeda[1], Matthew F. Glasser[3,4], David C. Van Essen[3], and Takuya Hayashi[1]

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Keywords: Blood Vessels, Blood vessels

Motivation: Although the brain's vascular network plays a crucial role in supplying oxygen and glucose while removing metabolic by-products to meet the high energy demands of neural information processing, our understanding of the vascular network architecture in the primate brain remains limited.

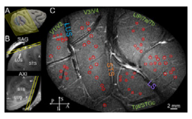
Goal(s): To address this issue, our study aims to explore the variability of the vascular network and its relationship to underlying neuroanatomy.

Approach: We investigate brain vascularity in macaque monkeys using ferumoxytol-weighted laminar MRI.

Results: We demonstrate that vascularity exhibits 3-fold variation across brain regions, moderate variability across cortical layers, distinct translaminar clusters, and strong association with neuron and synaptic densities.

Impact: Laminar ferumoxytol-weighted MRI shows considerable potential to delineate pial vessel network, intracortical feeding arteries and draining veins and density of capillary networks. The capillary density exhibits close association with the underlying neuroanatomy.

1130 9:27



Imaging small intracortical blood vessels at 64 µm in-plane resolution in macaque monkey brain in vivo using a large-bore 7T MRI scanner

Jianbao Wang[1,2], Yuhan Ma[3], Yipeng Liu[1], Libo Lin[1,4], Avery J. L. Berman[3,5], Saskia Bollmann[6], Jonathan R. Polimeni[7,8,9], and Anna Wang Roe[1,2,4,10]

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Keywords: Blood Vessels, Vessels, Ultra-high field MRI

Motivation: Hemodynamics of the cerebral cortex are shaped by vascular architecture; however, it remains challenging to study the small intracortical vascular anatomy *in vivo*.

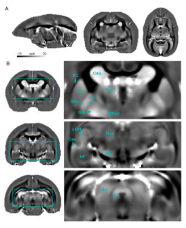
Goal(s): To test whether intracortical arterioles can be detected *in vivo* in non-human primates at 7 Tesla using a conventional human MRI scanner, and to study the organization of arterials and venules.

Approach: After conducting time-of-flight (TOF) contrast simulations, optimized TOF-MRA images from macaques were acquired using a 7T large-bore MRI scanner with 64-µm in-plane resolution.

Results: Intracortical arterioles and venules were reliably imaged and exhibited cortical area-specific differences in distribution. Imaging times were as fast as 10 minutes.

Impact: Using a standard human 7T MRI scanner, we illustrate that micron-scale intracortical arterioles are detectable non-invasively in vivo in primates. We suggest similar methods can be used to study human microvascular organization in health and disease.

1131 9:39



Quantitative susceptibility mapping of the common marmoset brain at 9.4 T

Rakshit Dadarwal[1] and Susann Boretius[1]

[1]Functional Imaging Laboratory, German Primate Center, Göttingen, Germany

Keywords: Large Animals, Nonhuman Primates, Susceptibility, Marmoset, Nonhuman primate, QSM, R2*, SWI, 9.4T, High-field

Motivation: Quantitative Susceptibility Mapping (QSM) is still not widely employed in non-human primates (NHP). Although it has been recently applied to cynomolgus and rhesus macaques, little attention has been given to other NHPs like marmosets.

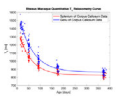
Goal(s): Our goal was to establish QSM in marmosets at 9.4 T.

Approach: We conducted high-field MRI on 33 healthy marmosets to achieve superior spatial resolution and sensitivity. We evaluated the contrast-to-noise ratio in the QSM map for four subcortical structures and generated cortex intensity profiles.

Results: In the marmoset brain, QSM provided excellent contrast of subcortical structure, various white matter tracts, and the cortex.

Impact: Establishing QSM in marmosets may be helpful to those interested in comprehending brain tissue structure and organization, refining brain parcellation, and facilitating procedures like MRI-guided stereotactic surgery, injections, and precise neuronal targeting.

1132 9:51



Comparison of White Matter Maturation Rates in Young Rhesus Macaques and Humans

Carly Allen[1], Douglas Dean[2], Jason Moody[3], Marissa DiPiero[4], Nakul Aggarwal[4], Ned Kalin[5], Andrew Alexander[1], and Steve Kecskemeti[6]

[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Pediatrics, University of Wisconsin-Madison, Madison, WI, United States, [3]Medicine, University of Wisconsin-Madison, Madison, WI, United States, [4]Neuroscience Training Program, University of Wisconsin-Madison, Madison, WI, United States, [5]Psychiatry, University of Wisconsin-Madison, Madison, WI, United States, [6]Waisman Center, University of Wisconsin-Madison, Madison, WI, United States

Keywords: Large Animals, Nonhuman Primates, White Matter, Non-Human Primates, Modeling, Normal Development

Motivation: Non-human primates are thought to develop 3-4 times faster than humans based on sexual maturity and death; however, there has been a lack of quantitative data to support this ratio to describe brain development.

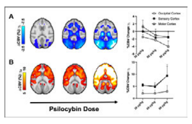
Goal(s): Our goal was to find a quantitative relationship between the rate of white matter myelination in rhesus macaques and humans.

Approach: We compared rates of change in quantitative relaxometry MRI T1 values in six ROIs for rhesus macaques and human infants.

Results: We found a ratio ranging from 4.7 to 6.2 in the ROIs, corresponding to 4.7-6.2 times faster white matter myelination in rhesus macaques than humans.

Impact: By providing a quantitative approach to comparing early-life rhesus macaques white matter development with human infants, research that relates rhesus macaques and human brain development can make a more informed comparison, assisting researchers in translating results between species.

1133 10:03



[Neuroimaging of Serotonergic and Psychedelic Agonist Drug Challenges in Non-Human Primates]

Ande Bagdasarian[1], Kristian Larsen[2,3], Patrick M. Fisher[2,4], Hanne D. Hansen[1,2], and Hsiao-Ying Wey[1]

[1]Radiology, Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School, Massachusetts General Hospital, Boston, MA, United States, [2]Neurobiology Research Unit, Copenhagen University Hospital, Rigshospitalet, Copenhagen, Denmark, [3]Department of Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark, [4]Department of Drug Design and Pharmacology, University of Copenhagen, Copenhagen, Denmark

Keywords: Pharmacology, Translational Studies, Psychedelics; phMRI; fMRI; Pharmacology; 5-HT2AR

Motivation: Acute effects of psychedelic drugs are under-reported in neuroimaging studies, warranting further investigation of their immediate pharmacology to explore the potential to monitor treatment response with imaging.

Goal(s): Our goal was to assess acute impacts of serotonergic (psychedelic and non-psychedelic) agonists on hemodynamics in non-human primates (NHP).

Approach: Pharmacological-MRI (phMRI) was used to measure cerebral blood volume (CBV) changes by psilocybin, lisuride and 25CN-NBOH.

Results: Psilocybin and lisuride induced bi-phasic hemodynamic response, whereas 25CN-NBOH was monophasic. Bi-phasic phenomena may be due to non-selectivity of agonist drugs. Elevated CBV at higher psilocybin doses persists longitudinally, while lisuride and 25CN-NBOH modulations trend toward baseline.

Impact: Bi-phasic signal profiles and downstream impacts to cerebral hemodynamics may reflect non-selective targeting of psilocybin and lisuride, highlighting the sensitivity of phMRI in drug evaluation.

Oral

Diffusion: Artificial Intelligence & Machine Learning

Nicoll 1 | Thursday 8:15 - 10:15 | *Moderators:* Daniel Alexander & ZERAII ABDERRAZEK

8:15 Introduction

Daniel Alexander

University College London, United Kingdom

1134 8:27

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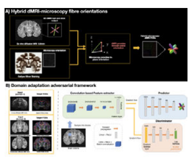

[Estimating microscopy-informed fibre orientations from in-vivo dMRI using a domain adaptation adversarial network]

Silei Zhu[1], Nicola K. Dinsdale[2], Saad Jbabdi[1], Karla L. Miller*[1], and Amy F.D. Howard*[1]

[1]Wellcome Centre for Integrative Neuroimaging, FMRIB Centre, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Oxford Machine Learning in NeuroImaging Lab (OMNI), Department of Computer Science, University of Oxford, Oxford, United Kingdom

Keywords: Tractography, Tractography & Fibre Modelling, Multimodal, Microscopy, structural connectivity, diffusion, machine learning

Motivation: Joint modelling of diffusion MRI and microscopy can leverage their complementary strengths to improve the estimation of fibre orientations. Ideally, these benefits would extend beyond the few datasets where dMRI and microscopy are acquired in the same brain to improve orientation estimates in *in-vivo* data.

Goal(s): To translate the unique properties of joint dMRI-microscopy data modelling to benefit *in-vivo* dMRI datasets.

Approach: We construct a domain adaptation adversarial network that can estimate microscopy-informed FODs from single-shell *in-vivo* dMRI.

Results: Tractography performed using network-derived FODs show improved tracking in grey matter, bottleneck regions, superficial white matter fibres, and long-range structural connectivity.

Impact: Our microscopy-informed neural network improves fibre orientation estimation from *in-vivo* single-shell dMRI datasets. We demonstrate improvements in fibre tracking that may enable more precise and detailed detection of connectivity, with a broad range of applications in basic and clinical neuroscience.

1135 8:39

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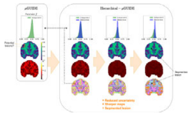


Hierarchical-µGUIDE: fast and robust Bayesian hierarchical modelling using deep learning simulation-based inference

Louis Rouillard[1], Demian Wassermann[1], Marco Palombo[2], and Maëliss Jallais[2]

[1]MIND team - Inria, Palaiseau, France, [2]CUBRIC - Cardiff University, Cardiff, United Kingdom

Keywords: Microstructure, Microstructure

Motivation: In-vivo brain microstructure can be estimated using diffusion MRI. However, most approaches do not quantify estimates reliability, although crucial for interpreting the results, and consider every voxel independently, leading to high uncertainties.

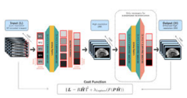
Goal(s): Our goal is to develop a new framework to efficiently estimate tissue microstructure and improve data fitting quality.

Approach: We propose Hierarchical-µGUIDE, a Bayesian method that estimates posterior distributions, by combining simulation-based inference with a hierarchical structure.

Results: Hierarchical-µGUIDE bypasses the high computational and time cost of conventional Bayesian approaches. Sharper microstructure parameter maps that preserve tissue heterogeneity are obtained, along with a tissue parcellation that segments an epileptic lesion.

Impact: The proposed Bayesian framework improves single-subject inference for clinical diagnosis, by efficiently estimating posterior distributions, reducing estimates uncertainty, and learning a tissue parcellation. This works unlocks the possibility to apply hierarchical Bayesian methods taylored for microstructure estimation to large datasets.

1136 8:51



gNET: gSlider Self-Supervised Neural Network for Accelerated Reconstruction of Super-resolution Diffusion MRI

Caique de Oliveira Kobayashi[1,2,3], Yohan Jun[1,4,5], Jaejin Cho[1,4,5], Xiaoqing Wang[4,5,6], Zihan Li[7], Qiyuan Tian[7], and Berkin Bilgic[1,4,5]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Boston, MA, United States, [2]Mechanical Engineering, Escola Politécnica da USP, São Paulo, Brazil, [3]Technical University of Munich, Munich, Germany, [4]Radiology, Harvard Medical School, Boston, MA, United States, [5]Harvard/MIT Health Sciences and Technology, Cambridge, MA, United States, [6]Boston Children's Hospital, Boston, MA, United States, [7]Department of Biomedical Engineering, Tsinghua University, Beijin, China

Keywords: Diffusion Reconstruction, Diffusion/other diffusion imaging techniques, gSlider, deep-learning, self-supervised, AI/ML Image Reconstruction

Motivation: gSlider utilizes radio-frequency encoding to acquire high and isotropic resolution brain diffusion-MRI with high SNR. However, this comes at the cost of prolonged acquisition time, which also increases the sensitivity to motion.

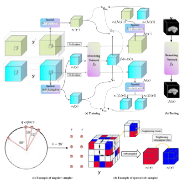
Goal(s): This work proposes gSlider Network (gNET) to accelerate gSlider from acquisitions with jointly subsampled RF- and q-space.

Approach: The self-supervised model was trained and tested on a 1mm^3 resolution BUDA-gSlider dataset (T_{acq} = 32 min). FSL and the DIMOND self-supervised were used to estimate the diffusion parameters.

Results: gNET achieved an acceleration factor of R=2 and, when combined with DIMOND, reached a total R=4-fold (T_{acq} = 8 min).

Impact: gNET facilitates super-resolution dMRI by reducing the acquisition time by 4-fold with high fidelity. Its application may propel new discoveries in the neuroscientific field and the clinical translation of the gSlider framework.

1137 9:03



[Spatio-Angular Noise2Noise for Self-Supervised Denoising of Diffusion MRI Data]

Haotian Jiang[1], Shu Zhang[2], Xuyun Wen[3], Hui Cui[4], Jun Lu[1], Islem Rekik[5], Jiquan Ma*[1], and Geng Chen*[2]

[1]Heilongjiang University, Harbin, China, [2]Northwestern Polytechnical University, Xian, China, [3]Nanjing University of Aeronautics and Astronautics, NanJing, China, [4]La Trobe University, Victoria, Australia, [5]Imperial College London, London, United Kingdom

Keywords: DWI/DTI/DKI, Diffusion/other diffusion imaging techniques, Denoising, Self-Supervised Learning, Spatio-Angular Domain

Motivation: Diffusion MRI (DMRI) suffers from heavy noise. The noise issue reduces the accuracy and reliability of the derived diffusion metrics.

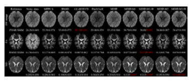
Goal(s): Existing Deep Learning (DL) methods for DMRI denoising usually rely on training with paired noisy-clean data, which are unavailable in a clinical setting. Therefore, we propose a self-supervised DL denoising method, called Spatio-Angular Noise2Noise, for DMRI denoising.

Approach: We stem from the fact that a network trained with paired noisy data can capture the essential information of underlying clean data for noise reduction.

Results: Extensive experiments on simulated and real datasets demonstrate the superiority of SAN2N over existing DMRI denoising methods.

Impact: SAN2N can reduce the noise effectively and improve the quality of fiber ODFs and tractography.

1138 9:15



[Unsupervised deep learning for denoising diffusion-weighted images with noise-correction loss functions]

Yunwei Chen[1], Zhicheng Zhang[2], Yanqiu Feng[1], and Xinyuan Zhang[1]

[1]Southern Medical University, Guangzhou, China, [2]JancsiLab, JancsiTech, HongKong, China

Keywords: DWI/DTI/DKI, Brain, denoise

Motivation: Since the noisy magnitude MR data generally follows Rician distribution, using the noisy images and network's output to construct unsupervised learning's loss function for denoising will lead to a biased estimation, especially for DW images which suffers from the lower SNR.

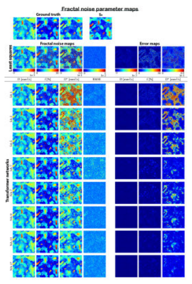
Goal(s): To address the noise bias issue.

Approach: We proposed two noise-correction loss functions for unsupervised denoising of DW images, based on DIP and the characteristics of Rician distribution.

Results: The experimental results on simulated and in-vivo data demonstrated that the proposed loss functions effectively corrected the signal-dependent noise bias and improved the accuracy of unsupervised learning-based DW images denoising method.

Impact: Firstly, we proposed two noise-correction loss functions and validate their effectiveness in denoising DW images. Secondly, the proposed loss functions are not limited to DW images and can be directly applied to other modality MR images.

1139 9:27



Neighborhood-attention models for incorporating spatial information in deep learning parameter estimation applied to IVIM

Misha Pieter Thijs Kaandorp[1,2,3], Frank Zijlstra[1,2], Davood Karimi[3], Ali Gholipour[3], and Peter Thomas While[1,2]

[1]Department of Radiology and Nuclear Medicine, St. Olav's University Hospital, Trondheim, Norway, [2]Department of Circulation and Medical Imaging, NTNU – Norwegian University of Science and Technology, Trondheim, Norway, [3]Department of Radiology, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States

Keywords: Analysis/Processing, Signal Representations, AI, transformers, synthetic data, parameter estimation, IVIM

Motivation: Conventional model-fitting approaches neglect spatial information. Recent work showed promise in using convolutional neural networks (CNNs) trained on spatially-correlated synthetic data. However, the convergence rate remained suboptimal, and the spatial extent was limited.

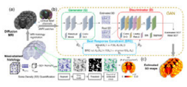
Goal(s): To improve estimator performance by utilizing transformer networks and training on larger receptive-fields.

Approach: Transformers with self-attention and neighborhood-attention with increased receptive-field were trained on spatially-correlated synthetic data (IVIM), and evaluated quantitatively using novel fractal-noise maps and in-vivo scans.

Results: Transformers excelled in integrating spatial information over CNNs. The application of larger receptive-fields with neighborhood-attention effectively leveraged correlated signal information from nearby voxels, leading to improved estimator performance.

Impact: The improved parameter estimation from neighborhood-attention models trained on synthetic data brings challenging ill-posed signal analysis problems, like IVIM, closer to clinical implementation. Additionally, the novel fractal-noise maps provide spatially-correlated ground truths, permitting new approaches to quantitative medical image analysis.

1140 9:39



Diffusion MRI-based Estimation of Cortical Architecture via Machine Learning (DECAM) enhanced by cortical label vectors

Tianjia Zhu[1,2], Minhui Ouyang[1,3], Xuan Liu[4], Risheng Liu[4], and Hao Huang[1,3]

[1]Department of Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States, [2]Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, United States, [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [4]School of Information Science and Engineering, Dalian University of Technology, Dalian, China

Keywords: Microstructure, Diffusion/other diffusion imaging techniques, Diffusion analysis and visualization, biomarkers, cortical architecture, non-invasive virtual histology

Motivation: Advanced diffusion MRI (dMRI) has enabled noninvasive assessment of cortical measures conventionally only available from neuropathology. Analytical dMRI models are limited by restrictive model assumptions.

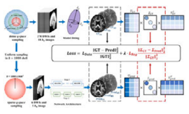
Goal(s): In this study, we develop Diffusion-MRI based Estimation of Cortical Architecture using Machine-learning (DECAM), a translational framework of "noninvasive neuropathology" that can quantify cortical architecture based on dMRI.

Approach: DECAM incorporates cortical label vectors to address the challenge of achieving perfect MRI-histology registration in primate brains due to their complex morphology.

Results: By providing high-fidelity, reproducible whole-brain soma density maps validated with histology, DECAM paves the way for data-driven noninvasive histology for potential applications such as Alzheimer's.

Impact: DECAM is the first translational framework and robust pipeline that addresses the challenge of estimating high-fidelity whole-brain soma density in primate brains with complex morphology. DECAM paves the way for data-driven noninvasive histology for potential applications such as Alzheimer's.

1141 9:51 [AID-DTI: fast and high-fidelity diffusion tensor imaging with detail-preserving model-based deep learning]



Wenxin Fan[1,2], Cheng Li[1], Jing Yang[3,4], Juan Zou[5,6], Hairong Zheng[1], and Shanshan Wang[1,7,8]

[1]Paul C Lauterbur Research Center for Biomedical Imaging, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [2]University of Chinese Academy of Science, Beijing, China, [3]Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [4]University of Chinese Academy of Science, Beijing, China,, Beijing, China, [5]School of Physics and Optoelectronics, Xiangtan University, Xiangtan, China, [6]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, [7]Guangdong Provincial Key Laboratory of Artificial Intelligence in Medical Image Analysis and Application, Guangzhou, China, [8]Peng Cheng Laboratory, Shenzhen, China

Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging, Deep Learning

Motivation: Existing methods tend to suffer from Rician noise, leading to detail loss during the reconstruction of DTI-derived parametric maps. This issue becomes particularly pronounced when sparsely sampled q-space data are used.

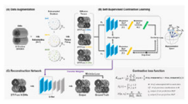
Goal(s): Our goal was to facilitate fast and high-fidelity estimation of DTI metrics.

Approach: We propose a novel SVD-based regularizer, which can effectively preserve fine details while suppressing noise during network training.

Results: Experimental results consistently demonstrate that the proposed method estimates DTI parameter maps with finer details, outperforming current state-of-the-art methods.

Impact: The proposed method may facilitate fast and high-fidelity DTI with a newly designed SVD-based regularizer, and it has a potential to become a practical tool in clinical and neuroscientific applications.

1142 10:03 [A Contrastive Learning for Accelerating Diffusion Tensor Imaging with High Adaptability to Diffusion Gradient Schemes]



Siyun Jung[1], Jae-Yoon Kim[1], and Dong-Hyun Kim[1]

[1]Department of Electrical and Electronic Engineering, Yonsei University, Seoul, Korea, Republic of

Keywords: Diffusion Reconstruction, Diffusion Tensor Imaging

Motivation: High-quality DTI requires numerous DWIs, extending scan times; however, despite deep learning's advances in reconstructing DTI with fewer DWIs, its adaptability across various gradient protocols remains limited, challenging its clinical application.

Goal(s): Our aim is to enable consistent, high-quality DTI reconstructions from fewer DWIs across different gradient schemes, enhancing adaptability in various clinical environments.

Approach: We employ self-supervised contrastive learning to extract and preserve key features between datasets derived from the same data with different gradient sampling methods.

Results: Our method reliably enhanced diffusion tensor maps from reduced DWIs across various gradient sampling schemes, outperforming both conventional methods and state-of-the-art deep learning model.

Impact: Our method creates high-quality DTI from fewer DWIs, reducing scan times and easing patient burden, while showing consistent performance across various gradient sampling schemes, ensuring high adaptability and ease of use in diverse clinical settings.

Oral
Pulse Sequence Design

Nicoll 2 | Thursday 8:15 - 10:15 | *Moderators:* Jürgen Finsterbusch & Yun Jiang

1143 8:15

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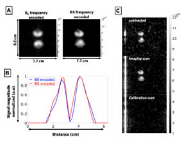


Gradient-Free Frequency Encoded MRI

Sai Abitha Srinivas[1], Antonio D Glenn[2], Christopher E Vaughn[3], Mark A Griswold[4], and William A Grissom[1]

[1]*Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States,* [2]*Computer Science, University of Washington, Seattle, WA, United States,* [3]*Biomedical Engineering, Vanderbilt University, Nashville, TN, United States,* [4]*Radiology, Case Western Reserve University, Cleveland, OH, United States*

Keywords: New Trajectories & Spatial Encoding Methods, Data Acquisition, low-field MRI, RF encoding, New spatial encoding, Bloch Siegert shift, STAR

Motivation: Eliminating conventional gradients can help miniaturize and lower costs of MRI significantly. No method using RF-gradients has been able to achieve frequency encoding, the fastest encoding mechanism in MRI.

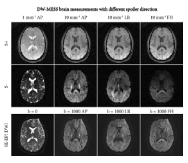
Goal(s): Develop a Simultaneous-Transmit-and-Receive (STAR) system and perform RF Frequency encoding using the Bloch Siegert shift.

Approach: A novel injection transformer, 2MHz/47.5mT RF coil setup and pulse sequence was developed to enable STAR to prevent the RF encoding signal from overwhelming the receiver while frequency encoding MR signal without conventional gradients.

Results: The novel STAR system achieved 99.75% cancellation of RF encoding signal, enabling the first-ever acquisition of frequency encoded MR images using RF-gradients.

Impact: We have demonstrated, for the first time ever, frequency encoded MRI using RF field gradients in place of conventional B_0 gradients. This is a fundamental requirement to make RF encoded-MR imaging as fast as conventional gradient encoding.

1144 8:27



Efficient T2 and diffusion weighted imaging using the multiple-echo steady-state (MESS) sequence with a 3D PROPELLER acquisition

Frank Zijlstra[1,2,3], Maxim Zaitsev[3], and Peter Thomas While[1,2]

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Keywords: Pulse Sequence Design, Pulse Sequence Design, Diffusion, New Trajectories

Motivation: The multiple-echo steady-state (MESS) sequence extends double-echo steady state and efficiently measures multiple images with different contrasts. Because diffusion contrasts are important in clinical imaging, this study aims to include strong diffusion weighting in the MESS sequence.

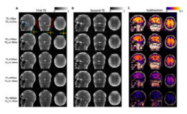
Goal(s): To extend the MESS sequence to provide distortion-free, high-resolution 3D T_1-, T_2- and diffusion-weighted imaging.

Approach: The DW-MESS sequence utilizes a 3D EPI-PROPELLER acquisition to acquire 32 echoes per repetition. An incoherent non-Cartesian k-space trajectory enables reconstruction of individual echoes.

Results: The DW-MESS images show contrasts comparable to SE-EPI with anterior-posterior diffusion encoding. Artifacts are present in other diffusion directions, and require further phase corrections.

Impact: This study enables stronger diffusion-weighting in DESS-type sequences in addition to T1- and T2-weighting. The incoherent k-space trajectory allows reconstruction of a B_0-map and coil-sensitivities, and could allow T2* and susceptibility quantification. This provides new opportunities for efficient multi-parametric imaging.

1145 8:39



[Three-Dimensional Balanced Steady State Free Precession Ultra-short Echo Time MRI for Multiple Contrasts Whole Brain Imaging]

Xin Shen[1], Eduardo Caverzasi[2], Yang Yang[1], Xiaoxi Liu[1], Ari Green[3], Roland Henry[3], Uzay Emir[4,5], and Peder Larson[1]

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Keywords: Pulse Sequence Design, Pulse Sequence Design

Motivation: Typical ultra-short echo time (UTE) sequences lack of meaningful contrast for long T_2 components, and lack of straightforward method to derive images with only ultra-short T_2 (uT_2) components.

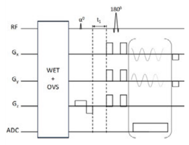
Goal(s): To develop a novel high-resolution fast UTE MRI sequence, potentially for myelin imaging.

Approach: The sequence was developed based on combining balanced steady-state free precession (bSSFP) and UTE techniques, together with a 3D rosette dual-echo k-space trajectory.

Results: The sequence provides PD contrast in both echo times (TEs) and enables easy separation of uT_2 components by subtraction between two TEs, which is sensitive to MS patients' lesions.

Impact: The fast and high-resolution (0.94 mm isotropic resolution under three minutes) dual-echo bSSFP UTE sequence provides both structural information (PD contrast) and uT2 components imaging for myelin quantification (by subtraction). It has great potential aiding diagnosis of multiple sclerosis patients.

1146 8:51



[Ultra-Short Echo-Time Based Accelerated Four-Dimensional Rosette J-resolved Spectroscopic Imaging (4D UTE-ROS-JRESI): A pilot study]

Ajin Joy[1], Uzay Emir[2], Paul Macey[3], and M. Albert Thomas[1]

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Keywords: Pulse Sequence Design, Spectroscopy, UTE, Rosette Spectroscopic Imaging, 4D JRESI

Motivation: Two-dimensional spectrum resolves information-coupled metabolites along an additional spectral dimension. However, acquisition after adding the 2nd spectral encoding can increase the total acquisition time significantly.

Goal(s): To achieve clinically feasible runtimes for J-resolved Spectroscopic Imaging (JRESI) using Ultra-Short Echo-Time (UTE) based sequence implementation.

Approach: Implement a UTE based 4D JRESI sequence with rosette readout, which would enable shorter repetition times and use of higher undersampling factors.

Results: This study demonstrated in-vivo 4D UTE-ROSE-JRESI in less than 10 minutes as compared to a semi-laser sequence with a TR of 1.5 seconds which will take 17 minutes for the same sequence.

Impact: With higher incoherence level of sampling patterns rosette based spectroscopic imaging sequence showed the potential for highly accelerated acquisitions. Using UTE based rosette 4D J-resolved Spectroscopic Imaging sequence allowed further reduction in scan time with the help of shorter TR.

1147 9:03

MERIT AWARD
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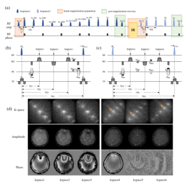

Simultaneously multi-parameter mapping via SSFP multiple overlapping-echo acquisition and deep learning reconstruction

Weikun Chen[1], Qing Lin[1], Qiaoli Yao[2], Liuhong Zhu[2], Liangjie Lin[3], Jiazheng Wang[3], Zhong Chen[1], Shuhui Cai[1], and Congbo Cai[1]

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Keywords: Pulse Sequence Design, Quantitative Imaging, multi-parametric quantification

Motivation: Multi-parametric quantitative magnetic resonance imaging provides a comprehensive and detailed characterization of tissue properties, enhancing the diagnostic accuracy and potential for scientific research. However, the long acquisition time limits its widespread application.

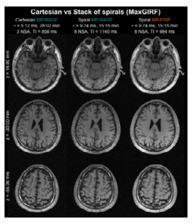
Goal(s): To provide a method that can quickly realize multi-parametric quantitative magnetic resonance imaging.

Approach: We designed a fast multi-parametric quantitative magnetic resonance imaging method which combines balanced steady-state free precession sequence with multiple overlapping echo detachment imaging technique.

Results: Experimental results show that the proposed method can simultaneously obtain accurate T_1, T_2, T_2^*, proton density (PD), B_0, and B_1 parametric maps.

Impact: The proposed method can simultaneously obtain accurate T_1, T_2, T_2^*, PD, B_0, and B_1 maps without distortion or artifacts, and no registration is needed. It has great potential for clinical application.

1148 9:15



High SNR rapid T1-weighted MP-RAGE and MP-FISP using a 3D stack-of-spirals trajectory at 0.55 T

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Keywords: Pulse Sequence Design, Low-Field MRI, structural brain imaging

Motivation: Acquiring High SNR T1-weighted MP-RAGE at low field strengths, such as 0.55T, often requires multiple averages due to reduced equilibrium polarization (~30 min for 3 averages).

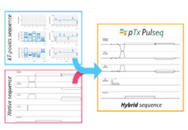
Goal(s): Provide high SNR MP-RAGE (and MP-FISP) within a reasonable scan time (~15 min) using an SNR-efficient readout while mitigating spatial blurring caused by static off-resonance and concomitant fields.

Approach: MP-RAGE and MP-FISP sequences with a stack-of-spirals trajectory were implemented with the Pulseq framework. Spatial blurring was mitigated using the MaxGIRF framework implemented in BART.

Results: Spiral MP-RAGE achieves comparable image quality and higher SNR relative to Cartesian MP-RAGE given only half of the scan time.

Impact: This work demonstrates the feasibility of acquiring high SNR T1-weighted structural brain imaging at 0.55T within a reasonable scan time (~15 min). This opens opportunities for structural neuroimaging and harmonized multi-site studies via code sharing with open-source frameworks.

1149 9:27



pTx Pulseq in hybrid sequences Universal Pulses, made Truly Universal

Thomas Roos[1], Kyung Min Nam[1], Edwin Versteeg[1], Mark Gosselink[1], Hans Hoogduin[1], Dennis Klomp[1], Jeroen Siero[1], and Jannie Wijnen[1]

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Keywords: Pulse Sequence Design, Parallel Transmit & Multiband

Motivation: Advancing MRI sequence development by integrating parallel transmit capabilities with the open-source and widely-used Pulseq framework.

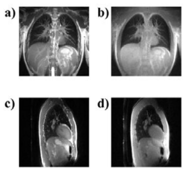
Goal(s): To integrate pTx capabilities into the Pulseq framework, facilitating the design of universal pTx pulses that enhance imaging homogeneity and quality.

Approach: Development of 'pTx-Pulseq' as a backwards-compatible extension, validated through single-channel control and complex sequence operation, culminating in a hybrid sequence that enhances a native MP-RAGE with Pulseq flexibility.

Results: Effective control of pTx channels using pTx-Pulseq, yielding uniform imaging results and demonstrating the potential of hybrid sequencing for improved MRI applications.

Impact: 'pTx-Pulseq' empowers researchers to universally and easily harness pTx technology, allowing for the creation of truly universally pTx pulses that reduce the burden of B1+ inhomogeneity and elevate the quality of high-field MRI.

1150 9:39



3D/4D Ultrashort Echo Time Balanced-SSFP MR Lung Images Reconstructed Using XD-GRASP-Pro

William J Garrison[1], Zachary Miller[2], John P Mugler III[1,2], Jing Cai[3], and G Wilson Miller[1,2,4]

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Keywords: Image Reconstruction, Sparse & Low-Rank Models

Motivation: Obtaining high-quality images of the lung using proton MRI is challenging due to breathing motion and the short T_2* and low proton density of lung parenchyma.

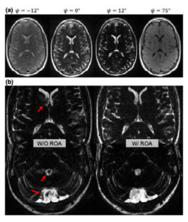
Goal(s): Our goal was to demonstrate a free-breathing proton lung MRI approach that maximizes parenchyma and vessel signal in the lungs.

Approach: This method combines a 3D ultra-short echo time (UTE) balanced steady-state free precession (bSSFP) pulse sequence with a GRASP-Pro-based reconstruction algorithm applied to respiratory phase-binned data.

Results: Image quality was markedly better for SSFP images than for spoiled images, and end-of-exhalation frames reconstructed from 4D images compared favorably with respiratory-triggered images.

Impact: A UTE bSSFP radial pulse sequence combined with temporally-constrained reconstruction produces high-signal, high-resolution lung images at end-of-exhalation collected during free breathing. While non-end-of-exhalation reconstruction was less effective, a similar reconstruction algorithm that incorporates motion fields could improve results.

1151 9:51



Motion-insensitive heavily T2-weighted phase-based imaging using readout alternation technique

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[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [3]Department of Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [4]Department of Medicine, University of Wisconsin-Madison, Madison, WI, United States, [5]Department of Emergency, University of Wisconsin-Madison, Madison, WI, United States

Keywords: Pulse Sequence Design, Motion Correction

Motivation: Heavily T2-weighted (T2W) imaging plays a central role in many fluid-sensitive applications. Drawbacks of T2W conventional methods include relatively long acquisition times and motion sensitivity.

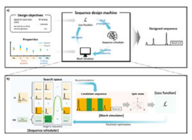
Goal(s): The goal of this study is to evaluate the feasibility of a novel approach using Heavily T2weighted Phase-Based (HT2WPB) imaging with readout alternation (ROA) to achieve motion-insensitive imaging.

Approach: Phantom and in vivo experiments where used to demonstrate the feasibility of heavily T2W using HT2WPB with ROA.

Results: Results from this work showed that PBT2W with ROA enabled heavily T2-weighted contrast for improved visibility of fluid containing anatomical structures with reduced motion sensitivity.

Impact: The use of heavily T2-weighted phase-based imaging with ROA in MR imaging is a promising method to improve visibility of fluid-containing anatomical structures. This technique has the potential to enhance diagnostic accuracy for the evaluation of various pathologies.

1152 10:03 [Automated Sequence Design using Neural Architecture Search: Reliability and Reproducibility]



Rokgi Hong[1], Hongjun An[1], Sooyeon Ji[1], and Jongho Lee[1]

[1]Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of

Keywords: Pulse Sequence Design, Pulse Sequence Design, Machine Learning/Artificial Intelligence

Motivation: An automated sequence design framework utilizing neural architecture search was proposed, and successfully designed optimal sequences for given properties and target objectives without any prior knowledge of MR physics.

Goal(s): We aimed to explore the reliability and reproducibility of this method.

Approach: The reliability of the method was evaluated by adjusting the weights of the desired objectives for sequence design. The reproducibility was tested through multiple runs of the design process.

Results: Our method exhibited reasonable reliability within a certain range of loss weights. Also, it demonstrated reasonable reproducibility in designing SE sequences; however, it exhibited less robustness when designing IR sequences.

Impact: Our previous work, an automated sequence design framework utilizing neural architecture search, is further explored. Our methodology successfully designed sequences with reasonable reliability and reproducibility, despite designing without prior knowledge of MR physics.

Oral

Pediatric: Neuro

Nicoll 3 | Thursday 8:15 - 10:15 | *Moderators:* Kenichi Oishi & Duan Xu

8:15 Introduction

Duan Xu
UCSF

1153 8:27 [Cellular signatures of microstructural development in the human cerebral cortex]

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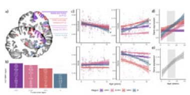

Sila Genc[1,2,3], Gareth Ball[3], Maxime Chamberland[2,4], Erika P Raven[2,5], Chantal MW Tax[2,6], Joseph YM Yang[1,3], Marco Palombo[2], and Derek K Jones[2]

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Keywords: Normal Development, Microstructure, Development, cortex, childhood, adolescence

Motivation: The adolescent brain has been well described using MRI, revealing ongoing cortical thinning and volume loss. But which underlying cellular properties drive these changes?

Goal(s): To model developmental patterns of soma and neurite architecture in the human cerebral cortex.

Approach: We quantified in vivo cortical neurite and soma microstructure in a sample of children and adolescents aged 8-18 years. We then analysed two human gene expression databases to determine cell-type specific profiles underlying these MR-based changes.

Results: Developmental increases in neurite density and reductions in soma radius suggest increasing cortical oligodendrocyte density, supporting the model of protracted intra-cortical myelination throughout the adolescent period.

Impact: Our novel study suggests that ongoing intracortical myelination underpins developmental patterns of cortical neurite and soma microstructure. Once thought to be driven by synaptic pruning, increasing cortical oligodendrocyte density may underlie previously reported patterns of cortical volume loss in adolescence.

1154 8:39

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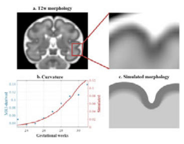

Neurological Underpinning of Cortical Folding in the Human Fetal Brain Using In-utero MRI-Informed Computational Modeling

Ruike Chen[1], Xinyi Xu[1], Ruoke Zhao[1], Mingyang Li[1], Zhiyong Zhao[1], and Dan Wu[1]

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Keywords: Fetal, Diffusion/other diffusion imaging techniques, Brain, Simulation

Motivation: Computational models may help to decipher the neuroscientific mechanisms of cortical folding. Past simulations relied on histology or ex-vivo MRI data, which may not fully capture the complexity of in-utero brain development.

Goal(s): To build a simulation model leveraging in-utero MRI data to elucidate how cortical microstructures impact fetal brain gyrification.

Approach: Based on diffusion MRI-measured microstructures, we simulated cortical folding in the right temporal lobe using a computational model.

Results: Differences in fiber density between sulci and gyri are critical for folding initialization and development, linked to regional differences in dendritic arborization. Simulation results agreed with experimentally measured fetal brain morphology.

Impact: Our work introduced a novel computational model that utilized in-utero MRI data to simulate the cortical folding process of the human fetal brain, suggesting local differences in dendritic arborization may be one of the driving forces of cortical folding.

1155 8:51

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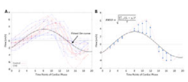

Higher Overall Pulsatile CSF flow Variance in Congenital Heart Disease Predict Poor Executive Function

Vincent Kyu Lee[1,2], William Thomas Reynolds[2,3], Julia Wallace[2], Nancy Beluk[2], Daryaneh Badaly[4], Rafael Ceschin[2,3], Cecilia Lo[5], and Ashok Panigrahy[1,2,3]

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Keywords: Adolescents, Pediatric, Congenital Heart Disease Neurodevelopment Cerebrospinal Fluid Flow

Motivation: Examine cerebrospinal fluid (CSF) flow abnormalities in congenital heart disease (CHD) and develop an evaluation method to measure the CSF flow variance over the entire CSF flow cycle.

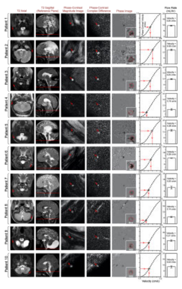
Goal(s): Determine CSF flow difference between CHD and healthy controls. Evaluate effectiveness of new method to measure CSF flow variance.

Approach: Use phase contrast MRI to acquire CSF flow velocity over the pulsatile flow cycle. Model consensus CSF flow of study cohort and calculate each participant's flow variance using root mean square deviation.

Results: CHD had greater pulsatile CSF flow variance, especially in CHD with single ventricle. Higher flow variance predicted poor working memory outcomes.

Impact: This study expands our understanding of CSF flow abnormality in CHD and its potential for predicting executive function deficit. A new method measuring CSF flow variance over the entire flow cycle offers an evaluation of CSF flow abnormalities more comprehensively.

1156 9:03



A Quantitative and Non-Invasive MR-based Method to Analyze Ventricular Shunt Flow in Patients with Hydrocephalus

Joseph H Ha[1], Matthew T Borzage[2], Eamon K Doyle[3], Madison Gutierrez[3], Jacob K Al-Husseini[1], Meghan Drastal[4], Isabel Torres[3], J. Gordon McComb[1], Stefan Blüml[3], and Peter A Chiarelli[1]

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Keywords: Neuro, Brain, shunt, hydrocephalus

Motivation: We investigate a new approach to evaluating ventricular shunt function using phase-contrast magnetic resonance imaging (PC-MRI).

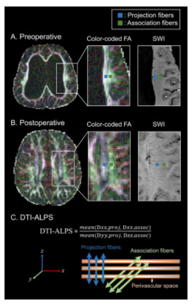
Goal(s): Our goal was to demonstrate the rapid (96-second) sequence as a practical adjunct for determining shunt function non-invasively.

Approach: An MRI phantom was constructed to assess CSF flows between 0-24 cc/hr while in vivo studies measured 21 consecutive patients.

Results: The PC-MRI calibration curve demonstrates a slightly non-linear relationship between flow output by pump and PC-MRI measured velocity. The in vivo patient studies flows ranged between 7 and 54 cc/hr.

Impact: Our work shows that PC-MRI is a non-invasive method for the measurement of CSF flow through the shunt in patients with hydrocephalus. Our work shows that PC-MRI is a promising addition to the clinical setting.

1157 9:15



Association of glymphatic and white matter impairment with outcomes of paediatric hydrocephalus after ventriculoperitoneal shunt

Cailei Zhao[1,2], YiPing OuYang[3], Gongwei Zhang[2], Dongdong Zang[4], Jun Xia[5], Guohua Liang[2], Miaoting Ye[6], Jingsheng Wang[4], Yungen Gan[2], Yangyang Zhou[2], Jian Yang[1,7], and Xianjun Li[1,7]

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Keywords: Neuro, Brain

Motivation: Whether there exist association between glymphatic/white matter impairment and postoperative outcomes of paediatric hydrocephalus.

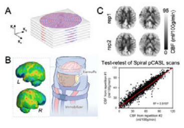
Goal(s): We tried to investigate the glymphatic and white matter abnormalities in paediatric hydrocephalus using MRI metrics.

Approach: Fifty-five children with hydrocephalus who underwent MRI and ventriculoperitoneal shunt surgery were prospectively enrolled. DTI metrics were analyzed.

Results: Compared with controls, DTI-ALPS index decreased before surgery and recovered after surgery. The preoperative and postoperative DTI-ALPS index and FA in association fibres could predict the short-term motor and long-term cognition outcomes, respectively.

Impact: The DTI-ALPS index and FA could be a sensitive biomarker of underlying neuroanatomical changes and developmental outcomes, which would benefit the decision-making of treatment plans.

1158 9:27



Spatiotemporal CBF dynamics underlies emergence of limbic-sensorimotor-association cortical gradient and adaptive behavior in human infancy

Minhui Ouyang[1,2], John A Detre[2,3], Kay L Sindabizera[1], Emily S Kuschner[1,4], J. Christopher Edgar[1,2], and Hao Huang[1,2]

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Keywords: Normal Development, Perfusion, infant; cortical gradient; hierarchy; behavior; neuroscience;

Motivation: Infant cerebral blood flow (CBF) delivers nutrients to meet the brain's energy demand for the fastest period of brain development across lifespan.

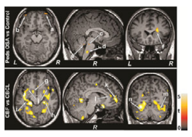
Goal(s): The presented study delineates the organizing principle of whole-brain CBF dynamics during infancy.

Approach: We optimized a state-of-the-art pseudo-continuous-arterial-spin-labeled (pCASL) sequence to obtain high-resolution spatiotemporal dynamics of infant CBF at isotropic 2.5mm.

Results: We revealed infant physiological heterogeneity and found the emergence of the limbic-sensorimotor-association cortical gradient based on CBF. Infant regional CBF changes were also associated with their improved real-world developmental functioning. These normative charts of infant CBF can serve as atlases for research and clinical care.

Impact: Capitalizing on a 3D multi-shot stack-of-spirals pCASL, we acquired the highest-resolution infant CBF maps available to date, discovered the emergence of the limbic-sensorimotor-association cortical gradient in infancy, and provide a standardized reference for infant CBF.

1159 9:39



Abnormal Cerebral Blood Flow, Brain Volume, Microstructural Tissue Changes in Pediatric Obstructive Sleep Apnea

Bhaswati Roy[1], Megan Carrier[1], Alisha N. West[2], and Rajesh Kumar[1]

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Keywords: Neuro, Arterial spin labelling

Motivation: OSA Children show cognitive and behavioral impairments along with brain tissue changes. The status of CBF, which may contribute to brain changes impacting cognitive and behavioral issues in pediatric OSA, is unknown.

Goal(s): Our goal was to examine CBF, brain volume, and microstructural changes in pediatric OSA and evaluate associations between CBF, cognition, and behavioral issues.

Approach: We used ANCOVA to compare CBF and brain tissue changes between OSA and controls, and partial correlations for associations.

Results: We observed reduced CBF in pediatric-OSA and associations of CBF with behavioral and cognitive issues, which may contribute to OSA pathogenesis.

Impact: This study showed altered cerebral blood flow and its associations with abnormal behavioral and cognitive functions in children with OSA, which have never been studied before. The reduced regional flow may lead to further neural damage in the condition.

1160 9:51 Abnormal white matter development during early childhood in autism spectrum disorder

Jiaying Zhang[1,2], Yuqi Liu[3], Edmund T. Rolls[4,5,6], Yuan Dai[3], Shujie Geng[4,7], Lin Deng[3], Zilin Chen[3], Yue Zhang[4,7], Minyi Tao[3], Lingli Zhang[3], Tai Ren[3], Jianfeng Feng[4,7], Miao Cao[4,7], and Fei Li[3]

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Keywords: Neuro, Brain, Autism, Neurodevelopment

Motivation: The axon morphology underlying the evolution of Autism Spectrum Disorder (ASD) symptoms during early childhood is still enigmatic.

Goal(s): To uncover the developmental patterns of axon density in early childhood of ASD , and further explore their relationships with clinical measures in ASD.

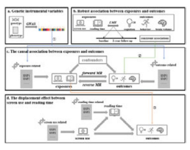
Approach: We used a multi-shell diffusion MRI dataset of 1- to 7-year-old children (including 156 ASD , 48 developmental delay/intellectual disability and 160 Typical Development).

Results: ASD reserved three white matter clusters during early childhood as TD, but exhibited abnormal curves with various developmental stages. The development-stage-specific associations between axon density and clinical measures were elucidated in ASD.

Impact: Whilst reserving uneven spatial layouts of white matter development during early childhood as TD, ASD exhibited developmental curves with altered growth rates and distinct clinical associations in different developmental stages, elucidating potential targets for early diagnoses and interventions in ASD.

1161 10:03 The causal effect of screen uses versus reading on the brain development in early adolescents

MERIT AWARD SUMMA CUM LAUDE



Mingyang Li[1], Ruoke Zhao[1], Xixi Dang[2], Xinyi Xu[1], Ruike Chen[1], Yiwei Chen[1], Yuqi Zhang[1], Zhiyong Zhao[1], and Dan Wu[1]

[1]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, [2]Department of Psychology, Hangzhou Normal University, Hangzhou, China

Keywords: Adolescents, Adolescents, screen use, reading, brain volume, brain development

Motivation: The causal relationships between screen use and mental health were not clear.

Goal(s): We used genetic, imaging, and questionnaire data from ABCD study to investigate the causal relationships between screen use and mental health in early adolescents.

Approach: One-sample Mendelian randomization analysis.

Results: We found a direct causal relationship between screen use and behavior problems and an indirect effect between screen use and brain volume by the changes in reading habits.

Impact: These findings provide new evidence for a causal influence of screen use and reading habits on brain development and highlight the importance of monitoring media use and related habits change in children.

Oral

Cancer & Treatment Response

Room 331-332 Thursday 8:15 - 10:15 *Moderators:* Ralph Mason & Natalie Serkova

8:15 Introduction

Ralph Mason
UT Southwestern, Dallas, TX, United States

1162 8:27 [Multi-Omics Integration of MRI Habitat, Pathology, and Clinical Parameters for Predicting Platinum Resistance of HGSOC]

MERIT AWARD
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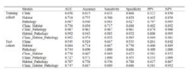


Qiu Bi[1], Jinwei Qiang[2], Yang Song[3], and Yunzhu Wu[3]

[1]the First People's Hospital of Yunnan Province, Kunming, China, [2]Jinshan Hospital, Fudan University, Shanghai, China, [3]MR Research Collaboration Team, Siemens Healthineers Ltd., Shanghai, China

Keywords: Cancer, Cancer

Motivation: Platinum resistance of high-grade serous ovarian carcinoma (HGSOC) is related to tumor heterogeneity. Multi-omics integration can complement tumor heterogeneity at multiple scales and enhance the predictive power of single models.

Goal(s): We aimed to explore a range of diverse multi-omics models to predict platinum resistance of HGSOC.

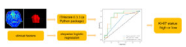
Approach: Multi-omics models were developed and validated using MRI-based habitat radiomics, pathomics based on haematoxylin and eosin (H&E)-stained whole slide images (WSIs), and clinical parameters.

Results: Among the array of single and composite models, the Clinic_Habitat model exhibited the most promising predictive performance, with the Clinic_Habitat_Pathology model ranking as the second-best performer.

Impact: This study carries the potential to equip clinicians with treatment strategies aimed at enhancing the efficacy of individualized therapy.

1163 8:39 WITHDRAWN

1164 8:51 [Intra-tumor heterogeneity based on synthetic MRI in predicting Ki-67 status of nasopharyngeal carcinoma]



Huanhuan Ren[1], Jiuquan Zhang[1], Junhao Huang[1], Yao Huang[1], Daihong Liu[1], Jing Zhang[1], Yong Tan[1], Hong Yu[1], and Lisha Nie[2]

[1]Chongqing University Cancer Hospital, Chongqing, China, [2]GE HealthCare MR Research, Beijing, China

Keywords: Cancer, Cancer

Motivation: The staging and prognosis of nasopharyngeal carcinoma (NPC) remain significant challenges, with potential correlations to the Ki-67 proliferation status.

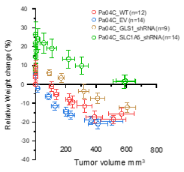
Goal(s): To assess and analyze an ITH model based on pre-treatment synthetic MRI (SyMRI) for predicting Ki-67 status in patients with pathologically confirmed NPC.

Approach: Twenty-eight NPC patients who underwent pre-treatment SyMRI. SyMRI data were processed to generate T1, T2, and PD maps. The ITHscore, derived from quantitative parameter maps, was utilized to establish models for predicting Ki-67 status based on clinical data.

Results: The ITHscore, based on quantitative parameter maps, demonstrated promise as an imaging marker for predicting Ki-67 status in NPC.

Impact: The ITHscore derived from SyMRI holds potential as a non-invasive imaging marker for predicting Ki-67 status, which can have clinical implications in the management of NPC.

1165 9:03



The Impact of Pancreatic Cancer Glutamine Transporter Downregulation on Cachexia and Visceral Organ Metabolism

Raj Kumar Sharma[1], Balaji Krishnamachary[1], Paul Winnard[1], Yelena Mironchik[1], Marie France Penet[1], and Zaver M. Bhujwalla[1]

[1]*Department of Radiology, Division of Cancer Imaging and Reserach, The Johns Hopkins University School of Medicine, Baltimore, MD, United States., Baltimore, MD, United States*

Keywords: Cancer, Cancer, PDAC, Pancreatic cancer, Glutamine tarnsporter

Motivation: We previously identified alterations in brain and plasma glutamine/ glutamate with cachexia that led us to downregulate the glutamine transporter, SLC1A5, in the cachexia-inducing patient derived Pa04C PDAC cells.

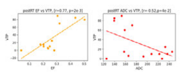
Goal(s): Targeting the glutamine transporter represents a promising approach to delay tumor progression and establish a novel treatment strategy in PDAC cachexia.

Approach: We performed 1H MRS to determine the metabolic changes in multiple organs of mice.

Results: We identified metabolic differences in organs of mice bearing SLC1A5 downregulated tumors compared to wild type or empty vector tumors. Our data identify SLC1A5 as a target to reduce PDAC induced cachexia and associated pathways

Impact: By detecting these visceral organ metabolic changes we identified potential metabolic pathways that can be targeted to reduce cachexia.

1166 9:15



Multi-parametric MRI for Response Assessment in Soft-Tissue Sarcoma; Post-Treatment EF and ADC Correlate with Viable Tumour Percentage

Imogen Thrussell[1,2], Jessica M Winfield[1,2], Khin Thway[3,4], Sadiq Usman[2], Jennifer Newman[2], Georgina Hopkinson[2], Amy Ho Ching Wong[5], Andrew Hayes[6], Shane Zaidi[1,4], Aisha Miah[1,4], Christina Messiou[1,2], and Matthew David Blackledge[1,2]

[1]*Department of Radiotherapy and Imaging, The Institute of Cancer Research, London, United Kingdom,* [2]*MRI Unit, The Royal Marsden NHS Foundation Trust, London, United Kingdom,* [3]*Division of Molecular Pathology, The Institute of Cancer Research, London, United Kingdom,* [4]*Sarcoma Unit, The Royal Marsden NHS Foundation Trust, London, United Kingdom,* [5]*Department of Radiology, Pamela Youde Nethersole Eastern Hospital, Hong Kong, Hong Kong,* [6]*Department of Surgery, The Royal Marsden NHS Foundation Trust, London, United Kingdom*

Keywords: Treatment Response, Cancer, Multi-parametric, Response, Quantitative

Motivation: New biomarkers are needed for response assessment of soft-tissue sarcoma (STS) that reflect underlying biology.

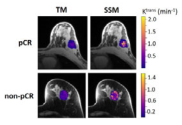
Goal(s): To (i) describe changes in six quantitative MRI biomarkers following radiotherapy treatment, (ii) assess correlation between changes in these markers, and (iii) evaluate correlation of post-treatment values with viable tumour percentage (VTP) after resection.

Approach: We evaluate the Pearson correlation between changes in all six biomarkers in a cohort of 23 patients treated with pre-operative radiotherapy for limb sarcoma.

Results: Large correlations are observed in changes of T2, ADC, fractional-anisotropy, fat-fraction and magnetization-transfer-ratio. Post-treatment values of tumour enhancement and ADC reflect VTP.

Impact: Multiparametric quantitative MR protocols capture heterogeneous changes in soft-tissue sarcomas following treatment. Changes in derived quantitative biomarkers following treatment are correlated, and post-treatment values may reflect viable tumour percentage determined through histopathology.

1167 9:27



Technical Considerations for Implementing Multi-Center and Multi-Platform Quantitative DCE-MRI to Predict Breast Cancer Therapy Response

Brendan Moloney[1], Xin Li[1], Michael Hirano[2], Assim Saad Eddin[3], Jeong Youn Lim[1], Debosmita Biswas[2], Anum S. Kazerouni[2], Alina Tudorica[1], Isabella Li[2], Mary Lynn Bryant[2], Courtney Wille[3], Chelsea Pyle[1], Habib Rahbar[2], Su Kim Hsieh[3], Travis Rice-Stitt[1], Suzanne Dintzis[2], Amani Bashir[3], Evthokia Hobbs[1], Alexandra Zimmer[1], Jennifer Specht[2], Sneha Phadke[3], Nicole Fleege[3], James H. Holmes[3], Savannah C. Partridge[2], and Wei Huang[1]

[1]Oregon Health & Science University, Portland, OR, United States, [2]University of Washington, Seattle, WA, United States, [3]University of Iowa, Iowa City, IA, United States

Keywords: Treatment Response, Quantitative Imaging, Multi-Center and Multi-Vendor Platform, DCE-MRI, Breast Cancer, Therapy Response, Ktrans

Motivation: Determine best-practice quantitative DCE-MRI for predicting breast cancer (BC) response to neoadjuvant chemotherapy (NAC) in a multi-center (MC) and multi-vendor platform (MP) setting.

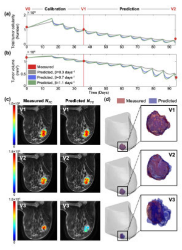
Goal(s): Evaluate effects of different pharmacokinetic analysis approaches on K^{trans} and its predictive performance.

Approach: 15 BC patients treated with NAC underwent longitudinal DCE-MRI at 3 sites using 3T systems from 3 vendors. Variations in analysis included Tofts model *vs.* Shutter-Speed model (SSM), ROI- *vs.* voxel-based analysis, and using fixed *vs.* measured R_{10}.

Results: Different analysis approaches resulted in significantly different K^{trans}, with SSM K^{trans} from voxel-based analysis using fixed R_{10} showing highest predictive accuracy for response.

Impact: Voxel-based SSM analysis using fixed R_{10} takes advantage of greater range of SSM K^{trans} changes in response to therapy, mitigates R_{10} measurement errors, and may be the best-practice quantitative DCE-MRI for predicting NAC response in a MC and MP setting.

1168 9:39



Predicting the response of I-SPY 2 breast cancer patients to treatment using a biology-based mathematical model calibrated with quantitative MRI

Reshmi J. S. Patel[1], Chengyue Wu[2,3,4,5,6], Casey E. Stowers[3], Rania M. Mohamed[7], Jingfei Ma[2], Gaiane M. Rauch[4,8], and Thomas E. Yankeelov[1,2,3,9,10,11]

[1]Department of Biomedical Engineering, The University of Texas at Austin, Austin, TX, United States, [2]Department of Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [3]Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX, United States, [4]Department of Breast Imaging, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [5]Department of Biostatistics, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [6]Institute for Data Science in Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [7]Department of Cancer Systems Imaging, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [8]Department of Abdominal Imaging, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [9]Department of Diagnostic Medicine, Dell Medical School, Austin, TX, United States, [10]Department of Oncology, Dell Medical School, Austin, TX, United States, [11]Livestrong Cancer Institutes, Dell Medical School, Austin, TX, United States

Keywords: Cancer, Modelling, Computational Oncology, Breast Cancer, Treatment Response, Tumor Prediction

Motivation: Optimizing treatment to improve outcomes necessitates a robust tool to accurately predict breast cancer response on a patient-specific basis.

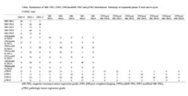
Goal(s): We are applying our biology-based mathematical model to I-SPY 2 breast cancer patients to test if its predictive ability generalizes to multi-site data.

Approach: Quantitative contrast-enhanced and diffusion-weighted MRI data collected early during treatment were used to calibrate a mathematical model describing tumor cell movement, proliferation, and response. After calibration, the model predicts tumor status after the treatment regimen.

Results: The concordance correlation coefficient between the measured and predicted 9-week change was 0.91 for tumor cellularity and 0.88 for tumor volume.

Impact: The high degree of agreement between measured and predicted changes in tumor cellularity and volume in the I-SPY 2 dataset indicates that our biology-based mathematical model can potentially make accurate predictions using MRI data from multiple clinical sites.

1169 9:51



[Prospective Determination of Tumor Regression Grade with Magnetic Resonance Imaging in Neoadjuvant Chemotherapy for Rectal Adenocarcinoma]

Yu Shen[1], Xiaoling Gong[2], Meng Qiu[1], Wenjian Meng[1], and Ziqiang Wang[1]

[1]Colorectal Cancer Center, Department of General Surgery, West China Hospital, Chendu, China, [2]Department of Radiology, West China Hospital, Chendu, China

Keywords: Cancer, Cancer, Rectal cancer; Neoadjuvant chemotherapy; Complete response; Magnetic resonance tumor regression grade; Diffusion-weighted imaging.

Motivation: The role of MRI in evaluating the tumor response following neoadjuvant chemotherapy (NCT) in rectal cancers remains pending.

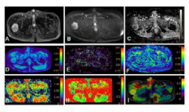
Goal(s): To investigate the reliability of MRI in assessing the pathological clinical response (pCR) in rectal cancer patients with NCT.

Approach: In two consecutive prospective clinical trials (Clinicaltrials.gov NCT03666442 and NCT04922853), tumor responses to NCT were evaluated using MRI-based models.

Results: 224 patients were enrolled. MR-TRG, DWI, DWImodMR-TRG mriCR, and rNAR score were all associated with pCR. DWImodMR-TRG achieved the highest area under the curve (AUC) of 0.940, with the highest sensitivity of 0.905 and the highest PPV of 0.976.

Impact: MRI-based models were feasible in determining the tumor response in LARC patients following NCT. DWI may improve the predictive performance of MR-TRG. Our findings provide evidence for the determination of tumor response for rectal cancer patients who underwent NCT.

1170 10:03



[The feasibility study of multiple functional imaging modalities in the differential diagnosis of benign and malignant bone tumors]

Ying Li [1], Cuiping Ren[1], Wenhua Zhang[1], Yong Zhang[1], Jingliang Cheng[1], Dandan Zheng[2], and Liangjie Lin[2]

[1]The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China, [2]Clinical & Technical Support, Philips Healthcare, Beijing, 100102, China, Beijing, China

Keywords: Cancer, Tumor

Motivation: The combination of multi-MRI techniques in the differential diagnosis of benign and malignant bone tumors represents a novel endeavor.

Goal(s): To investigate the utility of combining DWI, IVIM, DKI and APTWI in the differential diagnosis of benign and malignant bone tumors.

Approach: Relevant parameters of 45 patients were statistically compared through either the independent samples t-test or Mann-Whitney U test. Diagnostic performance was assessed using ROC curves for both individual examinations and their combined analysis in distinguishing between benign and malignant tumors.

Results: The combination of multi-MRI techniques proves to be a more effective approach in distinguishing between benign and malignant bone tumors.

Impact: Multimodal MRI provides biological and pathological information about the tumor cell microenvironment, and their combination proves to be a more effective approach in distinguishing between benign and malignant bone tumors.

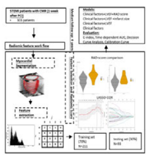
Oral

Myocardial Ischemia & Infarction

Room 334-336 | Thursday 8:15 - 10:15 | *Moderators:* Redha Boubertakh & Masaki Ishida

1171 8:15

Cardiac Magnetic Resonance Cine Images derived-Radiomics for the Prediction of Event Free Survival in Patients with Acute Myocardial Infarction



Xin A[1], Ying Zhang[2], and Yundai Chen[3]

[1]Department of Cardiology, Chinese PLA General Hospital, Beijing, China, [2]Chinese PLA General Hospital, Beijing, China, [3]Chinese PLA General Hospital, beijing, China

Keywords: Myocardium, Cardiovascular

Motivation: Prognostic value of radiomic features extracted from CMR cine image remains to be investigated.

Goal(s): To evaluate the prognostic value of radiomic features derived from cine images in patients with ST-segment elevation myocardial infarction (STEMI).

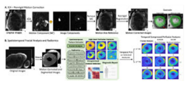
Approach: Radiomic features were extracted from CMR cine images on STEMI patients, and LASSO -Cox regression used to select predictive features for MACE. Cox regression was applied to build models.

Results: RAD score provided an incremental prognostic value above baseline clinical factors and LVEF (C-index 0.78 vs 0.69; p=0.002) and outperformed the addition of CMR markers of infarct injury (C-index: 0.78 vs 0.69, p<0.001).

Impact: Radiomic features provide incremental prognostic value to clinical and infarct size in the prediction of MACE, which would promote the development of the prognostic assessment with non-contrast enhanced CMR.

1172 8:27

Phase-Specific Spatiotemporal Fractal Analysis and Radiomics of Free-breathing Stress Myocardial Perfusion



Changyu Sun[1,2], Senthil Kumar[3], and Talissa Altes[2]

[1]Chemical and Biomedical Engineering, University of Missouri Columbia, Columbia, MO, United States, [2]Radiology, University of Missouri Columbia, Columbia, MO, United States, [3]Medicine-Cardiology, University of Missouri Columbia, Columbia, MO, United States

Keywords: Myocardium, Perfusion

Motivation: This research advances quantitative analysis of myocardial perfusion MRI, potentially enhancing the precision of coronary microvascular disease diagnosis.

Goal(s): To establish a novel spatiotemporal radiomics and fractal analysis approach, assessing myocardial perfusion patterns and complexity throughout all temporal frames of stress MRI.

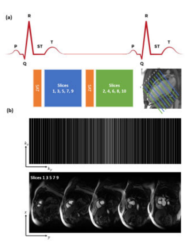
Approach: Employing free-breathing stress myocardial perfusion MRI, we utilized a comprehensive pixel-by-pixel spatiotemporal feature extraction, alongside phase-specific analysis, to derive global and segmental perfusion insights.

Results: Preliminary results indicate our method's efficacy in motion correction and feature extraction, offering a new quantitative perspective on myocardial perfusion, potentially relevant for CMD assessment.

Impact: The study introduces a framework that quantitatively captures myocardial perfusion patterns, potentially paving the way for enhanced diagnostic methods in coronary microvascular disease and facilitating a more precise approach to patient assessment.

1173 8:39

High Multiband Factor Highly Accelerated Whole Heart SMILE Perfusion



Shen Zhao[1], Junyu Wang[1], and Michael Salerno[1]

[1]Cardiovascular Medicine, Stanford University, Stanford, CA, United States

Keywords: Myocardium, Perfusion, SMS, CAIPIRINHA

Motivation: Clinical cardiac perfusion captures a limited number of slices sequentially within each heartbeat, causing incomplete left ventricle coverage and potential quantification variability due to different cardiac phases.

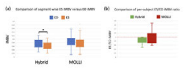
Goal(s): To image multiple slices simultaneously thereby reducing quantification variability and improve heart coverage.

Approach: We apply highly accelerated Simultaneous Multi-slice Imaging via Linear phase modulated Extended field of view (SMILE) acquisition and reconstruction framework to cardiac perfusion.

Results: With a high multiband factor and accelerated rate, SMILE perfusion achieve whole heart coverage and allows for more slices to be in the same cardiac phase. Retrospective and prospective experiments validated its good quality.

Impact: The proposed methods can significantly enhance the heart coverage of clinical cardiac perfusion and potentially benefit reducing variability in quantitative perfusion assessment.

1174 8:51



[Quantification of Cyclical Changes in Myocardial Blood Volume Using a Hybrid 3D/2D Sequence with Ferumoxytol-enhanced MRI]

Hazar Benan Unal[1], Shahriar Zeynali[1], Rohan Dharmakumar[2], and Behzad Sharif[1]

[1]Laboratory for Translational Imaging of Microcirculation, Krannert Cardiovascular Research Center, Indiana University School of Medicine, Indianapolis, IN, United States, [2]Krannert Cardiovascular Research Center, Indiana University School of Medicine, Indianapolis, IN, United States

Keywords: Myocardium, Pulse Sequence Design, myocardial blood volume, ferumoxytol

Motivation: Intramyocardial blood volume (iMBV) variations during cardiac cycle can be an important marker for detecting ischemic heart disease. However, quantifying the change in iMBV from diastole to systole under MRI has challenges such as through-plane motion or in-flow of unsaturated spins.

Goal(s): Our goal is to perform accurate quantification of iMBV variations from diastole to systole.

Approach: We developed a novel hybrid 3D/2D pulse sequence with continuous golden-angle radial acquisition to suppress the confounding factors for distinguishing diastolic and systolic iMBV.

Results: Our approach successfully showed that cyclic variations in iMBV can be correctly quantified under ferumoxytol-enhanced MRI.

Impact: We introduced, for the first time, an approach to quantify cyclic systolic and diastolic intramyocardial blood volume variations at rest on a clinical scanner with ferumoxytol-enhanced imaging. Our method has the potential to be used for detecting ischemic heart disease

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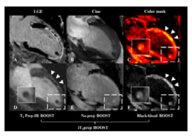
1175 9:03

MERIT AWARD MAGNA CUM LAUDE



[Multi-Contrast 3D Whole-Heart MRI for Intramyocardial Hemorrhage Stage Assessment in Patients with Myocardial Infarction]

Xin Liu[1], An Jing[2], Chen Zhang[3], Karl-Philipp Kunze[4], Radhouene Neji[5], René M Botnar[5,6], Claudia Prieto[5,6], and Qi Yang[7]

[1]Beijing Chaoyang Hosipital, Beijing, China, [2]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, Shenzhen, China, [3]China MR Scientific Marketing, Siemens Healthineers, Beijing, China, Beijing, China, [4]MR Research Collaborations, Siemens Healthcare Limited, Camberley, UK, Camberley, United Kingdom, [5]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, London, United Kingdom, [6]School of Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [7]Department of Radiology, Beijing Chaoyang Hospital, Capital Medical University, No. 8 Gongti 13 South Road, Chaoyang District, Beijing 100020, China, Beijing, China

Keywords: Myocardium, Cardiovascular

Motivation: Intramyocardial hemorrhage (IMH) staging can serve as a valuable reference point when exploring treatment options for this condition, but methodsfor detecting IMH staging has not been fully examined.

Goal(s): This study investigated whether BOOST, a novel iNAV-based free-breathing, multi-contrast 3D whole-heart MRI sequence could detect and stage IMH.

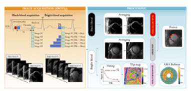
Approach: The efficacy of BOOST in diagnosing and staging IMH were compared with the performances of conventional T2* sequences.

Results: BOOST, used for IMH detection at 3T, demonstrates superior sensitivity and specificity, along with good quantitative consistency, relative to T2* alone. Additionally, BOOST has substantial potential for IMH staging.

Impact: The BOOST sequence can be used for future IMH staging, which will facilitate precise multi-dimensional IMH assessment, ultimately enabling accurate and targeted IMH treatment.

1176 9:15

MERIT AWARD MAGNA CUM LAUDE



Single-click joint bright- and black-blood late gadolinium enhancement and T1-rho mapping for improved myocardial scar imaging

Victor de Villedon de Naide[1,2], Matthias Stuber[1,3,4], Jana Huiyue Zhang[3], Manuel Villegas-Martinez[1,2], Nina Brillet[1], Kalvin Narceau[1], Pauline Gut[1,3], Victor Nogues[1], Ilyes Benlala[1,2], Hubert Cochet[1,2], and Aurélien Bustin[1,2,3]

[1]IHU LIRYC, Electrophysiology and Heart Modeling Institute, Université de Bordeaux - INSERM, Centre de Recherche Cardio-Thoracique de Bordeaux, U1045, Avenue du Haut Lévêque, Bordeaux, France, [2]Department of Cardiovascular Imaging, Hôpital Cardiologique du Haut-Lévêque, CHU de Bordeaux, Bordeaux, France, [3]Department of Diagnostic and Interventional Radiology, Lausanne University Hospital and University of Lausanne, Lausanne, Switzerland, [4]CIBM Center for Biomedical Imaging, Lausanne, Switzerland

Keywords: Myocardium, Quantitative Imaging, Tissue characterization, myocardial infarction, black-blood imaging

Motivation: Bright-blood sequences are used to retrieve information about cardiac anatomy and function, while black-blood sequences have been exploited for focal scar detection. Moreover, contrast agent-free T1-rho (T1ρ) mapping has shown promise for scar quantification, particularly of diffuse nature.

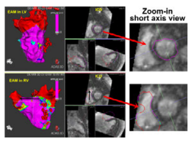
Goal(s): We propose SPOT1ρ, a single-click joint bright-blood, black-blood, and T1ρ mapping sequence providing improved scar localization, detection, and quantification.

Approach: The proposed SPOT1ρ was compared to reference sequences in phantom and patients (three myocardial infarctions, one cardiac amyloidosis and one healthy control).

Results: Excellent correlation was observed between SPOT1ρ and reference T1ρ values, along with co-registered bright- and black-blood images in phantom and patients.

Impact: The proposed single-click SPOT1ρ permits easier and faster planning for MR technicians, more comfort for the patient, promoted by fewer breath-holds, and a simplified interpretation for the radiologists, through co-registered, qualitative, and quantitative images.

1177 9:27



3D Isotropic Wideband LGE for Supporting Ventricular Tachycardia Ablation in Patients with an Implantable Cardioverter Defibrillator

KyungPyo Hong[1], Daniel C Lee[1], Roberto Sarnari[1], Ryan Avery[1], Jeremy Collins[2], Amit Patel[3], Mirmilad Khoshknab[4], Saman Nazarian[4], Albert Lin[1], Bradley Knight[1], and Daniel Kim[1]

[1]Northwestern University Feinberg School of Medicine, Chicago, IL, United States, [2]Mayo Clinic, Chicago, IL, United States, [3]University of Virginia, Charlottesville, VA, United States, [4]Hospital of the University of Pennsylvania, Philadelphia, PA, United States

Keywords: Arrhythmia, Tissue Characterization, ventricular tachycardia, catheter ablation

Motivation: Catheter ablation is clinically indicated for targeting re-entrant ventricular tachycardia (VT) in patients with an implantable cardioverter defibrillator (ICD), but its 1-year VT recurrence rate is high. We hypothesize that 3D wideband LGE is useful for guiding VT ablation.

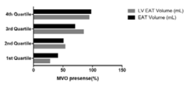
Goal(s): To determine whether 3D wideband LGE correlates with electroanatomic mapping (EAM) in ICD patients.

Approach: To develop a 3D isotropic wideband LGE pulse sequence and validate it against EAM in ICD patients.

Results: While myocardial scars and gray-zones in LGE correlated with the low voltage areas (<1.5 mV) in EAM, mid-myocardial non-ischemic scars was not correlated between LGE and EAM.

Impact: High-resolution 3D isotropic wideband LGE has potential to increase the success rate of catheter ablation for re-entrant ventricular tachycardia in patients with an implantable cardioverter defibrillation, as well as decrease the procedural time by providing a roadmap prior to ablation.

1178 9:39



[Association Between Epicardial Adipose Tissue volume and Microvascular Obstruction in Patients with STEMI]

Dan Mu[1], Jinxuan Zhao[2], Hongming Yu[1], Jing Liang[1], Biao Xu[2], Xiance Zhao[3], Xiuzheng Yue[4], Zhongping Zhang[3], and Bing Zhang[1]

[1]Department of Radiology, Nanjing Drum Tower Hospital, Affiliated Hospital of Medical School, Nanjing University, Nanjing, China, Nanjing, China, [2]Department of Cardiology, Nanjing Drum Tower Hospital, Affiliated Hospital of Medical School, Nanjing University, Nanjing, China, Nanjing, China, [3]Philips Healthcare, Shanghai, China, [4]Philips Healthcare, Beijing, China

Keywords: Inflammation, Infiltration, Cardiovascular, CMR

Motivation: Microvascular obstruction (MVO) after primary percutaneous coronary intervention (pPCI) is identifed as an independent risk factor for poor prognosis in patients with acute myocardial infarction (AMI). However, the clinical implications of Epicardial adipose tissue (EAT) in microvascular obstruction formation in patients with ST-segment elevation myocardial infarction (STEMI) remain unclear.

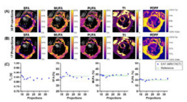
Goal(s): This study aimed to evaluate the correlation between EAT and MVO volume detected by CMR in STEMI patients.

Approach: Cardiac magnetic resonance (CMR) has emerged as the gold standard technique to detect the extent of MVO and evaluate EAT volume.

Results: Left atrioventricular EAT mass index is an independent predictor of MVO.

Impact: Measurement of EAT using CMR could be used for risk stratification and may be a promising target in developing new therapies to reduce myocardial reperfusion injury in patients with STEMI.

1179 9:51



[Accelerated Method for Joint Fatty Acid Composition and T1 (FACT) Mapping of Epicardial Adipose Tissue in Mice at 9.4 T]

Julia E. Bresticker[1], John T. Echols[1], and Frederick H. Epstein[1]

[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States

Keywords: Heart Failure, Fat, T1 Mapping

Motivation: Proinflammatory epicardial adipose tissue (EAT) contributes to heart failure (HF). MRI fatty acid composition (FAC) and T_1 of EAT may distinguish proinflammatory vs. healthy EAT. Applying separate FAC and T_1 mapping sequences is time consuming, motivating the development of accelerated methods.

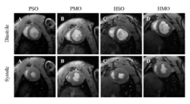
Goal(s): Our goal was to create an accelerated joint EAT FAC and T_1-mapping method (FACT) for use in mice at 9.4 T.

Approach: An inversion-recovery multi-echo sequence and model-based mapping method was developed with acceleration along orthogonal time dimensions.

Results: Results demonstrate feasibility of the FACT method with approximately rate 12 acceleration.

Impact: The FACT method efficiently and accurately determines both EAT fat composition and T_1 and could be used in-vivo to investigate mechanisms and efficacy of novel therapies targeting proinflammatory EAT in the context of metabolic heart disease.

1180 10:03 [Protective Effects of High-Altitude Hypobaric Hypoxia on Myocardial Infarction: A 7.0T Cardiovascular Magnetic Resonance Study in a Rat Model]



Xin Fang[1] and Fabao Gao[1]

[1]West China Hospital of Sichuan University, Chengdu, China

Keywords: Heart Failure, Cardiovascular

Motivation: The impact of high-altitude hypobaric hypoxia on myocardial infarction cardioprotection is a subject of ongoing research in cardiovascular studies.

Goal(s): We aimed to assess the potential protective effects of high-altitude hypobaric hypoxia in a rat model of MI using 7.0T CMR strain analysis.

Approach: We used rats model and transporting some rats to an elevation of 4,250 meters, while control rats remained at 500 meters. Then surgically induced myocardial infarctions in the rats at each elevation.

Results: The finding was that rats with MI living at high altitude had significantly better preservation of heart function compared to control rats living at 500 meters.

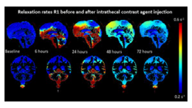
Impact: The outcomes of this study hold significance for the management of patients at risk of MI, particularly those residing in high-altitude environments or experiencing hypobaric hypoxia. Identifying the cardioprotective effects may result in the development of new therapeutic strategies.

Oral

Imaging CSF Dynamics & Neurofluid Coupling

Summit 2 | Thursday 8:15 - 10:15 | *Moderators:* Mina Park & Leonardo Rivera Rivera

1181 8:15 [T1 measurement in CSF: Intrinsic compartmental differences and tracer concentration assessment in the healthy brain]



Tryggve Holck Storås[1], Siri Fløgstad Svensson[1], Sofie Lysholm Lian[2], Geir Ringstad[3,4], Ingrid Mossige[1,2], Grethe Løvland[5], Ragnhild Marie Undseth[5], Kyrre Eeg Emblem[1], and Kaja Nordengen[2,6]

[1]Department for Physics and Computational Radiology, Oslo University Hospital, Oslo, Norway, [2]Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, Oslo, Norway, [3]Department of radiology, Division of Radiology and Nuclear Medicine, Oslo University Hospital, Oslo, Norway, [4]Department of Geriatrics and Internal Medicine, Sorlandet Hospital, Arendal, Norway, [5]The Intervention Center, Oslo University Hospital, Oslo, Norway, [6]Department of Neurology, Oslo University Hospital, Oslo, Norway

Keywords: Neurofluids, Neurofluids

Motivation: T1 mapping facilitates assessment of brain waste clearance by assessing native solutes or detection of endogenous tracers.

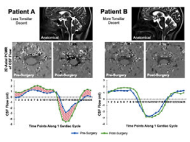
Goal(s): To provide a method for accurate measurement of T1 in CSF, to investigate variations in intrinsic T1 of CSF and to measure tracer in CSF after intrathecal administration.

Approach: A T2-weighted mixed spin-echo/inversion recovery sequence was implemented to measure T1 in CSF. Five healthy subjects were imaged prior to and four times after intrathecal gadobutrol injection.

Results: Baseline R1 is lower in the ventricles than in the subarachnoid space. At 72 hours after injection, there is still gadobutrol in the subarachnoid space.

Impact: Accurate T1 measurements in CSF facilitate quantitative study of brain clearance as concentration of Gd-based tracers in CSF can be established. Observed compartmental differences in intrinsic T1 of CSF indicate information on solute concentrations can be measured without endogenous tracer.

1182 8:27



Pre-surgical assessments of CSF flow and brain motion are indicative of improved cerebral dynamics following surgery in Chiari Malformation I

Grace McIlvain[1], Saeed Mohsenian[2], Mohamad Motaz Al Samman[2], Daniel L. Barrow[1], Francis Loth[2], and John N Oshinski [1]

[1]Emory University, Atlanta, GA, United States, [2]Northeastern University, Boston, MA, United States

Keywords: Neurofluids, Neurofluids, Neurosurgery, Posterior Fossa Decompression, Chiari Malformation, DENSE, CSF Flow

Motivation: Chiari Malformation I (CM-I) is a condition characterized by cerebellar tonsil herniation, leading to reduced cerebrospinal fluid (CSF) flow and various neurological symptoms. Posterior fossa decompression (PFD) surgery can relieve symptoms, but surgical decision making is often unclear.

Goal(s): Tonsillar descent poorly correlates with symptoms and surgical outcomes. We seek to better characterize the cerebral dynamic effects of CM-I and PFD surgery.

Approach: Measure CSF flow using PCMR, and brain motion using DENSE, before and after PFD surgery.

Results: Surgery showed best improvement in patients with significantly restricted pre-surgical CSF flow or severely increased pre-surgical brain motion, regardless of amount of tonsillar descent.

Impact: Presurgical indicators of an individual's likelihood of surgical improvement are critical in developing informed care plans. We find that direct measures of cerebral dynamics outperform standard measures of tonsillar decent at predicting improvement from posterior fossa decompression surgery in CM-I.

1183 8:39

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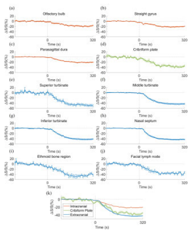


Distribution of intravenous Gadolinium-based contrast agents (GBCA) in human olfactory regions in healthy subjects

Xinyi Zhou[1,2,3], Sofia Garcia Del Barrio Cervera[1,2,3], Yuanqi Sun[1,2,3], Wei Li[1,2], Licia Pacheco-Luna[4], Haris I. Sair[4], Adrian Paez[1], Linda Knutsson[1,5], Peter C.M. van Zijl[1,2,3], Vidyulata Kamath[6], Arnold Bakker[5,6], Bryan Ward[7], and Jun Hua[1,2]

[1]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [2]Neurosection, Division of MRI Research, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States, [4]Division of Neuroradiology, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [5]Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [6]Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [7]Department of Otolaryngology - Head and Neck Surgery, Johns Hopkins University School of Medicine, Baltimore, MD, United States

Keywords: Neurofluids, Neurofluids, olfactory, DSC/DCE perfusion

Motivation: Animal studies show that the olfactory pathway is a primary CSF clearance route. However, human studies using intrathecal-GBCA show that the olfactory route may be less involved in CSF clearance in humans. As most GBCA-enhanced MRI exams are still performed using intravenous-GBCA, it is essential to investigate GBCA dis-tribution in human olfactory regions after intravenous GBCA administration.

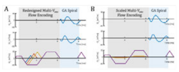
Goal(s): To measure intravenous-GBCA-induced signal changes in olfactory regions.

Approach: Dynamic-susceptibility-contrast-in-the-CSF (cDSC) MRI was performed in 25 healthy subjects.

Results: Significant MR signal changes were detected in the olfactory regions following intravenous-GBCA. Extracranial regions showed more significant GBCA-induced changes than intracranial regions.

Impact: GBCA-induced cDSC signal changes were detected in olfactory regions of healthy subjects following intravenous GBCA administration. Extracranial regions showed more significant changes than intracranial regions, stressing the importance of separating these areas when studying GBCA distribution using intravenous injection.

1184 8:51 [Simultaneous arterial, venous, and CSF flow dynamics using interleaved multi-Venc spiral imaging]



Kevin M Johnson[1] and Leonardo A Rivera Rivera[1]

[1]University of Wisconsin-Madison, Madison, WI, United States

Keywords: Neurofluids, Neurofluids

Motivation: Neurofluids dynamics are hypothesized to enable brain metabolite waste clearance pathways for healthy brain function including coupling between arterial, venous, and CSF fluid flow.

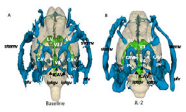
Goal(s): To enable quantification of arterial, venous and CSF flow simultaneously leveraging interleaved multi-Venc phase contrast encoding and spiral sampling.

Approach: A four-point velocity encoding scheme was integrated into a 2D golden angle spiral phase contrast sequence and used in studies of healthy subjects. The flow encoding collects multiple first moments at a fixed echo time.

Results: The multi-Venc encoding scheme allowed for simultaneous measures of cardiac-resolved arterial, venous, and CSF flow.

Impact: This work demonstrates a method for simultaneous arterial, venous, and CSF flow imaging for imaging neurofluid dynamics and their response to stimuli, challenges, and transient patient states.

1185 9:03 [Impact of jugular vein ligation on cerebrospinal fluid clearance from G-lymphatic system in mice]



Anthony Ruze[1,2], Laura Mouton[1,2], Ruchith Singhabahu[1], Joshua Gottschalk [1], Myriam Spajer[1], Jean-Léon Thomas[1,3], Stéphanie Lenck[1,4], and Mathieu David Santin[1,2]

[1]Institut du Cerveau – Paris Brain Institute - ICM, Sorbonne Université, INSERM, CNRS, Paris, France, [2]Centre de NeuroImagerie de Recherche – CENIR, Paris, France, [3]Department of Neurology, Yale University School of Medicine, New Haven, CT, United States, [4]Department of Neuroradiology, AP-HP, Pitié-Salpetrière, Paris, France

Keywords: Neurofluids, Neurofluids

Motivation: Cerebral venous outflow abnormalities have been linked to various neurological disorders, necessitating a detailed understanding of their impact on brain and lymphatic perfusion. This study aimed to investigate the G-lymphatic system change following bilateral jugular vein ligation (JVL) in mice.

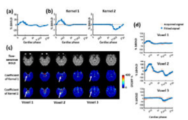
Goal(s): Deeper understanding of the venous system's role in CNS fluid homeostasis.

Approach: JVL was performed in mice. 2D-TOF, DCE-FLASH and 3D-MGE imaging were acquired at baseline, 2, 7 and 14-days post-surgery. Quantitative analysis was used to assess changes in lymphatic flow, brain volumetry.

Results: JVL induced hypertension, bigger brain and veinous system. The permeability in the brain reduced before returning to baseline.

Impact: Our study demonstrated progressive alterations in cerebral blood flow in mice following jugular vein ligation, highlighting the utility of MRI for studying the G-lymphatic system in brain. These findings contribute to a better understanding of cerebrovascular changes in living conditions.

1186 9:15 [Monitoring pulsatile CSF motion in the subarachnoid space using MRI]



Zhiyi Hu[1], Dengrong Jiang[2], Yimei Cao[1], Hongli Fan[1], Wen Shi[1], and Hanzhang Lu[1,2,3]

[1]Department of Biomedical Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Research Institute, Baltimore, MD, United States

Keywords: Neurofluids, Neurofluids

Motivation: The characterization of pulsatile cerebrospinal fluid (CSF) flow within the subarachnoid space remains insufficiently understood, presenting a challenge in distinguishing CSF flow from blood flow.

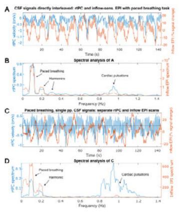
Goal(s): Our goal was to develop a time-efficient approach to monitor pulsatile CSF motion, independent of the pulsatile blood signal.

Approach: We introduced a cardiac-gated BOLD sequence with flow-sensitive bipolar gradients to characterize CSF motion, and evaluated blood contamination using cardiac-gated arterial-spin-labeling.

Results: We demonstrated that the main cause of the signal fluctuation is pulsatile CSF. The fluctuation patterns could be characterized by two components (hump and trough), which were consistently observe across subjects.

Impact: The pulsatile CSF motion in the subarachnoid space can now be efficiently monitored with our method. This technique complements the ventricular CSF motion methods and together they may provide a better understanding of CSF and glymphatic circulation in the brain.

1187 9:27 [Quantitative phase-contrast CSF-flow interleaved with cortical BOLD to measure glymphatic function via BOLD-CSF coupling]



Ingmar Eiling[1,2], Emiel C.A. Roefs[1,2], Jeroen de Bresser[1], Matthias J.P. van Osch[1], and Lydiane Hirschler[1]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Equal contribution, ., Netherlands

Keywords: Neurofluids, Neurofluids, Glymphatics

Motivation: CSF-mediated brain waste clearance is implicated in proteinopathies such as Alzheimer's disease. A better understanding of clearance mechanics is needed to understand pathological processes.

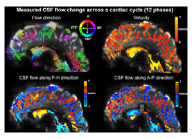
Goal(s): To quantify flow- and pulsatility dynamics of CSF-motion in the 4th-ventricle using real-time phase contrast (rtPC) with interleaved BOLD-imaging while manipulating flow.

Approach: rtPC is first interleaved with inflow-sensitized EPI to prove the same CSF-fluctuations are captured. Then, we show BOLD-CSF coupling between rtPC and cortical BOLD as well as between inflow-EPI and cortical BOLD during breathing and visual-stimulation paradigms.

Results: rtPC improves characterization of CSF-flow in the 4th-ventricle compared to traditional BOLD-sequences, showing more coherent BOLD-CSF coupling.

Impact: Clinical MR studies are increasingly looking at changes in BOLD-CSF coupling in patient populations as a measure of brain clearance efficiency. By interleaving phase contrast acquisitions with BOLD, we quantify CSF flow dynamics and obtain more robust BOLD-CSF measurements.

1188 9:39 [Simultaneous 4D CSF flowmetry and BOLD fMRI using EPTI for investigation of neural activity evoked CSF flow responses]



Fuyixue Wang[1,2], Timothy G. Reese[1,2], Bruce R. Rosen[1,2,3], Lawrence L. Wald[1,2,3], Laura D. Lewis[1,2,4], Jonathan R. Polimeni[1,2,3], and Zijing Dong[1,2]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States, [4]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: Neurofluids, Neurofluids, Data Acquisition, fMRI Acquisition, CSF Flow

Motivation: To investigate brain-wide CSF flow dynamics and how neural activity drives it.

Goal(s): Develop a novel tool to simultaneously map CSF flow and T2*-BOLD fMRI with high sensitivity/specificity and effectively measure neural-activity-evoked CSF flow.

Approach: Single-shot PGSE-EPTI is developed with high sensitivity to slow flow to acquire distortion-free phase-contrast flow velocity and directions, while simultaneously obtaining clean T2*-BOLD, T2, S0 contrasts with improved specificity.

Results: Using the EPTI CSF flowmetry technique, brain-wide CSF dynamics were measured with high spatiotemporal details, and visual-task-evoked CSF flow responses were observed in both ventricles (global-response) and visual cortex subarachnoid space (local-response), synchronized with the simultaneously-acquired T2*-BOLD-fMRI signal.

Impact: We developed a novel EPTI CSF-flowmetry technique to simultaneously map whole-brain CSF flow and T2*-BOLD-fMRI with high sensitivity/specificity for investigation of neural-activity-driven CSF flow. It successfully measured both global and local visual-task-evoked CSF flow responses in ventricles and visual-cortex subarachnoid-space.

1189 9:51 [Using Real Time Phase contrast MRI to investigate CSF oscillations and aqueductal pressure gradients during free breathing]

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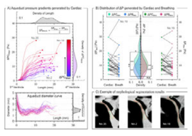


Pan LIU[1], Kimi Owashi[2], Cyrille Capel[3], Serge Metanbou[4], and Olivier Balédent[1,2]

[1]*Amiens Picardy University Hospital, CHIMERE UR.7516, Amiens, France,* [2]*Jules Verne University of Picardy, CHIMERE UR 7516, Amiens, France,* [3]*Amiens Picardy University Hospital, Neurosurgery Department, Amiens, France,* [4]*Amiens Picardy University Hospital, Radiology Department, Amiens, France*

Keywords: Head & Neck/ENT, Brain, aquduct, respiratory effects, real time imaging, phase contrast, intracranial pressure

Motivation: CSF dynamics is complex and regulates intracranial pressure. Pressure difference dynamics between the third and fourth ventricles (ΔP_t) drives CSF oscillations in the aqueduct. MRI can quantify aqueduct anatomy and CSF oscillations.

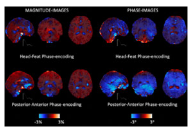
Goal(s): To quantify ΔP_t during free-breathing by combining MRI anatomical imaging with real-time phase-contrast MRI.

Approach: We developed a dedicated software to obtain: CSF flows dynamics Q(t), morphology of the aqueduct, its flow resistance (R) and ΔP_t which equal $R{\cdot}Q_t$. Cardiac and breathing contributions to ΔP_t were investigated in volunteers.

Results: Contributions to ΔP_t were 12.3 Pa and 9.5 Pa from cardiac and breathing respectively.

Impact: Dedicated post-processing of real-time phase-contrast MRI allows quantification of CSF oscillations in the aqueduct and the pressure gradient between the third and fourth ventricles. Furthermore, continuous flow acquisition allows calculation of the cardiac and breathing influence on the pressure gradient.

1190 10:03 [Fast 3D-EPI for characterization of CSF motion during the cardiac cycle.]



Pål Erik Goa[1,2], Simon Blömer[3], Rüdiger Stirnberg[3], and Tony Stöcker[3,4]

[1]*Department of Physics, NTNU, Trondheim, Norway,* [2]*Clinic of Radiology and Nuclear Medicine, St.Olavs University Hospital HF, Trondheim, Norway,* [3]*DZNE, Bonn, Germany,* [4]*Department of Physics and Astronomy, University of Bonn, Bonn, Germany*

Keywords: Neurofluids, Brain

Motivation: Individual variation in CSF dynamics may affect the efficiency of waste clearance from the brain.

Goal(s): To develop a fast and sensitive MRI method for measurement of CSF motion during the cardiac cycle.

Approach: Whole brain 3D-EPI at 3mm resolution and volTR=187ms was acquired at 7T for 94 seconds and retrospectively sorted into 20 cardiac phases based on pulse oximeter.

Results: CSF dynamics was observed in all ventricles as well as in sub-arachnoid space, in addition to arterial pulsation. Both magnitude and phase pulsations were present in the 3 subjects acquired. Highest sensitivity to motion was observed along the phase-encoding direction.

Impact: We show that fast 3D-EPI at 7T is very sensitive to the motion of CSF during the cardiac cycle. This method may be used to characterize CSF dynamics on individual patient level and aid understanding of brain diseases.

Power Pitch

Pitch: AI-Empowered Image Analysis & Processing

Power Pitch Theatre 1

Thursday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

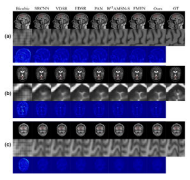
Moderators: Jennifer Steeden & Ze Wang

(no CME credit)

1191 Pitch: 8:15

Poster: 9:15

Screen 1



[Enhancing MRI Resolution with a Lightweight Network and Reverse Residual Attention Fusion]

Xia Li[1], Hui Zhang[1], Hao Yang[1], and Tie-Qiang Li[2,3]

[1]China Jiliang University, Hangzhou, China, [2]Karolinska Institute, Stockholm, Sweden, [3]Karolinska University Hospital, Stockholm, Sweden

Keywords: AI/ML Image Reconstruction, Brain

Motivation: In MRI reconstruction, deep-learning methods often increase network complexity for improved super-resolution, leading to longer reconstruction times and training difficulties.

Goal(s): Our solution introduces an enhanced lightweight network that maintains high-quality performance.

Approach: We accomplish this by stacking Reverse Residual Attention Fusion (RRAF) with PCA and Enhanced Spatial Attention (ESA) for precise feature extraction, utilizing Transformers with depth-wise dilated convolution for better context information, and employing High-Frequency Image Refinement (HFIR) for detailed information recovery.

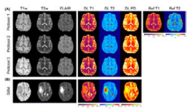
Results: Our experiments confirm the effectiveness of our approach.

Impact: Introducing the lightweight network represents an important improvement in MRI SR reconstruction. By integrating Reverse Residual Attention Fusion, it upholds exceptional image quality, streamlines network complexity, reduces reconstruction time, and simplifies training for SR MRI image reconstruction.

1192 Pitch: 8:15

Poster: 9:15

Screen 2



[Protocol-aware unsupervised retrospective T1 and T2 mapping with diverse imaging parameters]

Shihan Qiu[1,2], Yibin Xie[1], Anthony G. Christodoulou[2,3], Pascal Sati[1,4], Marcel Maya[5], Nancy L. Sicotte[4], and Debiao Li[1,2]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Bioengineering, UCLA, Los Angeles, CA, United States, [3]Department of Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [4]Department of Neurology, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [5]Department of Imaging, Cedars-Sinai Medical Center, Los Angeles, CA, United States

Keywords: Analysis/Processing, Relaxometry

Motivation: Quantitative MRI has the potential for improved disease characterization, but the limited accessibility impedes its application.

Goal(s): To develop a deep learning method for retrospective T1 and T2 quantification from real-world brain MRI data, with the ability to handle diverse imaging protocols.

Approach: A protocol-aware self-supervised learning framework was developed, with the imaging parameters incorporated as additional inputs to the model.

Results: Validation on volunteers showed errors within 10% for nine brain regions when compared to prospective T1/T2 mapping. Application to 376 glioblastoma patients with diverse imaging protocols revealed statistical differences in T1 and T2 among tumor sub-regions and normal-appearing tissues.

Impact: The proposed method may allow retrospective T1 and T2 mapping in large real-world MRI datasets, enabling analysis of them regardless of the difference in protocols and scanners. This will facilitate the large-scale investigation of quantitative MRI as biomarkers for diseases.

1193

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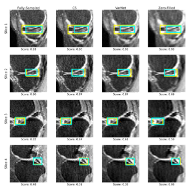
Poster: 9:15

Screen 3



Toward Task-Based Reconstruction: Evaluating Relationships Between Reconstruction and Object Detection Performance

Natalia Konovalova[1], Aniket Tolpadi[1,2], Rupsa Bhattacharjee[1], Johanna Luitjens[1], Felix Gassert[1], Paula Giesler[1], Sharmila Majumdar[1], and Valentina Pedoia[1]

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Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence

Motivation: Traditional medical image reconstruction emphasizes standard metrics, potentially overlooking optimization for downstream tasks like segmentation and anomaly detection.

Goal(s): Our study investigates the relationship between standard reconstruction and object detection metrics.

Approach: We trained a Faster R-CNN detector for meniscal anomalies, addressing class imbalance and implementing a custom detection-specific augmentation protocol.

Results: Evaluation on reconstructed datasets revealed that reconstruction quality was associated with true predictions but had a limited impact on overall detection performance, while boxes-based reconstruction metrics showed no correlation with prediction outcomes. These findings underscore the importance of considering associations between standard reconstruction and downstream task metrics when optimizing end-to-end pipelines.

Impact: Evaluation of standard reconstruction metrics, sliced by object detection outcomes, revealed a significant association between reconstruction and detection performance, emphasizing the utility of this approach in assessing task-based reconstruction.

1194

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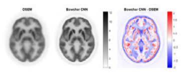
Poster: 9:15

Screen 4



Evaluation of an MR Anatomically Guided PET Reconstruction in Characterizing Multiple Sclerosis Lesions

Yujie Wang[1], Chunwei Ying[1], Matthew R. Brier[1], Xinzhou Li[2], David Faul[3], Tammie Benzinger[1,4], and Hongyu An[1]

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Keywords: Analysis/Processing, PET/MR, Bowsher CNN

Motivation: Bowsher CNN, an MRI anatomic-guided PET reconstruction method, can provide high-resolution PET images. It is unknown how it may affect lesion characterization in MS patients.

Goal(s): Evaluate PET signal without or with Bowsher CNN in various MS lesions.

Approach: FLAIR images defined WMH lesions and NAWM. WMH lesions were further separated into “T1-hypo” and “T1-iso” sub-categories based on T1 intensity. 18F-FDG SUVs were obtained from various lesion ROIs.

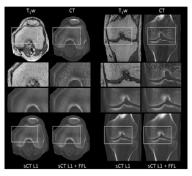
Results: The SUV differences between WMH and NAWM and between T1-hypo and T1-iso lesions became lower and higher, respectively, after applying Bowsher CNN.

Impact: Bowsher CNN PET reconstruction results in high-resolution PET images. SUV differences between WMH and NAWM became smaller, while the SUV differences between T1-hypo and T1-iso, two WMH subcategories, were larger after applying Bowsher CNN.

1195 Pitch: 8:15

Poster: 9:15

Screen 5



Synthetic CT generation using focal frequency loss improves image sharpness

Veronica Ravano[1,2,3], Adham Elwakil[1,2,3], Thomas Yu[1,2,3], Tom Hilbert[1,2,3], Bénédicte Maréchal[1,2,3], Jonas Richiardi[2], Jean-Philippe Thiran[3], Charbel Mourad[2], Paul Margain[4], Julien Favre[4], Tobias Kober[1,2,3], Patrick Omoumi[2], and Stefan Sommer[1,5]

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Keywords: Analysis/Processing, Data Processing, synthetic CT

Motivation: Standard intensity-based voxel-wise losses, generally used in image-to-image translation techniques, are typically biased towards the estimation of the low frequency content in image spectra. For the generation of synthetic CT (sCT) contrast, this results in limited image sharpness, and consequently a limited clinical utility.

Goal(s): To improve sharpness in synthetic contrasts.

Approach: We trained a model using a combination of intensity- and frequency-based losses for the generation of sCT images from MRI.

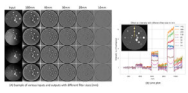
Results: Compared to a baseline model, sCT images generated using the focal-frequency loss resulted in an enhanced level of details in knee images.

Impact: Our results suggest that the use of frequency-based losses, in conjunction with an intensity-based L1 loss, improves image sharpness in synthetic contrasts, and thereby shows the potential to increase their clinical usefulness.

1196 Pitch: 8:15

Poster: 9:15

Screen 6



Contrast neutralization as a strategy to achieve generalizability in MR deep learning applications

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Keywords: Analysis/Processing, Spinal Cord, Contrast Neutralization

Motivation: Provide flexibility to clinicians to fine-tune protocols/contrasts while still leveraging existing Deep-learning (DL) applications trained with limited set of MR contrasts.

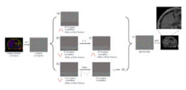
Goal(s): Develop task-specific contrast neutralization pre-processing step to handle multiple imaging contrasts, that are different from the contrasts in the trainset.

Approach: Investigate **S**imple **C**ontrast **Ne**utralization (SCNe) approach that leverages Fourier domain filtering to neutralize contrast from objects of desired sizes, and demonstrate its impact on generalization of cervical foramina plane determination.

Results: Statistically significant improvements in prediction of planes when SCNe is used on new MERGE T2* contrast with DL-model that was trained only with Ax-T2 images.

Impact: Use of our Simple Contrast Neutralization (SCNe) approach as pre-processing step was effective in making DL-model trained only with Ax-T2 images robust to unseen new contrast MERGE T2* MR dataset for Spine cervical foramina (CF) plane determination.

1197 Pitch: 8:15
Poster: 9:15
Screen 7



[A deep-learning model for effective ringing artifact removal by developing a novel multi-frequency Gibbs generator algorithm]

Lisong Dai[1], Zhenzhuang Miao[2], Lei Lu[2], Yuting Ling[3], Hongyu Guo[2], Xiaoyun Liang[3], Qin Xu[2], and Yuehua Li[1]

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Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence, multi-frequency Gibbs artifact, deep learning, model training, artifact removal

Motivation: Gibbs artifact generated by zero-padding k-space data for model training poses a huge challenge for the model to learn different severity and manifestation of Gibbs artifact in the image domain.

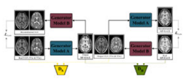
Goal(s): Our goal was to effectively remove ringing artifact with a deep-learning model by developing a novel multi-frequency Gibbs generator algorithm.

Approach: We introduced Gibbs artifact generator (GAG) algorithm to create Gibbs artifacts with different truncation ratios as the input and tested the performance with a proposed deep-learning model.

Results: The images processed using the proposed approach demonstrated higher image quality score than the original images (all $P < 0.05$).

Impact: The images generated by our new GAG algorithm with pronounced multi-frequency Gibbs artifacts could be used as a reliable training set for deep-learning model training, enabling the model to effectively identify and eliminate Gibbs artifacts in spinal MR imaging.

1198 Pitch: 8:15
Poster: 9:15
Screen 8



[Unpaired Image-to-Image Translation of ULF-MRI using Vision Transformers to Advance Volumetric Analyses]

Peter Hsu[1,2], Elisa Marchetto[1,3], Samantha Sanger[1], Hersh Chandarana[1,3], Jakob Asslaender[1,3], Daniel Sodickson[1,2,3], Patricia Johnson[1,2,3], and Jelle Veraart[1,3]

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Keywords: Analysis/Processing, Low-Field MRI, ULF MRI, Ultra-Low-Field MRI, Deep Learning, Unpaired Image Translation, Brain Segmentation, Vision Transformers, CycleGAN

Motivation: The image quality of ultra-low-field MRI impacts the reliability of volumetric analysis in the brain. Existing techniques that address this issue learn from synthetically generated images, leading to a domain shift problem when presented with real images.

Goal(s): Development of a deep learning method trained with real ULF and HF images to robustly generate an image that can be segmented with routine software tools.

Approach: We introduce a CycleGAN framework with Residual Vision Transformers to improve super-resolved images compared to existing methods.

Results: The accuracy of volumetric estimations improves using our method compared to others based on clinical correlations and test-retest reliability metrics.

Impact: Our new image enhancement method should allow reliable volumetric evaluation using ULF-MRI. This will allow investigators in regions with access to ULF systems to monitor brain health in a way that was previously unattainable.

1199

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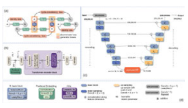
Screen 9



Dynamic Contrast-Enhanced MRI Parameter Mapping for Cervical Cancer Using CycleGAN-like model with UNet-Vision Transformer

Yuxi Jin[1], Gengjia Lin[1], Zhou Liu[2], Zixiang Chen[1], Zhenxing Huang[1], Yang Qian[2], Baijie Wang[2], Na Zhang[1], Hairong Zheng[1,3], Dong Liang[1,3], Dehong Luo[2], and Zhanli Hu[1,3]

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Keywords: Analysis/Processing, Cancer, Cervical Cancer， Dynamic Contrast-Enhanced MRI， UNet， Vision Transformer, CycleGAN, self-supervised pretraining

Motivation: DCE-MRI plays an important role in non-invasive detection and monitoring of cervical cancer, providing key information for improving diagnosis and treatment accuracy.

Goal(s): DCE-MRI faces complexities and noise issues in application and needs to be optimized and improved by deep learning techniques for parameter mapping. Existing deep learning based methods suffer from limited data and model efficiency.

Approach: We propose a CycleGAN-like model with UNet-Vision-Transformer generator, enhance the discriminator with gradient penalty, and pre-train the model via self-supervised image inpainting.

Results: The numerical experimental results demonstrate that the proposed model is quite efficient and robust compared with other deep learning-based methods.

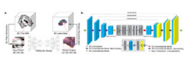
Impact: This research offers fresh avenues for processing medical imaging data by proposing a novel and efficient deep learning model, significantly impacting the improvement of disease diagnosis. Furthermore, it provides researchers with new directions and insights, advancing scientific and technological progress.

1200

Pitch: 8:15

Poster: 9:15

Screen 10



3D Hybrid Deep Learning Solution for Subcortical Segmentation

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Keywords: Analysis/Processing, Neuro

Motivation: For subcortical brain segmentation, the most widely accepted tools like FreeSurfer are slow and inefficient for large datasets, while faster methods often sacrifice accuracy and reliability.

Goal(s): In this study, we propose a novel deep learning based alternative and achieve consistent state-of-the-art performance within reasonable processing times.

Approach: Our model, TABSurfer, utilizes a 3D patch-based approach with a hybrid CNN-Transformer architecture.

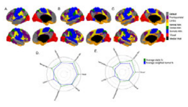
Results: We evaluated TABSurfer against FreeSurfer ground truths across various T1w MRI datasets, consistently demonstrating strong performance over a leading deep learning benchmark, FastSurferVINN. Then, we validated TABSurfer on a manual reference, outperforming both FreeSurfer and FastSurferVINN based on the gold standard.

Impact: Our proposed deep learning model, TABSurfer, demonstrated state-of-the-art subcortical segmentation performance and utility. TABSurfer displayed reliability across numerous datasets and outperformed well established traditional and deep learning tools in FreeSurfer and FastSurferVINN.

1201 Pitch: 8:15

Poster: 9:15

Screen 11



[Graph kernel assisted robust individual and group level functional brain parcellation (GRAFP)]

Sovesh Mohapatra[1,2], Minhui Ouyang[1,3], Qinmu Peng[4], and Hao Huang[1,3]

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Keywords: Analysis/Processing, fMRI (resting state), Functional Connectivity, Graph Kernel, Brain connectivity, Signal Modeling, Signal Representations

Motivation: Various rs-fMRI studies highlight the need for accurate delineation of different brain functional networks (FNs) to carry out precise therapeutic interventions in the individuals.

Goal(s): To develop a novel zero-shot non-linear graph kernel-assisted approach for enhanced functional brain parcellation at individual and group levels.

Approach: Utilization of Wavelet, Fourier, and Hilbert transformations for feature extraction from BOLD signals, and a propagation attribute graph kernel to capture non-linear temporo-spatial connectivity, using k-means clustering.

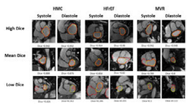
Results: The kernel-based approach outperforms static FC matrix parcellations, achieving higher accuracy in network delineation in both individual and group level, as evidenced by Dice and Jaccard scores.

Impact: The study introduced graph kernel-based method for functional brain parcellation, which improved the accuracy of functional network delineation in rs-fMRI data, surpassing traditional static functional connectivity approaches in both individual and group level, as validated by Dice and Jaccard metrics.

1202 Pitch: 8:15

Poster: 9:15

Screen 12



[Healthy-to-Patients Domain-Adaptive Deep Learning for Time-Resolved Segmentation of Left Atrium in Short-Axis Cine MRI Images]

Mohamed Elbayumi[1], Ulas Bagci[1], Maurice Pradella[1], Zachary Zilber[1], Philip Greenland[2], and Mohammed S.M. Elbaz[1]

[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Preventive Medicine, Northwestern University, Chicago, IL, United States

Keywords: Analysis/Processing, Segmentation, Left Atrium, Mitral Valve Regurgitation, Domain Adaptation, Deep Learning

Motivation: Addressing challenges with current deep learning (DL) techniques that struggle with domain shifts.

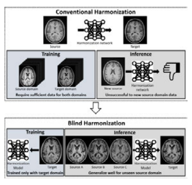
Goal(s): To introduce a domain-adaptive technique that is able to segment the Left Atrium from MRI of patients employing model trained exclusively on healthy data.

Approach: Our approach involves training exclusively on healthy data and incorporating stochastic encoding of temporal composite variations as augmentations to encode the underlying space of plausible anatomical changes and dynamics. We tested on three challenging unseen patient daatsets.

Results: Our domain-adaptive approach showed significant improvement over the state-of-the-art LA segmentation model. Enabling LA segmentation of all time frames of the cardiac cycle.

Impact: The proposed domain-adaptive deep learning approach addresses a fundamental challenge of training deep learning models only on healthy control datasets while maintaining high performance on unseen patients' populations. This could potentially lead to solve performance issues for limited patients cohorts.

1203 Pitch: 8:15 Poster: 9:15 Screen 13



BlindHarmony: Blind harmonization for multi-site MR image processing via unconditional flow model

Hwihun Jeong[1], Heejoon Byun[1], and Jongho Lee[1]

[1]*Department of electrical and computer engineering, Seoul national university, Seoul, Korea, Republic of*

Keywords: Analysis/Processing, Reproductive

Motivation: Conventional deep learning-based harmonization cannot handle the unseen source domain image when there is no large-size data.

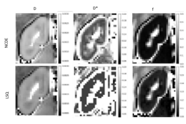
Goal(s): We propose blind harmonization, which requires only target domain data during training and generalizes well on unseen source domain data.

Approach: BlindHarmony utilizes an unconditional flow model to measure the probability of the target domain image and find a harmonized image that is structurally close to this source domain image but has a high probability in the target domain.

Results: BlindHarmony successfully harmonized the source domain image to the target domain and improved the performance of downstream tasks for the data with a domain gap.

Impact: Deep learning-based harmonization typically necessitates both source and target domain data, limiting its widespread applicability. This study eliminates the need for source domain data and exhibits robust generalization to new source domain data, thereby expanding the utility of harmonization.

1204 Pitch: 8:15 Poster: 9:15 Screen 14



Generic and Robust Quantitative MRI Parameter Estimation using Neural Controlled Differential Equations

Daan Kuppens[1,2], Sebastiano Barbieri[3], Susanne Rauh[1,4], and Oliver Gurney-Champion[1,2]

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Keywords: Analysis/Processing, Quantitative Imaging

Motivation: Tissue properties are estimated from MRI data using bio-physical models that relate MRI signal to underlying tissue properties via quantitative MRI parameters. Deep learning can improve parameter estimation, but needs retraining for different acquisition protocols, hindering implementation.

Goal(s): Implement a deep learning algorithm able to estimate quantitative MRI parameters for multiple quantitative MRI applications, irrespective of acquisition protocol.

Approach: Neural controlled differential equations (NCDEs) overcome this limitation as they are independent of the configuration of input data.

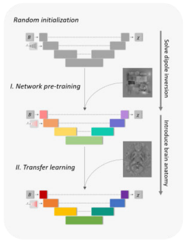
Results: NCDEs have improved performance compared to least squares minimization in estimating quantitative MRI parameters when SNR is low or when the parameter has low sensitivity.

Impact: Neural controlled differential equations are a generic purpose tool for parameter estimation in quantitative MRI that outperform least squares minimization in quantitative MRI parameter estimation, irrespective of acquisition protocol or quantitative MRI application.

1205 Pitch: 8:15

Poster: 9:15

Screen 15



Applying adaptive convolution to brain data – Making use of transfer learning

Simon Graf[1,2], Walter Wohlgemuth[1,2], and Andreas Deistung[1,2]

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Keywords: Analysis/Processing, Quantitative Susceptibility mapping

Motivation: Deep learning approaches for QSM-based dipole inversion lack generalizability towards acquisition parameters.

Goal(s): Our aim was to address data scarcity by integrating known information in the network model and investigate the feasibility of transfer learning.

Approach: The acquisition parameters (voxel size, FOV orientation) were integrated with manifold learning. The models were pre-trained on large-scale synthetic data sets and fine-tuned on in-vivo brain data in a second step.

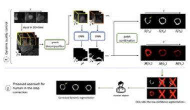
Results: The use of manifold learning increased generalizability, while transfer learning substantially improved the quality of computed susceptibility maps.

Impact: While this study demonstrates the feasibility of cross-domain knowledge transfer in deep learning approaches for QSM, it also points to the potential of fine-tuning network parameters to scanner-specific data in general, boosting the performance of neural networks therewith.

1206 Pitch: 8:15

Poster: 9:15

Screen 16



Efficient Analysis of Myocardial Perfusion MRI with Human-in-the-loop Dynamic Quality Control: Initial Results Using the SCMR Registry

Dilek M. Yalcinkaya[1,2], Zhuoan Li[1,3], Khalid Youssef[4], Bobak Heydari[5], Rohan Dharmakumar[3,4], Robert Judd[6], Orlando Simonetti[7], Subha Raman[4], and Behzad Sharif[1,3,4]

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Keywords: Analysis/Processing, Segmentation

Motivation: Accurate segmentation of free-breathing (FB) myocardial perfusion (MP) MRI is a labor-intensive yet necessary preprocessing step. A quality control (QC) tool for deep learning (DL)-based segmentation of FB MP MRI is lacking.

Goal(s): Developing a DL-based dynamic QC (dQC) tool for automatic analysis of MP MRI.

Approach: Using the discrepancy between patch-based segmentations, a dQC map is derived and quantified into a dQC metric. The utility of this metric in detecting erroneous segmentations is demonstrated by considering a human-in-the-loop (HiTL) framework.

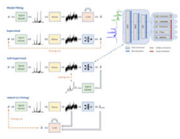
Results: Referral of the dQC-detected timeframes to a HiTL has markedly improved the segmentation results when compared to a random referral approach.

Impact: We proposed a dynamic quality control tool for automatic segmentation and analysis of free-breathing myocardial perfusion MRI datasets. Our results show that the proposed approach has markedly improved segmentation accuracy when used within a practical and efficient clinician-in-the-loop setting.

1207 Pitch: 8:15

Poster: 9:15

Screen 17



Assessing Machine Learning Robustness in MRS Quantification: Impact of Training Strategies on Out-of-Distribution Generalization

Julian P. Merkofer[1], Antonia Kaiser[2], Anouk Schrantee[3,4], Oliver J. Gurney-Champion[3,5], and Ruud J. G. van Sloun[1]

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Keywords: Analysis/Processing, Spectroscopy, ML Robustness, MRS Quantification

Motivation: Despite promising developments, current machine learning methods for magnetic resonance spectroscopy (MRS) suffer from limited robustness and generalization issues, restricting their clinical application.

Goal(s): This study compares training strategies for MRS quantification, focusing on neural network resilience to out-of-distribution samples.

Approach: Bias towards the training distribution was assessed for various out-of-distribution cases in synthetic data and in-vivo data.

Results: Our findings reveal that, while common supervised regression is most accurate for in-distribution cases, it shows the most data bias; physics-informed self-supervised training is more robust; while integrating a least-squares fitting method within the training framework enhances standalone performance while remaining generalizable.

Impact: To advance integration in clinical MRS, robust and generalizable machine learning methods are needed. This study's exploration of quantification training strategies offers insights into data biases and advocates hybrid models that combine traditional methods with neural networks to maintain robustness.

1208 Pitch: 8:15

Poster: 9:15

Screen 18

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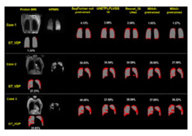
1209 Pitch: 8:15

Poster: 9:15

Screen 19



SegFormer for Precise Quantification of Lung Ventilation Defects in Hyperpolarized Gas Lung MRI

Ramtin Babaeipour[1], Ryan Zhu[2], Harsh Patel[2], Matthew S Fox[2,3], and Alexei Ouriadov[1,2,3]

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Keywords: Analysis/Processing, Hyperpolarized MR (Gas), Deep Learning; Magnetic Resonance Imaging (MRI); Hyperpolarized Gas MRI; Segmentation; Ventilation Defect; Chronic Obstructive Pulmonary Disease (COPD); Lung Imaging

Motivation: Current methods for quantifying lung ventilation defects using hyperpolarized gas MRI are effective but time-consuming. Deep Learning offers potential enhancements in image segmentation, with Vision Transformers (ViTs) emerging as notable alternatives to traditional CNNs.

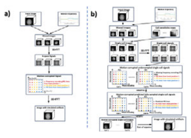
Goal(s): The study aims to assess SegFormer's capability for automating the segmentation and quantification of ventilation defects in hyperpolarized gas MRI, comparing its efficiency and accuracy against traditional methods.

Approach: Utilizing a dataset from 56 study participants, the study adopted the SegFormer architecture for segmenting MRI slices.

Results: SegFormer, especially with ImageNet pretraining, surpassed CNN-based techniques in segmentation. Specifically, the MiT-B2 configuration of SegFormer showcased exceptional efficacy and efficiency.

Impact: SegFormer's efficiency in hyperpolarized gas MRI enhances future clinical decision-making with swift and precise segmentation. Its superiority may inspire broader adoption and further exploration into Vision Transformers' potential in medical imaging.

1210 Pitch: 8:15 Poster: 9:15 Screen 20



[Enhanced motion artifact simulator for structural MRI with MP-RAGE sequence]

Tianqi Wu[1], Magdalena Sokolska[2], David L. Thomas[3], Matthew Grech-Sollars[1], and Hui Zhang[1]

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Keywords: Analysis/Processing, Simulations, Motion artifacts

Motivation: Motion compromises the utility of structural MRI with MP-RAGE sequence, a workhorse of quantitative neuroimaging research. Recent interest in deep learning-based mitigating solutions, and the scarcity of motion-corrupted data, motivates the need for realistic data simulation. Unfortunately, existing open-source simulators fail to consider important features in real-world acquisitions, including variations in phase-encoding direction, multi-coil acquisition and GRAPPA parallel imaging, resulting in less realistic simulations.

Goal(s): We aim to develop a more realistic motion artifact simulator for MP-RAGE structural MRI.

Approach: We extend TorchIO, an existing simulation framework, to support aforementioned features.

Results: The comparison between simulations demonstrated the importance of including these features.

Impact: The proposed simulation framework can be used to generate more realistic motion-corrupted MRI data from clean images. These data can be served as training sets for deep learning algorithms in motion artifact related applications.

Power Pitch

Pitch: Coils, Metals & Their Interactions

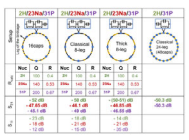
Power Pitch Theatre 2

Thursday
Pitches: 8:15 - 9:15
Posters: 9:15 - 10:15

Moderators: Natalia Gudino

(no CME credit)

1211 MERIT AWARD SUMMA CUM LAUDE Pitch: 8:15 Poster: 9:15 Screen 21



[The Efficiency Optimization of a Triple-Tuned (2H/23Na/31P) Body Coil at 7T]

Busra Kahraman-Agir[1], Jiying Dai[1,2], Martijn Lunenburg[2], Mark Gosselink[1], and Dennis Klomp[1]

[1]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Tesla Dynamic Coils, Zaltbommel, Netherlands

Keywords: High-Field MRI, High-Field MRI, multi-tuned body coils, triple-tuned body coils, efficiency improvement

Motivation: Low B_1^+ field 1)increases the RF pulse duration which jeopardizes SNR in the short T2 of 23Na spins and 2)limits of the excitation bandwidth which might be insufficient to excite the full chemical shift dispersion of 31P spins.

Goal(s): To improve the efficiency of a triple-tuned (2H/23Na/31P) body coil.

Approach: Reducing the total loss on a birdcage design by decreasing the number of multi-tuned circuits.

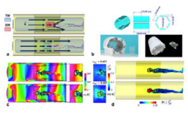
Results: The 8-rungs (i.e., 16 triple-tuned circuits) design wins 3dB in efficiency against a conventional 24-rungs (i.e., 48 double-tuned circuits) design, while covering one more excitation frequency, and the homogeneity is practically unaffected.

Impact: The high loss of the multi-tuned circuits is a determinant in multi-tuned borecoil designs. Reducing the number of multi-tuned circuits used in the design substantially improves the B1 efficiency of a body coil facilitating even triple tuning.

1212 Pitch: 8:15

Poster: 9:15

Screen 22



Subwavelength dielectric waveguide for human head travelling-wave MRI at 7T

Yang Gao[1,2,3], Tong Liu[1], Tao Hong[1,2], Wen Jiang[1,2], and Xiaotong Zhang[3,4,5,6]

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Keywords: Non-Array RF Coils, Antennas & Waveguides, Non-Array RF Coils, Antennas & Waveguides

Motivation: Radiative excitation (e.g., travelling-wave, TW) has strength in large coverage and low SAR. It's well compatibility with single-channel (clinical-mode) makes it promising as whole-body excitation solution at UHF. But it has apparent weakness in efficiency.

Goal(s): Improve excitation efficiency as well as homogeneity of TW MRI under clinical-mode.

Approach: Subwavelength dielectric waveguide was designed to enhance excitation efficiency as well as homogeneity through mode conversion, power-focusing, wave-impedance-matching and phase-velocity-matching.

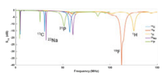
Results: The excitation efficiency was improved by 114% over brain compared to classic TW . SAR efficiency was 10.8% higher than birdcage. The B_1^+ RMSE in brain was reduced by 21.9% compared to birdcage.

Impact: Our results offered insights into the design of new generation TW MRI excitation systems at UHF. The improved TW MRI systems operated under single channel may hold promises to whole-body imaging at UHF in clinical scenarios.

1213 Pitch: 8:15

Poster: 9:15

Screen 23



Quintuple-tuned Surface Coil Elements

Ali Caglar Özen[1] and Michael Bock[1]

[1]Division of Medical Physics, Department of Radiology, Medical Center - University of Freiburg, University of Freiburg, Freiburg, Germany

Keywords: RF Arrays & Systems, RF Arrays & Systems, X Nuclei, Multinuclear coil, Flexible coil

Motivation: X-nuclear MRI is used to monitor metabolic processes but requires RF coils that are individually tuned to each resonance frequency.

Goal(s): To introduce a modular, flexible transmission line resonator array element for 5 resonance frequencies to enable multiple X-nuclear applications with a single coil.

Approach: A quintuple-tuned shielded loop resonator (SLR^5) was designed consisting of three stacked shielded loop resonators with one element for ^{13}C and ^{23}Na, another for ^{31}P, and a third for ^{19}F and ^{1}H. Switching between nuclei was realized by PIN diodes.

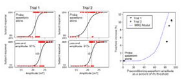
Results: SLR^5 can be used to acquire X-nuclear signals of 5 nuclei.

Impact: The SLR^5 concept might facilitate the implementation of X-nuclear MRI methods for metabolic imaging in early diagnosis and monitoring of disease. SLR^5 coils can be arranged favorably in coil arrays due to the inherently low coupling of SLR coils.

1214 Pitch: 8:15

Poster: 9:15

Screen 24



Experimental reduction of peripheral nerve stimulation (PNS) using pre-excitation targeting of the potassium system (PRE-TAPS)

Natalie G. Ferris[1,2,3], Alex C. Barksdale[3,4], Valerie Klein[3,5], Bastien Guerin[3,5], Lawrence L. Wald[1,2,3,5], and Mathias Davids[3,5]

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Keywords: Bioeffects & Magnetic Fields, Gradients, PNS thresholds, EM exposure, neurodynamic modeling, sequence development

Motivation: Peripheral nerve stimulation (PNS) limits the current generation of MRI gradient coils. We seek a sequence-based approach to improve scanner performance without hardware changes.

Goal(s): Experimentally demonstrate that pre-excitation targeting of the potassium system (PRE-TAPS) using a kHz-frequency preconditioner waveform can be used to increase PNS thresholds.

Approach: We measure changes in the PNS threshold of a 1.1kHz frequency probe waveform when a 10kHz preconditioner waveform is played immediately before the probe waveform and compare measured results to our model predictions.

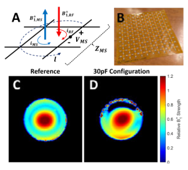
Results: We found up to 10% greater PNS thresholds using PRE-TAPS in one subject and qualitative agreement with our PNS model.

Impact: Waveform-based modulation of PNS thresholds, such as pre-excitation targeting of the potassium system (PRE-TAPS) with a kHz-frequency preconditioner waveform, may enable increased performance in PNS-limited sequences such as EPI.

1215 Pitch: 8:15

Poster: 9:15

Screen 25



Reduction of Radiofrequency Induced Heating around Passive Implants via Flexible Metasurface Shielding at 7T

Paul S Jacobs[1], Neil E Wilson[1], Wyger M Brink[2], Anshuman Swain[1], Aniketh Hanumapur[1], Neeraj Panchal[3], Samir Mehta[4], Mark A Elliott[1], and Ravinder Reddy[1]

[1]Center for Advanced Metabolic Imaging in Precision Medicine, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Magnetic Detection and Imaging group, TechMed Centre, University of Twente, Enschede, Netherlands, [3]Department of Oral and Maxillofacial Surgery, University of Pennsylvania, Philadelphia, PA, United States, [4]Department of Orthopedic Surgery, University of Pennsylvania, Philadelphia, PA, United States

Keywords: Safety, Safety

Motivation: Metallic implant compatibility at ultra-high field strengths (≥7T) continues to be often contraindicated as RF induced heating can result in surrounding tissue damage. Metasurface technology has been shown in the past to locally null the B_1^+ field, thereby providing a potential solution for shielding implants.

Goal(s): To demonstrate a metasurface based method for shielding metallic implants to reduce RF heating.

Approach: Eight implants were tested in a polyacrylic acid (PAA) phantom using a high-SAR sequence with and without a prototype metasurface.

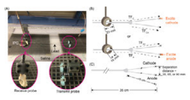
Results: On average the metasurface design reduced RF induced implant heating in the phantom by 41.6%.

Impact: Patient undergoing invasive brain or trauma surgeries typically have passive metallic devices placed, making them unable to receive MRI scans at ultra-high field strengths due to RF induced heating. This work benefits this patient population by reducing RF heating.

1216 Pitch: 8:15

Poster: 9:15

Screen 26



A novel cumulative transfer function concept for accurate prediction of RF heating of bipolar leads

Jasmine Vu[1,2], Bhumi Bhusal[2], and Laleh Golestanirad[1,2]

[1]Department of Biomedical Engineering, McCormick School of Engineering, Northwestern University, Evanston, IL, United States, [2]Department of Radiology, Feinberg School of Medicine, Northwestern University, Chicago, IL, United States

Keywords: Safety, Modelling, Medical Implants, Transfer Function, ISO/TS 10974

Motivation: Radiofrequency (RF) tissue heating is a known safety risk for patients with cardiac implantable electronic devices (CIEDs), especially children with epicardial systems.

Goal(s): We present the first cumulative transfer function based on the guidelines in ISO/TS 10974 to evaluate the RF heating of a CIED with a bipolar epicardial lead.

Approach: We measured, calibrated, and validated cumulative transfer functions for predicting RF heating through *in vitro* experiments and electromagnetic simulations.

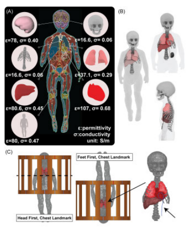
Results: Our cumulative transfer functions accurately predicted RF heating around the electrode ends for 48 unique lead trajectories ($r=0.90-0.97$, $p<0.05$).

Impact: We introduce a high-fidelity cumulative transfer function model of a CIED with a bipolar epicardial lead to enable the evaluation of RF heating of bifurcating leads during MRI.

1217 Pitch: 8:15

Poster: 9:15

Screen 27



Computer-assisted surgical modification of lead trajectory can substantially reduce RF heating of epicardial leads in children during 1.5T MRI

Fuchang Jiang[1], Bhumi Bhusal[2], Pia Sanpitak[2], Gregory Webster[3], Michael Monge[4], Giorgio Bonmassar[5], Daniel Kim[2], and Laleh Golestanirad[1,2]

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Keywords: Safety, Safety, epicardial leads;implants

Motivation: Once epicardial CIEDs are implanted in pediatric patients, they pose a relative contraindication for MRI scans due to the increased risk of RF heating.

Goal(s): Enhance MRI safety by reducing RF heating through surgical modification of the lead configuration.

Approach: Mathematical models of the CIED with different lead configurations were developed and validated using the transfer function approach. Low heating trajectories were identified and implemented in a patient.

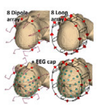
Results: Placing the excess lead length on the heart's inferior surface resulted in an average 4-fold reduction in RF heating compared to anterior placement.

Impact: Implementing physics-based surgical modifications to the trajectory of epicardial leads can consistently and significantly reduce RF heating in children undergoing MRI at 1.5T.

1218 Pitch: 8:15

Poster: 9:15

Screen 28



Evaluation of Specific Absorption Rate of Tight-Fit Array Coils for Human Head MRI at 9.4T in Presence of EEG Caps

Egor Berezko[1], Georgiy Solomakha[1], Jonas Bause[1], Vinod Jangir Kumar[1], Klaus Scheffler[1,2], and Nikolai Avdievich[1]

[1]High-field MR Center, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Department of Biomedical Magnetic Resonance, University of Tübingen, Tuebingen, Germany

Keywords: Safety, Safety, Ultra-High-Field, Electroencephalography (EEG)

Motivation: The electroencephalography (EEG) in combination with MRI allows performing multi-modal imaging. The presence of EEG-caps can increase SAR of tight-fit transceiver RF-arrays at Ultra-High-Field.

Goal(s): To numerically evaluate SAR generated by a tight-fit array at 9.4T in the presence of EEG-caps.

Approach: Numerical models of 8-channel 9.4T transceiver arrays with EEG-electrodes were constructed. B_1^+ and SAR were simulated for the human head voxel models using CST Studio.

Results: In this work, we numerically showed that EEG-caps don't significantly change B_1^+ and SAR of the arrays at 9.4T. Furthermore, the created models of the caps can be used in future simulations.

Impact: We numerically showed that EEG caps don't significantly change B_1^+ and SAR of the arrays at 9.4T. The developed cap models can be used in future simulations

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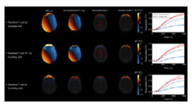
1219 Pitch: 8:15

Poster: 9:15

Screen 29



Temperature Changes in the Brain due to External Heat Sources: an MR Thermometry Study

Mathijs Kikken[1,2], Bart Steensma[1], Ettore Flavio Meliadò[1,3], Cornelis van den Berg[1], and Alexander Raaijmakers[1,2]

[1]Center for Image Sciences - Computational Imaging Group, UMC Utrecht, Utrecht, Netherlands, [2]Biomedical Engineering - Medical Imaging Analysis, Eindhoven University of Technology, Eindhoven, Netherlands, [3]Tesla Dynamic Coils, Zaltbommel, Netherlands

Keywords: Safety, Safety

Motivation: RF-induced temperature rise is considered a safety risk for MRI.

Goal(s): To study temperature changes in the brain due to (generally considered safe) heat or cool pads placed on a subject's forehead for comparison to RF-induced temperature elevations.

Approach: Using the Projection onto Dipole Fields method, susceptibility and drift induced field changes are separated from temperature effects to enable assessment of temperature rise in the brain.

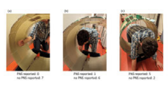
Results: Up to 2.5 °C temperature rise was measured at the brain edge in 2 volunteers. Similarly, a 2.0 °C decrease was observed at the brain edge when a coolpad was placed on the forehead.

Impact: RF-induced temperature changes in the brain can be considered modest compared to temperatures induced by (generally considered safe) external heating/cooling sources. The temperature increase due to a heatpad on the forehead is much larger than previously measured RF-induced temperature increases.

1220 Pitch: 8:15

Poster: 9:15

Screen 30



Preliminary Results on Torso PNS Thresholds at the Ultrasonic Driving Frequency of 20 kHz using a Whole-Body Gradient Coil

Michael JB McGrory[1], Edwin Versteeg[1], Jeroen CW Siero[1,2], and Dennis WJ Klomp[1]

[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Spinoza Center for Neuroimaging, Amsterdam, Netherlands

Keywords: Safety, Bioeffects & Magnetic Fields

Motivation: For silent whole-body MRI using ultrasonic encoding at 20kHz, very high slew rates will be experienced by body parts such as the torso with PNS risk. However, PNS thresholds for these body parts at ultrasonic frequencies are not well known.

Goal(s): To estimate PNS thresholds for the torso at 20kHz.

Approach: We test volunteers in a whole-body gradient coil driven at 20kHz to determine when PNS occurs and compare to simulations and current IEC guidelines.

Results: PNS occurs at much higher dB/dt values than predicted by IEC guidelines at 20kHz, where we found a mean threshold value of 1316T/s for the torso.

Impact: PNS is a concern for body MRI using ultrasonic encoding. Here, we show much higher measured PNS thresholds than IEC guideline predictions for 20kHz gradient switching, suggesting that whole-body silent MRI at 20kHz is possible with reduced risk of PNS.

1221 Pitch: 8:15

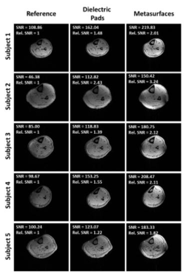
Poster: 9:15

Screen 31

Optimization of Flexible Metasurfaces at 7T and in vivo B1+ Correction Effects

Paul S Jacobs[1], Neil E Wilson[1], Wyger M Brink[2], Anshuman Swain[1], Ryan R Armbruster[1], Aniketh Hanumapur[1], Dylan Tisdall[3], John A Detre[1,4], Ravi Prakash Reddy Nanga[1], Mark A Elliott[1], and Ravinder Reddy[1]

[1]Center for Advanced Metabolic Imaging in Precision Medicine, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Magnetic Detection and Imaging group, TechMed Centre, University of Twente, Enschede, Netherlands, [3]Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [4]Department of Neurology, University of Pennsylvania, Philadelphia, PA, United States



Keywords: New Devices, New Devices

Motivation: Ultra-high field imaging (≥7T) lacks transmit (B_1^+) field inhomogeneity due to the shortened RF wavelengths, often resulting in poor image quality. Novel metasurface designs have previously been effective at improving image quality at lower field strengths but have not yet been implemented at 7T.

Goal(s): To optimize and demonstrate a novel metasurface design for *in vivo* usage at 7T.

Approach: Empirical optimization and phantom testing produced the final design, while image enhancement was assessed via *in vivo* calf skeletal muscle imaging.

Results: The metasurface produced a 126.5% increase in image relative SNR and a 27.6% increase in transmit efficiency.

Impact: The work impacts 7T imaging by presenting a novel piece of hardware that can effectively improve image quality. Future work on this project will include further optimization via variable distributed capacitance across the metasurface.

1222 Pitch: 8:15

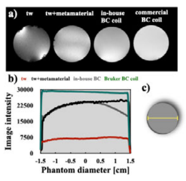
Poster: 9:15

Screen 32

Travelling wave MRI with a parallel-plate waveguide loaded with a metamaterial at 7 T

Sergio Solis-Najera[1], Jelena Lazovic[2], Saul Rivera[1], Fabian Vazquez[1], and Alfredo Odon Rodriguez[3]

[1]Departamento de Fisica, UNAM, Mexico City, Mexico, [2]Department of Physical Intelligence, Max Planck Institute for Intelligent Systems, Stuttgart, Germany, [3]Department of Electrical Engineering, UAM Iztapalapa, Mexico City, Mexico



Keywords: Non-Array RF Coils, Antennas & Waveguides, Non-Array RF Coils, Antennas & Waveguides, travelling wave MRI

Motivation: The utilization of traveling-wave MRI in conjunction with a parallel-plate waveguide provides an alternative for acquiring images at ultrahigh magnetic fields, circumventing the resonant frequency limitations.

Goal(s): To improve the image quality and to investigate the application of metamaterials within the waveguide to improve performance.

Approach: A bio-inspired surface coil in the transceiver mode and a C-shaped unit metamaterial made from copper sheets laminated onto a nonconductive board within the parallel-plate waveguide filled with a saline solution were used.

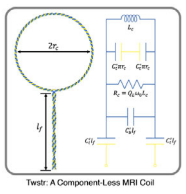
Results: Images acquired with the metamaterial-loaded waveguide demonstrated improved signal-to-noise ratio and closely matched the image quality achieved with in-house birdcage coils

Impact: To provide an effective alternative for remote detection in MRI, enabling high-quality image acquisition with efficiency.

1223 Pitch: 8:15

Poster: 9:15

Screen 33



Twstr: A Resonant, Matched MRI Coil without any Discrete Components

Julian Adolfo Maravilla[1], Ana Claudia Arias[1], and Michael Lustig[1]

[1]EECS, University of California, Berkeley, Berkeley, CA, United States

Keywords: RF Arrays & Systems, RF Arrays & Systems, Implantable Coils, Flexible Coils

Motivation: Component-less MRI coils have the potential to increase the strength and flexibility of array elements making them suitable for implantables, multi-modal imaging, and body conformal applications.

Goal(s): As a result, this work strives to demonstrate a resonant, matched MRI coil without the use of discrete components.

Approach: A Twstr coil is composed of a single Twisted-Pair wire manipulated by twisting and cutting such that the coil presents a match at its resonant frequency.

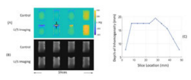
Results: Twstr coils have a high quality factor, similar *SNR* performance in a *Rx*-Only configuration, and outstanding *TRx* capabilities when compared to a standard loop coil.

Impact: Twstr coils are component-less, flexible MRI coils made from a single piece of Twisted-Pair wire. Such coils eliminate the need for discrete components on a coil providing a viable solution for implantable and multi-modal imaging coils without compromising performance.

1224 Pitch: 8:15

Poster: 9:15

Screen 34



Simultaneous MRI and Ultrasound Imaging on a High-performance Gradient Platform

Afis Ajala[1], David Mills[1], Eric Fiveland[1], Heather Chan[1], Seung-Kyun Lee[1], Thomas KF Foo[1], Jia Xu[2], Bryan Bednarz[3], Diego Hernando[3], Shane Wells[4], James H. Holmes[2], and Desmond Yeo[1]

[1]GE HealthCare, Niskayuna, NY, United States, [2]University of Iowa, Iowa City, IA, United States, [3]University of Wisconsin-Madison, Madison, WI, United States, [4]University of Michigan, Ann Arbor, MI, United States

Keywords: MR-Guided Interventions, MR-Guided Interventions

Motivation: Simultaneous ultrasound (U/S) and MR imaging has been reported on whole-body MRI systems with conventional gradients (CVG) but remains unexplored on high-performance gradient (HPG) platforms.

Goal(s): We assessed the MR and U/S image quality, alongside thermal impact on an MR-compatible U/S probe at CVG and HPG configurations.

Approach: Fast spoiled gradient echo imaging, echo planar imaging (EPI), B_0-field map and U/S probe temperature were measured.

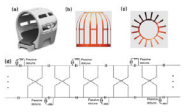
Results: Moderate-to-severe susceptibility-induced signal loss (due to U/S probe) extended ~8 mm into phantom at gradient isocenter with no visible U/S image artifacts. A substantial temperature rise was observed on U/S probe during EPI at HPG configuration.

Impact: This study evaluates and compares image quality and thermal risks of simultaneous MR and U/S imaging on a high-performance gradient system versus a conventional clinical system. Our findings can help optimize the protocols for image-guided U/S intervention using high-performance gradients.

1225 Pitch: 8:15

Poster: 9:15

Screen 35



Detunable Wireless Litzcage Coil for Human Head MRI at 1.5T

Haoqin Zhu[1], Michael L. Lang[1,2], Yijin Yang[3], Melanie Martin [4], Gong Zhang[5], Qiang Zhang[6], Yuanyuan Chen[7], and Xinqiang Yan[3,8,9]

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Keywords: Non-Array RF Coils, Antennas & Waveguides, RF Arrays & Systems, Wireless Coil, Detune, Litzcage, Birdcage, RF Coil.

Motivation: Detuning wireless volume coils is challenging due to their complex structure, multiple resonant modes and multiple detuning circuits.

Goal(s): Developing an efficient method to geometrically decouple from the body coil

Approach: Designing an inductive birdcage coil featuring a figure-of-eight conductor pattern within the rungs, conducting volunteer and phantom image for compare its performance with the body coil and a receive array.

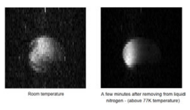
Results: The wireless Litzcage coil offers ~3.9 times higher SNR than the body coil. A 10% boost in the central area, a 21% reduction at the surface, and similar head image quality compared to a commercial 12-channel Head coil.

Impact: Applies to 0.55T, 3.0T, and 7T MRI systems, and expands to extremity, breast and body imaging. Simplifies coil design, improves detuning, and lowers costs. Lightweight and user-friendly, enabling MRI-guided therapy and streamlined clinical processes.

1226 Pitch: 8:15

Poster: 9:15

Screen 36



Feasibility of boosting SNR using cooled RF receive coils for low field human brain imaging at 72mT

Monika Sliwiak[1], Aaron R Purchase[1,2], Lawrence L Wald[1,2], Clarissa Zimmerman Cooley[1,2], and Jason P Stockmann[1,2]

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Keywords: Non-Array RF Coils, Antennas & Waveguides, Low-Field MRI, Cyrogenic RF receive coil, Portable MRI

Motivation: Cooled coils could provide an boost SNR for portable low field MRI as an alternative to increasing the field strength using larger, heavier magnets.

Goal(s): Test whether cooling RF receive coils with liquid nitrogen could provide an appreciable boost to signal-to-noise ratio (SNR) on low-field portable MRI scanners, where noise is dominated by copper losses in the coil.

Approach: A 3.04 MHz multi-turn surface coil was cooled to ~77K using liquid nitrogen and performance was assessed using bench Q measurements and imaging data.

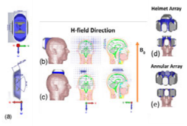
Results: The unloaded Q increases from 220 at 293K to 541 at 77K. SNR for the cooled coil increased 4.15x.

Impact: Liquid nitrogen cooled radiofrequency receive coils could improve image quality for low field portable MRI scanners, broadening the impact of these systems.

1227 Pitch: 8:15

Poster: 9:15

Screen 37



Helmet RF Applicator Enhances Thermal Magnetic Resonance Theranostics of Brain Tumours

Faezeh Rahimi[1,2], Bilguun Nurzed[1,3], Thomas Wilhelm Eigentler[1,4], Andre Kuehne[5], Eva Oberacker[1], Pirus Ghadjar[6], Jason M. Millward[1,7], Rolf Schuhmann[2], and Thoralf Niendorf[1,5,7]

[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max-Delbrück Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [2]FG Theoretische Elektrotechnik, Technische Universität Berlin, Berlin, Germany, [3]Berliner Hochschule für Technik, Berlin, Germany, [4]Chair of Medical Engineering, 3Technische Universität Berlin, Berlin, Germany, [5]MRI.TOOLS GmbH, Berlin, Germany, [6]Charite' Universitätsmedizin, Berlin, Germany, [7]a joint cooperation between the Charité Medical Faculty and the Max-Delbrück Center for Molecular Medicine, Berlin, Germany

Keywords: RF Arrays & Systems, RF Arrays & Systems, Novel soil design, Brain MRI, 7T, Hyperthermia, Thermal MR, Theranostics, Simulations, Experiments

Motivation: Thermal MR adds an interventional dimension to an MRI device. Ultrahigh-field MRI is an excellent fit for ThermalMR since it benefits from multi-channel transmission in the short wavelength regime

Goal(s): This work investigates the MRI and RF heating performance gain of a multi-channel Tx in a helmet array versus an annular array.

Approach: We aim to enhance B_1^+ uniformity for brain MRI at 7.0T and enhance SAR_{10g} for brain thermal therapy using perpendicular RF elements.

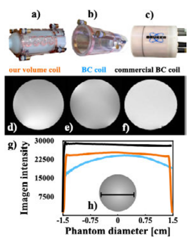
Results: Our simulations and phantom experiments demonstrate superior mean B_1^+ coverage and better B_1^+ uniformity for MRI and enhanced SAR_{10g} for thermal therapy using the helmet configuration.

Impact: Dome-shaped helmet transmit RF applicators provide a viable alternative for theranostics involving ultrahigh-field MRI and targeted RF-heating for thermal therapy The performance gain of the helmet transmit RF applicator is demonstrated in numerical simulations and in experiments at 7.0 T.

1228 Pitch: 8:15

Poster: 9:15

Screen 38



B1 uniformity improvement of a birdcage coil with a chain mail configuration

Rodrigo Ruiz[1], Jelena Lazovic[2], Alfredo Odon Rodriguez[3], and Sergio Solis-Najera[1]

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Keywords: RF Arrays & Systems, RF Arrays & Systems, Birdcage coil

Motivation: The main goal is to enhance the performance of an RF coil used in preclinical MRI imaging, specifically at a field strength of 7 T.

Goal(s): The researchers proposed a modification to a standard birdcage (BC) coil. This modification involves adding a "chain mail layout" to the rungs of the coil.

Approach: The idea for the chain mail layout was inspired by previous low pass wiring schemes used in chain mail coils, as reported by Mansfield. Chain mail refers to a type of flexible armor composed of interlinked metal rings.

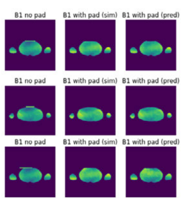
Results: Phantom images were acquired and used to compute uniformity profiles.

Impact: These results obtained with the chain mail BC coil contributes to our overarching goal of achieving improved MRI coil performance for preclinical applications at 7 T.

1229 Pitch: 8:15

Poster: 9:15

Screen 39



Tailored dielectric shimming in MRI using machine learning - a feasibility study

Mengying Zhang[1], Nawal Panjwani[1], Elizaveta Motovilova[1], Jonathan Dyke[1], Fraser Robb[2], and Simone Angela Winkler[1]

[1]Radiology, Weill Cornell Medicine, New York, NY, United States, [2]GE Healthcare, Aurora, OH, United States

Keywords: Analysis/Processing, Shims

Motivation: Inhomogeneities of the MRI transmit field cause image shading and hinder diagnosis. In dielectric shimming, pads of high permittivity are used to recover signal in low intensity areas, but full-wave calculation of the resulting fields is too slow for real-time use at the scanner.

Goal(s): We study feasibility of using AI to rapidly predict the transmit field with dielectric pads.

Approach: An AI pipeline is trained using a small simulated data set for proof of concept.

Results: We obtain a structural similarity of 97% with a mean squared error of 0.02%, demonstrating feasibility and the potential for a real-time implementation in the future.

Impact: This work improves image shading and diagnostics. Dielectric shimming in particular and rapid calculation of electromagnetic fields in general especially apply to ultra-high field strengths such as 7T, 9.4T and 10.5T, where significant inhomogeneity is hindering proper evaluation.

Power Pitch

Pitch: Special Session: 2025 Clinical Translation Unmet Needs

Power Pitch Theatre 3 | Thursday | *Pitches:* 8:15 - 9:15 | *Moderators:* Natalia Petridou & Anthony Christodoulou

(no CME credit)

9001 8:15 Radiation-Free Cardiac Catheterization
Tarique Hussain[1]

[1]UT Southwestern, Dallas, TX, United States

9002 8:15 Ischemic Heart Disease
Lilian Salingwa[1]

[1]Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania

9003 8:15 Fat Suppressed Gadolinium-Enhanced MRI Near Metal
Mingming Wu[1]

[1]LMU Klinikum, Munich, Germany

9004 8:15 SAR Deposition in the Fetus During Prenatal MRI
Mingming Wu[1]

[1]LMU Klinikum, Munich, Germany

9005 8:15 Motion-Robust 3D Fetal Brain
Mingming Wu[1]

[1]LMU Klinikum, Munich, Germany

9006 8:15 Cranial Neurological Abnormalities in Preterm Babies
Helena Machibya[1]

[1]Temeke RRH and MUHAS, Dar es Salaam, Tanzania

9007 8:15 Brain Aneurysm Detection in Fetus
Anita Nsiah Donkor[1]

[1]University For Development Studies, Tamale, Ghana

9008 8:15 Delayed Cerebral Ischemia in Subarachnoid Hemorrhage
Bianka Forgo[1]

[1]Karolinska University Hospital, Stockholm, Sweden

9009 8:15 Tumor Recurrence vs Pseudoprogression in Glioblastoma Multiforme
Gaoyang Zhao[1]

[1]The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China

9010 8:15 QA of Automated White Matter Hyperintensity Quantification
Kersten Villringer[1]

[1]Charité-Universitätsmedizin, Berlin, Germany

9011 8:15 Response to Treatment in Immune-Mediated Renal Disease
Jamie MacKay[1]

[1]University of Cambridge, Cambridge, United Kingdom

9012 8:15 Motion Insensitive Prostate DWI
Kenneth Kwong[1]

[1]Massachusetts General Brigham, Boston, MA, United States

Study Group Business Meeting
MR in Psychiatry Business Meeting
Room 303-304 Thursday 9:15 - 10:15

(no CME credit)

Study Group Business Meeting
Placenta & Fetus Business Meeting
Room 324 Thursday 9:15 - 10:15

(no CME credit)

Plenary Session
Thursday Plenary
Organizers: Emmanuel Barbier, Candace Fleischer, Shaihan Malik, Andrew Scott, Dan Wu

Plenary Hall (Hall 603-604) Thursday 10:30 - 12:15 *Moderators:* Candace Fleischer & Andrew Scott

10:30 The Basics: Dynamics of Water & Other Molecules in Biological Tissue
Olivier M. Girard[1,2]

[1]Aix Marseille Univ, CNRS, CRMBM, Marseille, France, [2]APHM, Hôpital Universitaire Timone, CEMEREM, Marseille, France

11:00 Why Does Exchange Matter in MR?
Penny Anne Gowland[1]

[1]Physics and Astronomy, Sir Peter Mansfield Imaging Centre, Nottingham, United Kingdom

11:30 Water Exchange Across Biological Barriers as a Biomarker
Ruiliang Bai[1]

[1]Zhejiang University

Plenary Session
Young Investigator Awards Presentation
Plenary Hall (Hall 603-604) Thursday 10:30 - 10:45

10:30 Young Investigator Awards Presentation

Plenary Session
We Are One: Patient Experiences with MRI
Plenary Hall (Hall 603-604) Thursday 10:45 - 11:15

10:45 Introduction

10:47 Patient Videos

10:52 My Experience as a Neuroimaging Patient

11:12 Closing Comments

Other
Gold Corporate Symposium United Imaging Healthcare
Plenary Hall (Hall 603-604) Thursday 12:30 - 13:30

(no CME credit)

Study Group Business Meeting
Hyperpolarization Methods & Equipment Business Meeting

Room 303-304 | Thursday 13:45 - 14:45

(no CME credit)

Study Group Business Meeting
MR Flow & Motion Business Meeting

Room 324 | Thursday 13:45 - 14:45

(no CME credit)

Weekday Course
Advanced Contrast Mechanisms in CMR

Organizers: Tarique Hussain, Christopher Nguyen, Andrew Scott

Summit 1 | Thursday 13:45 - 15:45 | *Moderators:* Irvin Teh & Sergio Uribe

13:45 T1ρ Contrast in Cardiovascular MRI

TBD

14:15 CEST & MT in Contrast in Cardiovascular MRI

Qing Zou[1]

[1]Department of Pediatrics, UT southwestern medical center, Dallas, TX, United States

14:45 MR Spectroscopy in Cardiac MRI

Ladislav Valkovič[1,2]

[1]University of Oxford, Oxford, United Kingdom, [2]Slovak Academy of Sciences, Bratislava, Slovakia

Keywords: Cardiovascular: Cardiac metabolism, Contrast mechanisms: Spectroscopy, Contrast mechanisms: Non-Proton

Whether you are working in the field of cardiac MRI, or just want to start exploring this exciting organ this talk is meant for you. I will provide an overview of the current status of metabolic imaging of the heart using multinuclear MR Spectroscopy, focusing on its challenges and current use. I will add also a few ideas for potential future directions of the field.

15:15 Cardiac Diffusion Weighed & Tensor Imaging

Kévin Moulin[1]

[1]Boston Children's Hospital, Boston, MA, United States

Keywords: Contrast mechanisms: Diffusion, Cardiovascular: Cardiac

This educational presentation will focus on the technical advancements in the emerging field of cardiac diffusion imaging. Initially, we'll explore the impact of cardiac motion on the diffusion signal and examine the various diffusion encoding techniques devised to mitigate it. Additionally, we'll investigate respiratory motion and explore methods for imaging during free breathing. Subsequently, we'll delve into the fundamental principles underlying cardiac diffusion tensor reconstructions and the primary diffusion markers derivable from them. Lastly, we'll explore several clinical applications of cardiac diffusion imaging.

Oral
AI-Empowered Image Planning, Quantification & Modeling

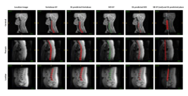
Hall 606 | Thursday 13:45 - 15:45 | *Moderators:* Li Feng & Muge Karaman

13:45 Introduction

Li Feng

New York University Grossman School of Medicine, New York, NY, United States

1230 13:57



Integrated Multi-label 3D Deep Learning Multi-task Model for Intelligent MR Spine Scan Planning

Ashish Saxena[1], Chitresh Bhushan[2], Saumya Ghose[2], Uday Patil[1], and Dattesh Shanbhag[1]

[1]*GE Healthcare, Bangalore, India,* [2]*GE Healthcare, Niskayuna, NY, United States*

Keywords: Analysis/Processing, Spinal Cord, Localizer images, MRI, Spine, Segmentation, Deep Learning

Motivation: Obtaining consistent spine MRI images irrespective of patient posture, spine deformities, and technologists' skills, with minimal disruption in the existing workflow.

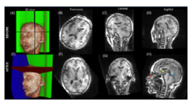
Goal(s): To develop an intelligent scan plane prescription for spine MRI using deep learning on regular 3-plane localizer images.

Approach: We adopted a multi-resolution CNN network for multiple segmentation tasks - spine vertebrae, intervertebral disc (IVD), and saturation band (SB) across all the spine stations (cervical, thoracic, and lumbar) and orientations (sagittal and coronal).

Results: We reported good segmentation of vertebrae and IVD, along with consistent SB placement with angle error of less than 5 degree and no overlap with the spine region.

Impact: We present a first-of-its-kind integrated multi-label 3D DL model that operates on 2D 3-plane regular localizers to aid consistent MRI scan planning. This model combines MRI localizer images across orientation, across spine stations, and across multiple imaging tasks.

1231 14:09



Deep learning-based automated scan planning for brain MRI

Gaojie Zhu[1,2], Xiongjie Shen[2], and Hua Guo[1]

[1]*Department of Biomedical Engineering, School of Medicine, Tsinghua University, Center for Biomedical Imaging Research, Beijing, China,* [2]*Anke High-tech Co., Ltd, Shenzhen, China*

Keywords: Analysis/Processing, Brain, automatic scan planning

Motivation: Manual scan planning in clinical MRI is inaccurate, inconsistent and time-consuming.

Goal(s): A deep learning-based end-to-end automated scan planning framework has been developed for MRI head scans.

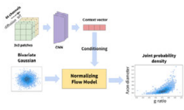
Approach: We propose a two-stage end-to-end 3D cascaded convolutional network framework, called 3D CFP-UNet, which localizes the positions of five key anatomical landmarks and achieves a coarse-to-fine result. We also propose loss functions PRL and DRL with physical meaning in automatic scan planning.

Results: Our approach yields satisfactory scan planning results on 229 test subjects, with PAE and PRE reaching 0.872mm and 0.10%, respectively.

Impact: MRI automated scan planning can help improve scan efficiency. Also, it improves scan consistency for follow-up comparisons.

1232 14:21 [Transfer learning for non-parametric prediction of joint distributions of g-ratios and axon diameters from MRI]

MERIT AWARD SUMMA CUM LAUDE



Gustavo Chau Loo Kung[1,2], Emmanuelle M.M. Weber[2], Ankita Batra[3], Lijun Ni[3], Michael Zeineh[2], Juliet Knowles[3], and Jennifer A. McNab[2]

[1]Bioengineering Department, Stanford University, Stanford, CA, United States, [2]Radiology Department, Stanford University, Stanford, CA, United States, [3]Neurology Department, Stanford University, Stanford, CA, United States

Keywords: Analysis/Processing, Microstructure, Histology, Diffusion Imaging, g-ratio, axon diameter

Motivation: Machine learning approaches are an alternative to conventional biophysical model fitting used to generate MRI microstructural maps, but the lack of paired MRI-histology data complicates end-to-end training of these models.

Goal(s): Develop a nonparametric deep learning based prediction of joint distributions of g-ratios and axon diameters from multimodal MRI data.

Approach: Histology-based synthetic MRI data was used to pretrain a conditioned normalizing flow model. Transfer learning was then performed on limited paired MRI-histology data.

Results: The joint distribution shows good visual agreement with actual samples and the distances between the marginal probabilities and their respective samples exhibit a Jensen-Shannon distance smaller than 0.22.

Impact: We present an optimized model to obtain non-parametric joint distributions of g-ratios and axon diameters from multimodal MRI from limited experimental data. The approach can easily be adapted to other microstructural modeling tasks.

1233 14:33 [RNN-aided metabolite quantification from incomplete FIDs in 1H-MRS of the brain]

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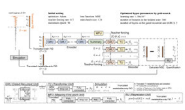


Eunho Jeong[1], Joon Jang[2], and Hyeonjin Kim[3,4]

[1]Department of Applied Bioengineering, Seoul National University Graduate School of Convergence Science and Technology, Seoul, Korea, Republic of, [2]Department of Biomedical Sciences, Seoul National University College of Medicine, Seoul, Korea, Republic of, [3]Department of Radiology, Seoul National University Hospital, Seoul, Korea, Republic of, [4]Department of Medical Sciences, Seoul National University College of Medicine, Seoul, Korea, Republic of

Keywords: Analysis/Processing, Spectroscopy, Brain, Deep learning, Quantification, RNN

Motivation:
Incomplete FIDs can be obtained due to the limited sampling windows as in spectroscopic MRF and SSFP-MRSI, or due to FID truncation for removing spectral artifact.

Goal(s): Developing a means of quantifying metabolites from incomplete FIDs will allow more efficient sequence design and better experimental outcome.

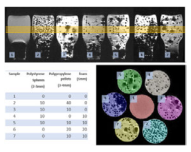
Approach: We developed a recurrent-neural-network (RNN) for metabolite quantification from incomplete FIDs at 3.0T. The RNN was trained on simulated data and tested on in vivo data.

Results: Although the performance of the RNN requires further improvement for low concentration metabolites (e.g., GABA), it may allow quantification of the major metabolites under highly limited sampling windows.

Impact: Incomplete FIDs can be obtained due to the limited sampling windows as in spectroscopic MRF and SSFP-MRSI. We developed a recurrent-neural-network, which can quantify the major metabolites from the initial 64 FID data points, thereby allowing more efficient sequence design.

1234 14:45 The Effect of Deep Learning on Radiomic Imaging Features: A Phantom Study

MERIT AWARD MAGNA CUM LAUDE



Edward J Peake[1], Joao G Duarte[2], Andrew N Priest[1,2], and Martin J Graves[1,2]

[1]Imaging, Cambridge University Hospital, Cambridge, United Kingdom, [2]Department of Radiology, University of Cambridge, Cambridge, United Kingdom

Keywords: Analysis/Processing, Radiomics

Motivation: To investigate the effect of a deep learning reconstruction algorithm on radiomic image features.

Goal(s): To assess the effect of AIR^{TM} Recon Deep Learning (ARDL), a commercial AI reconstruction algorithm, on radiomic features in a set of phantoms.

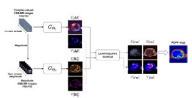
Approach: A set of radiomic phantoms were constructed and used to acquire images with different numbers of signal averages and ARDL levels. Effects were evaluated through intraclass correlation coefficient (ICC) measures.

Results: Radiomic features maintain excellent ICC values (>0.9) at a constant SNR with ARDL Low, but ICC values decrease with higher ARDL levels

Impact: This research highlights how deep learning image reconstruction can alter radiomic features and could help define a subset of stable features. The level of deep learning reconstruction applied is shown to have significant impact, even at constant SNR.

1235 14:57 Physics-informed and uncertainty-aware deep learning approach for liver PDFF quantification

MERIT AWARD MAGNA CUM LAUDE



Juan Pablo Meneses[1,2], Cristobal Arrieta[2,3], Pablo Irarrazaval[1,2,4,5], Marcelo Andia[1,2,6], Carlos Sing Long[1,2,4,7], Juan Cristobal Gana[8], Jose Eduardo Galgani[9,10], Cristian Tejos[1,2,5], and Sergio Uribe[2,11]

[1]Biomedical Imaging Center, Pontificia Universidad Catolica de Chile, Santiago, Chile, [2]i-Health Millennium Institute for Intelligent Healthcare Engineering, Santiago, Chile, [3]Faculty of Engineering, Universidad Alberto Hurtado, Santiago, Chile, [4]Institute for Biological and Medical Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile, [5]Department of Electrical Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile, [6]Radiology Department, School of Medicine, Pontificia Universidad Catolica de Chile, Santiago, Chile, [7]Institute for Mathematical & Computational Engineering, Pontificia Universidad Catolica de Chile, Santiago, Chile, [8]Pediatric Gastroenterology and Nutrition Department, Division of Pediatrics, School of Medicine, Pontificia Universidad Catolica de Chile, Santiago, Chile, [9]Nutrition & Dietetics. Department of Health Sciences; Faculty of Medicine, Pontificia Universidad Catolica de Chile, Santiago, Chile, [10]Department of Nutrition, Diabetes and Metabolism. Faculty of Medicine, Pontificia Universidad Catolica de Chile, Santiago, Chile, [11]Department of Medical Imaging and Radiation Sciences, Monash University, Melbourne, VIC, Australia

Keywords: Analysis/Processing, Fat, Proton Density Fat Fraction

Motivation: Most Deep Learning (DL) methods to estimate liver PDFF require reference results for training and can only calculate deterministic outputs with unknown uncertainty.

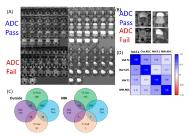
Goal(s): To estimate liver PDFF using a fully-unsupervised DL method for MR water-fat separation capable of quantifying uncertainty.

Approach: We propose a physics informed DL-based framework which can be trained purely on chemical shift-encoded MR images. Our method estimates stochastic R2* and Δf maps, enabling uncertainty quantification, which are then used to obtain stochastic water-only and fat-only components.

Results: Liver PDFF estimations showed good agreement with a reference technique, and uncertainty maps associated with imperfections in the considered physical model.

Impact: The proposed physics-informed DL model requires only MR data for training, which facilitates the data gathering process. Moreover, our uncertainty-aware approach can quantify the uncertainty associated to the final estimations, which may be of significant value in clinical practice.

1236 15:09



Prediction of Low Quality ADC Maps from T2 Scans

Jeffrey R. Brender[1], Mitsuki Ota[1], Murali Cherukuri Krishna[1], Joshua Ford[1], Peter L. Choyke [1], and Ismail Baris Turkbey[1]

[1]*Molecular Imaging Branch, NCI/NIH, Bethesda, MD, United States*

Keywords: Analysis/Processing, Prostate, Quality Control, DWI, ADC, Preduiction

Motivation: ADC maps are an essential tool for early prostate cancer detection but are often uninterpretable due to imaging artifacts

Goal(s): Detect problems early in the imaging procedure using T2 images to predict the future quality of the ADC map

Approach: Constructed a multisite corpus of 486 patients imaged at both the NIH and outside. Investigated the influence of acquisition parameters on image quality and the predictive power of neural networks and simple anatomy measurements from the T2 image

Results: ADC image quality can be predicted from the T2 image using either a neural network approach or measurement of the rectal cross-section

Impact: The probability of a low quality, uninterpretable ADC maps can be inferred early in the imaging process, allowing corrective action (e.g. removal of gas by a muscle relaxant) to be employed

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1237 15:21

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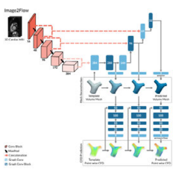


Image2Flow: Fast Calculation of Pulmonary Artery Flow Fields from 3D Cardiac MRI Using Graph Convolutional Neural Networks

Tina Yao[1], Endrit Pajaziti[1], Michael Quail[1], Jennifer Steeden[1], and Vivek Muthurangu[1]

[1]*Institute of Cardiovascular Science, University College London, London, United Kingdom*

Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence

Motivation: Computational fluid dynamics (CFD) is used for non-invasive cardiovascular hemodynamic assessment, but it is limited by time-consuming manual segmentation and expertise needed for simulation.

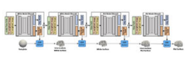
Goal(s): Improve the speed and simplify volume mesh generation and CFD flow field calculation.

Approach: Develop a single deep-learning model capable of reconstructing the pulmonary artery from a 3D cardiac MRI as a volume mesh and predicting CFD-like pressure and flow.

Results: Our model achieves accurate pulmonary artery reconstruction with a median Dice score of 0.9. It computes CFD-like pressure and flow with median errors of 14.9% and 9.0%, respectively. Our model is ~10,000 times faster than manual calculation.

Impact: Image2Flow is a single-pass deep-learning model that rapidly and accurately reconstructs pulmonary artery volume meshes from 3D cardiac MR and predicts CFD-like flow fields. Our model can potentially streamline and expedite cardiovascular haemodynamic assessment and facilitate more efficient treatment planning.

1238 15:33



Rapid Reconstruction of Infant Cortical Surfaces with Spherical Topology

Xiaoyang Chen[1], Junjie Zhao[1], Siyuan Liu[2], Sahar Ahmad[1], and Pew-Thian Yap[1]

[1]*University of North Carolina at Chapel Hill, Chapel Hill, NC, United States,* [2]*Dalian Maritime Time University, Dalian, China*

Keywords: Analysis/Processing, Segmentation, Cortical Surface Reconstruction

Motivation: Cortical surface reconstruction (CSR) is important for surface-based analysis of the structure and function of the cerebral cortex.

Goal(s): We present an efficient method for simultaneous CSR and spherical mapping, all within a matter of seconds. Inherent correspondence allows easy and direct mapping of geometric features from cortical surfaces to the sphere.

Approach: Our flow-based method learns velocity fields to deform a spherical template mesh to the cortical surfaces with one-to-one vertex correspondence for direct spherical mapping.

Results: Using data from the Baby Connectome Project (BCP), we demonstrate that our method predicts more accurate and uniform surface meshes compared with several state-of-the-art methods.

Impact: Our method provides a way for fast and accurate infant cortical surface reconstruction. The one-to-one vertex correspondence between template sphere and the cortical surfaces enables easy and direct downstream analyses.

Oral

Psychosis & Mood Disorders

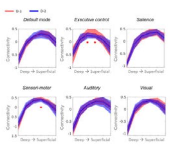
Nicoll 1 | Thursday 13:45 - 15:45 | *Moderators:* John Port & Lianqing Zhang

13:45 Introduction

John Port

Mayo Clinic, United States

1239 13:57



<u>Resting-state changes along the cortical depth detected during evolution of major depressive disorder</u>

Patricia Pais-Roldán[1], Seong Dae Yun[1], Shukti Ramkiran[1,2], Ravichandran Rajkumar[1,2,3], Jana Hagen[2], Areej Al Okla[1], Tanja Veselinovic[1,2], Gereon Schnellbächer[2], Irene Neuner*[1,2,3], and N. Jon Shah*[1,3,4,5]

[1]Institute of Neuroscience and Medicine 4, INM-4, Forschungszentrum Jülich, Jülich, Germany, [2]Department of Psychiatry, Psychotherapy and Psychosomatics, RWTH, Aachen, Germany, [3]JARA - BRAIN - Translational Medicine, Aachen, Germany, [4]Department of Neurology, RWTH Aachen University, Aachen, Germany, [5]Institute of Neuroscience and Medicine 11, INM-11, JARA, Forschungszentrum Jülich, Jülich, Germany

Keywords: Psychiatric Disorders, Brain Connectivity, Laminar connectivity, depression

Motivation: The relative contribution of each cortical depth to the network disturbances coupled with depression remains unexplored.

Goal(s): We aim to identify changes in connectivity along the cortical thickness during depression recovery.

Approach: We use high-resolution, large-coverage EPIK to functionally map the brain of patients before and after treatment and perform cortical-depth specific analysis of network connectivity.

Results: Changes in connectivity linked to depression treatment were observed at multiple depths of the cortex in two resting-state networks.

Impact: The demonstration that network connectivity does not change homogeneously in a patient population along the cortical depth suggests the importance of adding this variable to the analysis of psychiatric disorders to improve understanding of the mechanisms behind network disturbances.

1240 14:09

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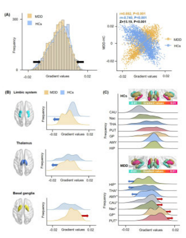


<u>Cognition-related connectome gradient dysfunctions of thalamus and basal ganglia in drug-naïve first-episode major depressive disorder</u>

Qian Zhang[1], Youjin Zhao[1], Aoxiang Zhang[1], Lizhou Chen[1], and Qiyong Gong[1]

[1]Huaxi MR Research Center (HMRRC), Department of Radiology, West China Hospital of Sichuan University, Chengdu, China

Keywords: Psychiatric Disorders, Psychiatric Disorders, major depressive disorder, fMRI, functional gradient, subcortical structure, cognition

Motivation: The continuous spatial patterns of inter-region connectivity within the subcortical network still remain less well-understood in MDD.

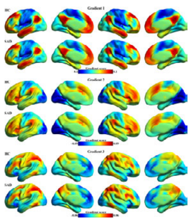
Goal(s): Using functional gradient mapping, a novel approach to identify hierarchical organization of functional networks, we aim to evaluate multiscale subcortical gradients in MDD and their association with cognition.

Approach: Subcortical gradient alterations at the global-, system-, and subregion-levels and their relation to neuropsychological functioning were assessed in MDD patients relative to healthy controls.

Results: Principal gradient values were lower in thalamic and limbic systems but higher in basal ganglia in MDD. Interactions between thalamic and basal ganglia gradient alterations were implicated in MDD-related memory impairments.

Impact: Multiscale subcortical gradient alterations can enhance our understanding of MDD-related hierarchical disturbances in subcortical function and may provide useful clinical biomarkers for cognitive impairments in MDD.

1241 14:21 [Disrupted brain functional connectome gradient in social anxiety disorder]



Xun Zhang[1] and Qiyong Gong[1]

[1]*Huaxi MR Research Center (HMRRC), West China Hospital of Sichuan University, Chengdu, China*

Keywords: Functional Connectivity, fMRI (resting state), biomarker

Motivation: Although discrete macroscale functional network abnormalities were observed in social anxiety disorder (SAD), the alterations of continuous spatial patterns of functional connectomes remain unknown.

Goal(s): We aimed to use a novel method to characterize aberrant patterns of connectome gradients in SAD patients.

Approach: We applied diffusion map embedding to characterize functional connectome gradients and investigated between-group differences of global and regional topological features and their clinical relevance.

Results: Globally, SAD patients demonstrated decreased explanation ratio, narrower gradient range and less spatial variation in the principal gradient. Regionally, SAD group showed increased gradients in the sensorimotor networks and decreased in the default mode network.

Impact: Our findings of internally clinically-relevant disrupted hierarchy patterns of functional connectomes could add further insights into the neurobiological underpinnings of SAD, and may advance the development of objective biomarkers for early diagnosis, targeted intervention, and therapeutic efficacy evaluation in SAD.

1242 14:33 [Brain connectomic and transcriptional signatures of suicidal thoughts and behaviors in major depressive disorder]

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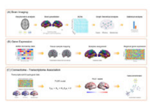


Kun Qin[1,2], Huiru Li[3], Rui Hu[1], Lisha Zhang[2], Cunqing Kong[1], Wen Chen[1], Qiyong Gong[2], and Zhiyun Jia[2]

[1]*Department of Radiology, Taihe Hospital, Hubei University of Medicine, Shiyan, China,* [2]*West China Hospital of Sichuan University, Chengdu, China,* [3]*The First Affiliated Hospital of Kunming Medical University, Kunming, China*

Keywords: Psychiatric Disorders, Brain

Motivation: Suicide-related connectomic signatures in depression and underlying transcriptional patterns have been poorly understood, most previous findings were limited by small-sample and single-site design.

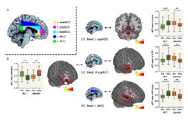
Goal(s): To identify robust brain structural network deficits associated with suicidal thoughts and behaviors (STB) in major depressive disorder (MDD) and to determine related transcriptional profiles.

Approach: Based on mutlicenter MRI data of over 700 individuals, group-level connectomic comparisons and connectome-transcriptome association were analyzed.

Results: Robust structural connectomic alterations associated with STB in MDD were distributed in the prefrontal, limbic and temporal areas. STB-related connectomic alterations were spatially correlated with genes enriched for cellular metabolism and synaptic signaling.

Impact: These findings reveal a robust pattern of brain structural deficits at network level and demonstrate its linkage to gene expression patterns, which provides novel insights into the neurobiological underpinnings and potential markers for prediction and prevention of STB.

1243 14:45 MERIT AWARD MAGNA CUM LAUDE



Effects of bright light therapy on cingulate cortex dynamic functional connectivity and neurotransmitter activity in subthreshold depression

Guixian Tang[1], Pan Chen[1], Guanmao Chen[1], Wei Cui[2], and Ying Wang[1]

[1]First Affiliated Hospital of Jinan University, Guangzhou, China, [2]MR Research, GE Healthcare, Beijing, China, Guangzhou, China

Keywords: Psychiatric Disorders, fMRI (resting state)

Motivation: Bright light therapy (BLT) is one of the effective interventions for subthreshold depression, but its neural mechanism is still unclear.

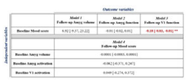
Goal(s): The goal of this double-blind, randomized, placebo-controlled clinical trial was to assess the correlation between BLT and the dynamic functional connectivity (dFC) changes in the cingulate cortex along with distribution of specific neurotransmitters in subthreshold depression.

Approach: A double-blind randomized controlled trial

Results: BLT alleviates depressive symptoms and changes the cingulate cortex dFC variability in subthreshold depression. And pre-treatment dFC variability of the cingulate cortex could be used as a biomarker for improved BLT treatment in subthreshold depression.

Impact: BLT alleviates depressive symptoms and changes the cingulate cortex dFC variability in subthreshold depression, which raises the possibility that pre-treatment dFC variability of the cingulate cortex could be used as a biomarker for improved BLT treatment in subthreshold depression.

1244 14:57



Current mood status is associated with future brain MRI readouts, but not the other way around: insights from healthy adults in the UK Biobank

Guocheng Jiang[1,2], Walter Swardfager[2,3], Hugo Cogo-Moreira[4], Sandra E Black[2,5], Benjamin I Goldstein[3,6], and Bradley J MacIntosh[1,2]

[1]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Hurvitz Brain Science Research Program, Sunnybrook Research Institute, Toronto, ON, Canada, [3]Department of pharmacology and toxicology, University of Toronto, Toronto, ON, Canada, [4]Department of Education, ICT and Learning, Østfold University College, Halden, Norway, [5]Department of Medicine, University of Toronto, Toronto, ON, Canada, [6]Centre for Youth Bipolar Disorder, The Centre for Addiction and Mental Health, Toronto, ON, Canada

Keywords: Psychiatric Disorders, Psychiatric Disorders, Mood

Motivation: The mood status of an individual can influence the brain anatomy and function.

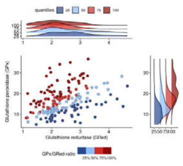
Goal(s): We studied whether the mood state is associated with brain structural and functional alteration at 2.25 years follow-up and vice versa.

Approach: We focus on the regional brain volumes and task-induced function of the amygdala and primary visual cortex using T1w and task fMRI. Linear models tested for associations between mood and MRI readouts.

Results: Baseline mood score is significantly associated with functional activation in the primary visual cortex. However, baseline volume and functional activation in the amygdala and primary visual cortex are not associated with future mood status.

Impact: We showed that mood status is associated with future functional activation in the primary visual cortex. However, MRI estimates of anatomy and function in the amygdala and primary visual cortex demonstrated a lack of predictive power for future mood status.

1245 15:09



Associations between blood markers of redox regulation and brain white matter microstructure display distinct signatures in psychosis

Tommaso Pavan[1,2], Yasser Alemán-Gómez[1,2], Pascal Steullet[1], Zoe Schilliger[1,3], Daniella Dwir[1], Raoul Jenni[1,3], Martine Cleusix[1], Luis Alameda[1,3], Kim Q. Do[1,3], Philippe Conus[1], Paul Klauser[1,3], Patric Hagmann[1], and Ileana Jelescu[1]

[1]Lausanne University Hospital (CHUV), Lausanne, Switzerland, [2]University of Lausanne, Lausanne, Switzerland, [3]University of Lausanne (UNIL), Lausanne, Switzerland

Keywords: Psychiatric Disorders, White Matter, biomarker, diffusion, DKI, kurtosis, DTI, DWI, psychosis

Motivation: It is unclear whether Glutathione peroxidase (GPx) and reductase (GRed) activity, peripheral proxy of redox homeostasis, could be linked to white matter alterations in psychosis.

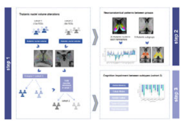
Goal(s): We seek to link white matter alterations to processes connected to neuroinflammation, namely raising from dysregulation of the glutathione redox homeostasis.

Approach: We applied diffusion kurtosis imaging and White Matter Tract Integrity – Watson to patients data and analyzed the maps via Tract-Based Spatial Statistics(TBSS) and regression contrast analysis.

Results: We found selective and widespread association of kurtosis metrics with glutathione redox enzymes that significantly dissociate between patients and controls.

Impact: Our findings reveal that Redox GSH dysregulation in patients may impact WM microstructure, indicating therapeutic possibilities and reinforcing the connection between microstructure and neuroinflammation. Furthermore, the neat selectivity of the kurtosis metrics highlights potential for widespread clinical research applications.

1246 15:21



Two distinct thalamic subtypes associated with cognitive impairment in first-episode schizophrenia

Wei Yu[1,2], Bo Tao[1,2], Qiannan Zhao[2,3], Yuan Xiao[1,2], Fei Zhu[1,2], Ziyang Gao[1,2], and Su Lui[1,2]

[1]Department of Radiology, West China Hospital of Sichuan University, Chengdu, China, [2]Research Unit of Psychoradiology, Chinese Academy of Medical Sciences, Chengdu, China, [3]Huaxi MR Research Center (HMRRC), West China Hospital of Sichuan University, Chengdu, China

Keywords: Psychiatric Disorders, Brain, thalamic nuclei

Motivation: Schizophrenia is characterized by high heterogeneity, with the core symptom of cognitive impairment. However, it is unclear that whether the patterns of thalamic nuclei volume alterations is associated with cognitive function in schizophrenia.

Goal(s): To investigate the pattern and heterogeneity of thalamic nuclei alterations and cognition in schizophrenia.

Approach: The cluster analysis (K-means++) was used to identify the subtype of schizophrenia. And machine learning model was developed to validate the reproducibility of subtypes.

Results: We uncovered two markedly distinct neuroanatomical subtypes of schizophrenia. One of the subtypes characterized as widespread decrease in thalamic nuclei and severe cognition deficit.

Impact: These findings could help to identify biological targets related to the treatment of schizophrenia, and improve the functional outcomes in patients with schizophrenia.

Oral
Overcoming Imperfections & Artifacts

Nicoll 2 | Thursday 13:45 - 15:45 | *Moderators:* Barbara Dymerska & Michael Hoff

1247 13:45

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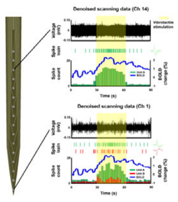

A Novel Deep Learning Denoising Algorithm for Neural Signal Recovery in fMRI Scanning

Bo-Wei Chen[1], Zhuyuan Lyu[2,3], Xiao Yu[2,3], Tingting He[2,3], Boyi Qu[2,3,4], Haiming Wang[2,3,4], Zheng Tang[2,3], Mingfeng Ye[2,3], You-Yin Chen*[1], and Hsin-Yi Lai*[2,3,4,5]

[1]*Department of Biomedical Engineering, National Yang Ming Chiao Tung University, Taipei, Taiwan,* [2]*Department of Neurology of the Second Affiliated Hospital, Interdisciplinary Institute of Neuroscience and Technology, Key Laboratory of Medical Neurobiology of Zhejiang Province, Zhejiang University School of Medicine, Hangzhou, China,* [3]*MOE Frontier Science Center for Brain Science and Brain-Machine Integration, State Key Laboratory of Brain-machine Intelligence, School of Brain Science and Brain Medicine, Zhejiang University, Hangzhou, China,* [4]*College of Biomedical Engineering and Instrument Science, Zhejiang University, Hangzhou, China,* [5]*Affiliated Mental Health Center & Hangzhou Seventh People's Hospital, Zhejiang University School of Medicine, Zhejiang University, Hangzhou 310000, China*

Keywords: Artifacts, Artifacts

Motivation: While fMRI infers neural activity from hemodynamic changes, the relationship between the two remains to be further clarified. Simultaneous electrophysiological recordings (Ephy) and fMRI can provide additional insights into neurovascular coupling and brain function.

Goal(s): Our objective is to address the electromagnetic interference (EMI) noise in the simultaneous Ephy and fMRI recording.

Approach: A deep learning-based fully convolutional neural network (FCNN) was proposed to effectively eliminate EMI noise. Simulated neural signals and tactile-evoked neural signals were implemented for training and testing.

Results: FCNN significantly reducing EMI noises, maintaining spike waveform consistency and successfully retaining the most neural signals.

Impact: This research proposed a universal and robust denoising approach to address electromagnetic interference during simultaneous recording of neural signals and fMRI data, which will be relevant for understanding of neurovascular coupling and brain function.

1248 13:57

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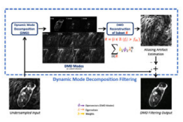


Dynamic Mode Decomposition enables low-latency high temporal resolution reconstruction for golden-angle spiral real-time MRI

Ecrin Yagiz[1], Ibrahim K. Ozaslan[1], Bilal Tasdelen[1], Mihailo R. Jovanovic[1], Ye Tian[1], and Krishna S Nayak[1]

[1]*Electrical and Computer Engineering, University of Southern California, Los Angeles, CA, United States*

Keywords: Image Reconstruction, Cardiovascular, fetal, low-field, online reconstruction

Motivation: Real-time MRI methods with higher spatiotemporal resolution employ undersampled non-Cartesian trajectories combined with a computationally intense reconstruction to mitigate aliasing. However, often, a low-latency, coarse-temporal resolution, low-quality reconstruction is provided online. This may hinder the scan quality in interventional and fetal imaging.

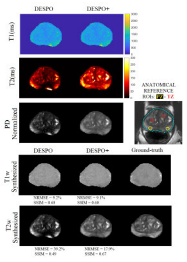
Goal(s): To develop a low-latency, high-temporal resolution online reconstruction for real-time MRI.

Approach: We introduce a novel method using Dynamic Mode Decomposition for low-latency, high-temporal resolution reconstruction that removes spiral aliasing. The online version is achieved by predicting and removing aliasing artifacts in upcoming frames.

Results: We evaluate DMD Filtering in the context of real-time adult and fetal cardiac function assessment.

Impact: The proposed technique, Dynamic Mode Decomposition filtering, achieves low-latency (<20ms/frame), high-temporal resolution reconstruction with negligible spiral aliasing artifact, and no iterations. This may be valuable for online reconstruction during interventional and fetal cardiac imaging.

1249 14:09



[Banding insensitive DESPO for T1 and T2 mapping applied to 3D prostate at 3T.]

Ronal Coronado[1,2], Carlos Castillo-Passi[3,4], Cecilia Besa[2,5], and Pablo Irarrazaval[1,2,6]

[1]Pontificia Universidad Catolica de Chile, Santiago, Chile, [2]Millenium Institute for Intelligent Healthcare Engineering, Santiago, Chile, [3]Institute for Biological and Medical Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile, [4]School of Biomedical Engineering and Imaging Sciences, King's College London, London, United Kingdom, [5]Department of Radiology, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile, [6]Institute for Biological and Medical Engineering, Santiago, Chile

Keywords: Artifacts, Prostate, Banding artifacts, bSSFP mapping

Motivation: DESPO is a robust T2 brain mapping technique based on balanced steady-state free precession (bSSFP). However, it is susceptible to off-resonance artifacts, especially in areas with high susceptibility changes, such as the prostate.

Goal(s): Our proposed method, DESPO+, integrates the complete bSSFP and spoiled-gradient echo (SPGR) models, using a simulation-based approach for 3D T1/T2 maps in the prostate region.

Approach: We employed a simulated-based method of the full bSSFP and SPGR models incluiding off-resonance to reconstruct T1/T2/PD simultaneously.

Results: DESPO+ provides off-resonance insensitive with high-resolution 3D T1/T2 mapping, synthesizing T1-weighted/T2-weighted images using a short scan time of 3.6 minutes, similar to DESPO.

Impact: DESPO+ provides an off-resonance insensitive and customizable solution, enabling high-resolution 3D T1/T2 mapping and synthesized T1-weighted/T2-weighted images for the entire prostate, all achieved within a short scan time of 3.6 minutes, similar to DESPO.m

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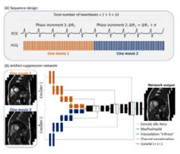
1250 14:21



[Joint suppression of cardiac bSSFP cine banding and flow artifacts based on twofold phase-cycling and a dual-encoder neural network]

Zhuo Chen[1], Juan Gao[1], Haiyang Chen[1], Xin Tang[2], Yixin Emu[1], and Chenxi Hu[1]

[1]Shanghai Jiao Tong University, Shanghai, China, [2]United Imaging Healthcare Co., Ltd, Shanghai, China

Keywords: Artifacts, Artifacts, Cardiac function, Cine

Motivation: Cardiac bSSFP cine imaging suffers from banding and flow artifacts caused by the off-resonance. Although fourfold phase cycling suppresses the banding artifacts, it invokes flow artifacts and prolongs the scan.

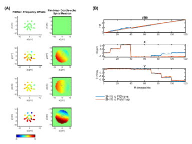
Goal(s): To develop a twofold phase-cycling sequence with a neural-network-based reconstruction for a fast and joint suppression of banding and flow artifacts in cardiac cine imaging.

Approach: We compared the method with standard bSSFP and regular phase cycling in the left ventricle and atrium in 10 healthy subjects.

Results: Needing only 10 heartbeats, the proposed method robustly suppressed both artifacts in the presence of anatomical variations.

Impact: Banding and flow artifacts are common in bSSFP cine imaging, especially with cardiac devices or high-field MR. The proposed method provides a robust and practical tool for suppression of them and improves the reliability of cine MRI.

1251 14:33



Dynamic Estimation of Respiration-Induced B0 Inhomogeneities in OSSI fMRI: A Novel Framework Using FIDNavs and SENSE Maps

Mariama Salifu[1] and Douglas C Noll[1]

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

Keywords: Artifacts, System Imperfections: Measurement & Correction, Artifacts, Physiological noise correction, FID navigators, fMRI

Motivation: In OSSI fMRI, temporal fluctuations in the B0 field, predominantly resulting from respiration, can induce changes to the steady state, subsequently diminishing the temporal signal-to-noise ratio (tSNR)

Goal(s): Our objective is to develop an efficient technique for estimating respiration-induced B0 variations in OSSI fMRI

Approach: We have used Free Induction Decay (FID) frequency offset to estimate the first-order field inhomogeneities. A novel element in our approach lies in adopting a spatial encoding strategy for these FIDs, drawing on the geometric centroids of each coil's sensitivity profile

Results: Our initial findings indicates comparable results between our FIDNavs method and image-based field map method.

Impact: This approach allows for a rapid measurement of B0 variations, thus facilitating faster real-time corrections. This method bypasses the lengthy process of calibration or the need for reference images.

1252 14:45

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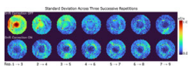


RF Power Amplifier Drift Compensation for Reliable B1 Mapping Using Bloch-Siegert Technique

Ali Aghaeifar[1] and Klaus Scheffler [1,2]

[1]*Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*Department of Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany*

Keywords: Artifacts, Reproductive, RFPA, Drift, Bloch-Siegert, B1

Motivation: RFPA drift affects reproducibility of B_1^+ mapping

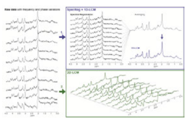
Goal(s): The goal of study is to investigate factors influencing RFPA output drift and introducing a real-time feedback mechanism to compensate for drift

Approach: B_1^+ with Bloch-Siegert shift technique is measured in a repetitive manner and reproducibility of maps is assessed. The RFPA output is continuously monitored through the use of DICOs, and adjustments to the transmit voltage are made to compensate for drift

Results: The findings indicate that RFPA output drift is more noticeable with extended RF pulses and shorter TR. Implementing real-time drift correction effectively minimizes drift, leading to enhanced stability in B_1^+ maps

Impact: Our demonstration of real-time feedback to mitigate RFPA drift enhances measurement accuracy and reproducibility. This approach can be advantageous to achieve the consistency and reliability of research, particularly in the context of multi-center studies.

1253 14:57 [Model-based frequency-and-phase correction of 1H-MRS data with 2D linear-combination modeling]



Dunja Simicic[1,2], Helge Jörn Zöllner[1,2], Christopher William Davies-Jenkins[1,2], and Georg Oeltzschner[1,2]

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

Keywords: Signal Modeling, Spectroscopy, MRS; Frequency-and-phase correction; linear-combination modeling; 2D-modeling

Motivation: Retrospective frequency-and-phase correction (FPC) methods like spectral registration struggle at low SNR.

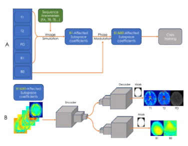
Goal(s): To develop model-based correction FPC with simultaneous 2D fitting of all transients. To compare its performance to conventional FPC.

Approach: Inclusion of all transients (without prior FPC) into a 2D linear-combination model with frequency and phase parameters for each transient. Comparison with conventional approach (spectral registration, averaging and 1D modeling). Outcome measures: frequency/phase/amplitude ground truth error & standard deviation, amplitude CRLB.

Results: Model-based FPC is feasible and retrieves frequency/phase variations with high fidelity. At low SNR, frequency and metabolite amplitude estimation is more accurate and precise.

Impact: Direct integration of frequency-and-phase correction into 2D linear-combination modeling is feasible and has great potential to improve metabolite level estimation for conventional and dynamic MRS data, especially for low-SNR conditions, e.g., long TEs, strong diffusion weighting, etc.

1254 15:09 [Sequence Adaptive B1+ and B0 Field-imperfections Estimation (SAFE) for enhanced MRF quantification]



Mengze Gao[1], Xiaozhi Cao[1,2], Daniel Abraham[2], Zihan Zhou[1], and Kawin Setsompop[1,2]

[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Department of Electrical Engineering, Stanford University, Stanford, CA, United States

Keywords: Artifacts, Machine Learning/Artificial Intelligence

Motivation: B_1^+ and B_0 field-inhomogeneities can significantly reduce accuracy and robustness of MRF's quantitative parameter estimates. Additional B1+ and B0 calibration scans can mitigate this but add scan time and cannot be applied retrospectively to previously collected data.

Goal(s): Here, we proposed a calibration-free sequence-adaptive deep-learning framework, to estimate and correct for B1+ and B0 effects of any MRF sequence.

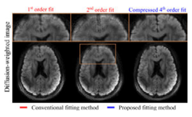
Approach: We demonstrate its capability on arbitrary MRF sequences at 3T, where no training data were previously obtained.

Results: Such approach can be applied to any previously-acquired and future MRF-scans. The flexibility in directly applying this framework to other quantitative sequences is also highlighted.

Impact: Proposed method can estimate B1+ and B0 maps without calibration scan and be applied to arbitrary MRF sequence without new training data. It can be used retrospectively to improve quality of parameter maps of any previously-acquired or future MRF data.

1255 15:21 [Basis function compression for compact representation of high spatial orders of field variation using field monitoring]

MERIT AWARD SUMMA CUM LAUDE



Paul I. Dubovan[1,2], Gabriel Varela-Mattatall[1,3], Ravi S. Menon[1,2], Adam B. Kerr[4,5], and Corey A. Baron[1,2]

[1]Medical Biophysics, Western University, London, ON, Canada, [2]Centre for Functional and Metabolic Mapping, Western University, London, ON, Canada, [3]Lawson Health Research Institute, London, ON, Canada, [4]Center for Cognitive and Neurobiological Imaging, Stanford University, Stanford, CA, United States, [5]Department of Electrical Engineering, Stanford University, Stanford, CA, United States

Keywords: Artifacts, Artifacts, Field Monitoring

Motivation: Field monitoring using field probes has shown to inaccurately estimate higher order field variations on a high-performance gradient system using the conventional fitting procedure.

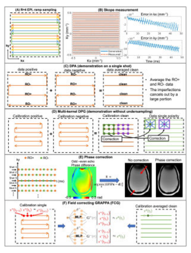
Goal(s): To develop and validate a new fitting approach for field monitoring measurements for improved higher order field characterizations on complex MRI systems.

Approach: Perform a calibration scan by moving probes around imaging volume to accurately characterize field variations, then compress this data to preserve important field information, with the purpose of applying this information to new scans.

Results: Quantitative phantom results and qualitative in-vivo diffusion images show significantly improved image quality when using the proposed fitting method.

Impact: This work presents a new method for accurately calculating higher order field monitoring measurements on a head-only MRI scanner, resulting in substantially improved image quality. This may be useful for other research centers that also utilize complex, high-performance MRI systems.

1256 15:33 [Field-Correcting GRAPPA (FCG) for improved mitigation of even-odd and field-related artifacts in EPI]



Nan Wang[1], Daniel Abraham[2], Adam B Kerr[2,3], Hua Wu[3], Congyu Liao[1], Xiaozhi Cao[1], Jonathan R Polimeni[4,5,6], Renzo Huber[7], and Kawin Setsompop[1]

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Keywords: Artifacts, Artifacts

Motivation: Field perturbation from gradient error and eddy current has been a long-standing issue for EPI, especially with high gradient performance or ramp sampling

Goal(s): To develop a MLP based Field-Correcting GRAPPA (FCG) that accounts for spatial-varying field and produces artifacts-mitigated images

Approach: Calibration data with dual polarity were acquired. A MLP based kernel was trained to take single-polarity data as input and output the clean averaged data. It was applied for both phantom and in vivo undersampled EPI with ramp-sampling.

Results: FCG produced best correction results for ramp-sampling EPI, with potentials for wide applications including fMRI.

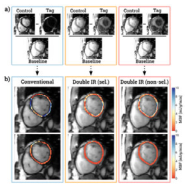
Impact: A Field-Correcting GRAPPA (FCG) technique was developed to correct the field perturbation induced image artifacts for EPI, which accounts for spatial varying field and produced promising resulting on ramp-sampling cases, with great potentials for wide applications including fMRI.

Oral

Novel Techniques for Perfusion

Nicoll 3 | Thursday 13:45 - 15:45 | *Moderators:* Daniel Kim & Peiying Liu

1257 13:45



Double Inversion Recovery in myocardial Arterial Spin Labeling (ASL) for reduced physiological noise

Maša Božić-Iven[1,2,3], Yi Zhang[3], Qian Tao[3], Stanislas Rapacchi[4], Lothar R. Schad[1], and Sebastian Weingärtner[3]

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Keywords: Arterial Spin Labelling, Arterial spin labelling, Myocardial perfusion

Motivation: Myocardial Arterial Spin Labeling (myoASL) presents a promising contrast-agent-free approach for assessing myocardial blood flow (MBF), but its clinical translation is hampered by high levels of physiological noise (PN).

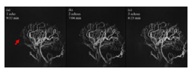
Goal(s): We introduce double inversion recovery (DIR) preparations for FAIR-myoASL to mitigate sensitivity to heart rate variations and reduce PN.

Approach: A flip-back inversion pulse was added immediately after the FAIR-labeling, to allow for near-complete recovery and, thus, for more effective cancellation of the myocardial background signal in the presence of heart rate variations.

Results: Using DIR preparations in vivo, led to a PN reduction of up to 66 % compared to conventional myoASL.

Impact: FAIR-myoASL with double inversion recovery (DIR) labeling can compensate for fluctuating myocardial background signals due to heart rate variability. In vivo, experiments suggest that DIR-preparations substantially reduce PN, thus, improving overall robustness and potentially facilitating broader clinical translation of myoASL.

1258 13:57



Time-Resolved pCASL MRA Using A Multi-Echo 3D-Radial SPGR Sequence

Andreas Petrovic[1,2], Martin Soellradl[1,2], Thomas Okell[3], Leon Lai[1,2], Shalini A Amukotuwa[1,2], and Roland Bammer[1,2]

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Keywords: Arterial Spin Labelling, Arterial spin labelling

Motivation: To improve signal, spatial and temporal resolution, and acquisition time for time resolved ASL imaging for cerebral angiography.

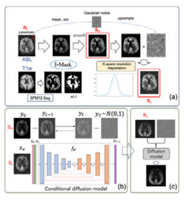
Goal(s): To exploit a time-resolved multi-echo radial 3D ASL sequence to acquire ASL MRA data in a shorter amount of time.

Approach: We performed three flip angle optimized scans with a 1, 2, and 3 echo readout, respectively, and compared image quality and acquisition time.

Results: Using a 3-echo readout, scan time could be reduced from 9:32 min to 6:23 min, without the loss of image quality. Multi-echo scans even showed more details than in the single-echo case.

Impact: Multi-echo 3D radial ASL angiography enables substantial scan time reduction for high-resolution time-resolved cerebral angiography. This will improve clinical applicability and scanner throughput, avoid the use of contrast agents, and is of direct benefit to patients.

1259 14:09 Self-Supervised SUper-Resolution ASL Enhancement based on Conditional Diffusion Models (SURED)



Yunzhi Xu[1], Liangchen Shi[1], Jiaxin Zheng[1], Jiaxin Li[1], Yu Zeng[1], Weiying Dai[2], David Alsop [3], and Li Zhao[1]

[1]College of Biomedical Engineering & Instrument Science, Zhejiang University, Hangzhou, China, [2]Department of Computer Science, State University of New York, Binghamton, NY, United States, [3]Radiology, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA, United States

Keywords: Arterial Spin Labelling, Arterial spin labelling, Super-resolution, Conditional diffusion model

Motivation: Arterial spin labeling (ASL) MRI is a non-invasive technique used for measuring perfusion. However, the resolution of ASL is limited by its low SNR.

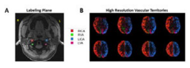
Goal(s): to propose an ASL super-resolution method based on a self-supervised training strategy and the conditional diffusion model.

Approach: Synthetic high resolution ASL images were generated by utilizing paired T1w images and low-resolution ASL images. A modified conditional diffusion model was trained to simultaneously achieve resolution enhancement and denoising. The proposed model was tested on simulated and volunteer images.

Results: The proposed network demonstrates superior enhanced image details, improved SNR, and preserved original contrast in conventional low-resolution ASL images.

Impact: The proposed method enhanced the ASL images without requiring the high-resolution ASL for training. It enables super-resolution ASL images from 4 minutes scans to approach those acquired in 17min.

1260 14:21 Vessel-Encoded Arterial Spin Labeling at 7 Tesla



Hongwei Li[1], Yang Ji[2], He Wang[1,3], Zhensen Chen[1,3], Joseph G. Woods[2], and Thomas W. Okell[2]

[1]Institute of Science and Technology for Brain-inspired Intelligence, Fudan University, Shanghai, China, [2]University of Oxford, Wellcome Centre for Integrative Neuroimaging, FMRIB Division, Nuffield Department of Clinical Neurosciences, Oxford, United Kingdom, [3]Key Laboratory of Computational Neuroscience and Brain-Inspired Intelligence (Fudan University), Ministry of Education, Shanghai, China

Keywords: Arterial Spin Labelling, Arterial spin labelling, ultra-high field

Motivation: Vessel-encoded arterial spin labeling (VEASL) allows the visualization of collateral blood flow and blood supply to lesions, but has limited SNR. At ultra-high field, ASL benefits from significantly improved SNR and longer blood T1 relaxation time. However, B_0 field inhomogeneity can reduce labeling efficiency and disrupt encoding patterns.

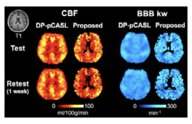
Goal(s): Implementing VEASL robustly at 7 Tesla.

Approach: Optimized ASL parameters, dynamic B_0 shimming and OES-based correction methods were used to mitigate the impact of B_0 field inhomogeneity.

Results: Good vascular territory maps, labeling both the neck and above the circle of Willis, were achieved, including at high spatial resolution.

Impact: We demonstrate the first vessel-encoded ASL perfusion maps at ultra-high field, and the vascular territory maps significantly improved after applying B_0 correction techniques, with the potential to push for even higher spatial resolution.

1261 14:33 <u>Sub-space Low-rank Imaging for mapping of blood-brain barrier Water Exchange Rate (SLIWER) using multi-PLD diffusion-weighted pCASL</u>



Xingfeng Shao[1], Chenyang Zhao[2], Rong Guo[3,4], Qinyang Shou[2], Zhi-Pei Liang[4,5], Keith S St Lawrence[6,7], and Danny J.J. Wang[2]

[1]Laboratory of FMRI Technology (LOFT), Mark & Mary Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, Arcadia, CA, United States, [2]Laboratory of FMRI Technology (LOFT), Mark & Mary Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [3]Siemens Medical Solutions USA, Inc., Urbana, IL, United States, [4]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [5]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [6]Lawson Health Research Institute, London, ON, Canada, [7]Department of Medical Biophysics, Western University, London, ON, Canada

Keywords: Arterial Spin Labelling, Permeability, Blood-brain barrier, water exchange, cerebral small vessel disease

Motivation: Non-invasive MRI mapping of the blood-brain barrier (BBB) function using water as an endogenous tracer can be a valuable tool for early detection of subtle BBB dysfunctions.

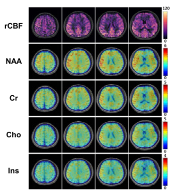
Goal(s): To develop an advanced MRI technique and reconstruction methods for reliable BBB water exchange rate (kw) mapping.

Approach: We introduce a Sub-space Low-rank Imaging method for mapping BBB Water Exchange Rate (SLIWER) with an innovative pulse sequence termed motion compensated diffusion weighted pCASL (MCDW-pCASL).

Results: The SLIWER method demonstrated high test-retest reliability, indicating its potential in clinical settings, such as in evaluating cerebral small vessel disease (cSVD).

Impact: We developed a reliable tool for early BBB dysfunction detection, potentially transforming the diagnosis and treatment of neurological disorders such as cerebral small vessel disease.

1262 14:45 <u>High-Fidelity ASL Perfusion Imaging Using Unsuppressed Water Signals in MR Spectroscopic Imaging</u>



Rong Guo[1,2], Xingfeng Shao[3], Yudu Li[2,4], Yibo Zhao[2,5], Wen Jin[2,5], Yao Li[6], Danny JJ Wang[3], Brad Sutton[2,4,7], and Zhi-Pei Liang[2,5]

[1]Siemens Medical Solutions USA, Inc., Urbana, IL, United States, [2]Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]Laboratory of FMRI technology (LOFT), USC Mark and Mary Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [4]National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [5]Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [6]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [7]Department of Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States

Keywords: Arterial Spin Labelling, Arterial spin labelling, Spectroscopy

Motivation: ASL and MRSI experiments are currently performed using different sequences, and EPI-based ASL methods suffer from spatial distortion and limited SNR.

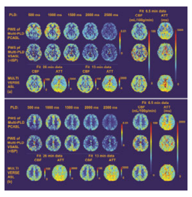
Goal(s): To develop a water unsuppressed MRSI based imaging method for high-fidelity ASL-based perfusion imaging.

Approach: The SPICE sequence was integrated with a PASL module for ASL acquisition, and a GS model-based method was used for image reconstruction.

Results: The proposed method achieved ASL at 2×2×2 mm^3 resolution and MRSI at 2×3×3 mm^3 within 9 minutes in total. Compared with typical EPI-based methods, the resulting ASL images were free from spatial distortion, and had adequate SNR within a short scan time.

Impact: This work presents a new method for high-fidelity ASL-based perfusion imaging combining with MRSI-based metabolic imaging. With further development, it may provide a powerful brain imaging tool for both functional studies and clinical applications.

1263 14:57 MULti-TImepoint VElocity-selective Reconciled with Spatially-sElective (MULTIVERSE) ASL: Pushing the Limit of Arterial Transit Time



Feng Xu[1,2], Dapeng Liu[1,2], Dan Zhu[1,2], Anja Soldan[3], Marilyn Albert[3], Martin Lindquist[4], Doris D. M. Lin[1], and Qin Qin[1,2]

[1]The Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Neurology, Johns Hopkins University, Baltimore, MD, United States, [4]Department of Biostatistics, Johns Hopkins University, Baltimore, MD, United States

Keywords: Arterial Spin Labelling, Perfusion, Cerebral blood flow, arterial transit time, multi time point, arterial spin labeling

Motivation: Existing multi-timepoint arterial spin labeling (ASL) methods can only estimate cerebral blood flow (CBF) and arterial transit time (ATT) with a limited range of ATT (<2000ms).

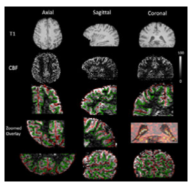
Goal(s): Improve quantification of CBF and ATT for a wide range of ATT.

Approach: MULTIVERSE ASL applies combined fitting of multi-PLD pseudo-continuous (PC) ASL and multi-PLD velocity-selective (VS) ASL to measure CBF and ATT.

Results: With the same scan time, MULTIVERSE ASL improved the accuracy and precision and reduced uncertainty in CBF and ATT quantification across an extended range of ATT (500-4000ms).

Impact: This novel and straightforward approach improves perfusion measurement over the extended range of arterial transit time which was not possible with existing ASL methods. It highlights the clinical potential of ASL-based perfusion mapping in various altered physiological and pathological conditions.

1264 15:09 Iso-1.25mm Whole-cerebrum pCASL at 7T for Mapping Depth-dependent Cortical Gray Matter and Tract-specific White Matter Cerebral Blood Flow



Chenyang Zhao[1], Fanhua Guo[1], Qinyang Shou[1], Xingfeng Shao[1], Yuan Li[2], Shuo Huang[2], Yonggang Shi[2], and Danny JJ Wang[1,3]

[1]Laboratory of FMRI Technology (LOFT), Mark & Mary Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [2]Neuro Image Computing Research (NICR), Mark & Mary Stevens Neuroimaging and Informatics Institute, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States, [3]Department of Neurology, Keck School of Medicine, University of Southern California, Los Angeles, CA, United States

Keywords: Arterial Spin Labelling, Arterial spin labelling, 7T, Compressed Sensing

Motivation: Mapping CBF in the whole cerebrum extent at a microvascular level at 7T has been hampered by SNR, susceptibility artifacts, BOLD effect, and field inhomogeneity.

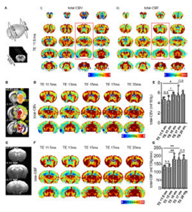
Goal(s): We aim to achieve an isotropic 1.25 whole cerebrum pCASL imaging.

Approach: We developed a pCASL sequence which incorporates recent optimizations of labeling and background suppression and a 3D TFL readout. Poisson-disc undersampling and compressed sensing were used to improve image quality.

Results: CBF mapping with high SNR and resolution was achieved, revealing depth-dependent CBF and an inverse relationship between tract-specific CBF and fractional anisotropy.

Impact: The proposed pCASL imaging technique will impact neuroscientists by enabling fine-grained mapping of CBF at microvascular level in cortical gray matter and white matter at 7T.

1265 15:21



[Optimization of Echo Time for BOLD Dynamic Susceptibility Contrast MRI]

THUY THI LE[1], SANG HAN CHOI[1], CHAN HEE LEE[1], GEUN HO IM[1], and SEONG-GI KIM[1]

[1]Center for Neuroscience Imaging Research (CNIR), Institute for Basic Science (IBS), Suwon, 16419, Republic of Korea, Suwon, Korea, Republic of

Keywords: Perfusion, Perfusion, TE-dependency

Motivation: Achieving accurate quantification of absolute CBV and CBF in BOLD-DSC depends on maximizing the hypoxia-induced signal changes and accurately determining the arterial input function.

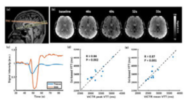
Goal(s): The choice of echo time affects both baseline signal-to-noise ratio and hypoxia-induced changes[1,2], our study aimed to investigate the effects of different TEs on the quantification of CBV and CBF.

Approach: We systematically varied TE within the range of 11.57 ms to 20 ms , measured hypoxia-induced signal changes in arterial, venous, and somatosensory tissue voxels, and quantified perfusion metrics.

Results: We discovered that a shorter TE, which produces sufficient signal changes without causing arterial peak saturation, is preferable.

Impact: Shorter TE leads to less hypoxia-induced signal changes, while longer TE decreases baseline SNR and increase the risk of arterial signal saturation. This signal saturation leads to the underestimation of AIF, and consequently, overestimation of perfusion quantification.

1266 15:33



[Validation and assessment of venous transit time in the human brain using VICTR MRI]

Wen Shi[1,2], Dengrong Jiang[2], Zhiyi Hu[1,2], Kaisha Hazel[2], George Pottanat[2], Ebony Jones[2], Cuimei Xu[2], Vivek Yedavalli[2], Doris Lin[2], Sevil Yasar[3], Yulin Ge[4], Abhay Moghekar[3], and Hanzhang Lu[1,2]

[1]Department of Biomedical Engineering, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Department of Radiology & Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [4]Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Velocity/Flow, Perfusion, Transit Time, Vein

Motivation: Venous transit time (VTT) is insufficiently investigated and can be a useful marker for clinical populations with abnormalities in the cerebral venous system.

Goal(s): To further verify a novel non-contrast VICTR MRI and investigate advanced VTT properties and their age effects in the brain.

Approach: We compared the VTT from VICTR and a contrast-based method. Statistical properties of VTT distribution were studied in a caffeine challenge and compared between young and older subjects.

Results: VTT from VICTR MRI showed great agreement with contrast-based VTT. The mean, peak, and spread of VTT increased in the caffeine challenge. VTT is longer in the older subjects.

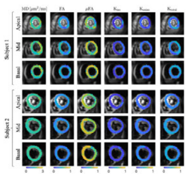
Impact: VICTR MRI can measure venous transit time in the adult brain which increases with age. The non-contrast measurement of venous transit time paves the way for several research avenues to better understand vascular function in the normal and pathological brain.

Oral

Diffusion on Unconventional Systems

Room 331-332 | Thursday 13:45 - 15:45 | *Moderators:* Andrew Alexander & Chunlei Liu

1267 13:45 [Quantifying microscopic anisotropy in the human heart in vivo using ultra-strong gradients]



Maryam Afzali[1,2,3], Lars Mueller[1,3], Sam Coveney[1], Sarah Jones[2], John Evans[2], Fabrizio Fasano[4,5], Erica Dall'Armellina[1], Filip Szczepankiewicz[6], Irvin Teh[1], Derek K Jones[2], and Jürgen E Schneider[1]

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Keywords: DWI/DTI/DKI, Diffusion/other diffusion imaging techniques, Cardiac diffusion MRI, microscopic anisotropy, strong gradients, tensor-valued diffusion encoding, Diffusion Kurtosis imaging

Motivation: Tensor-valued diffusion encoding has been shown to provide more information on tissue microstructure than conventional diffusion weighting/tensor imaging.

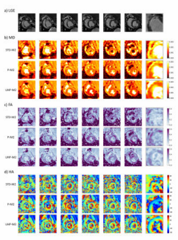
Goal(s): Quantifying microscopic anisotropy, isotropic and anisotropic kurtosis in a human heart in vivo with a TE commonly used for DTI.

Approach: We used strong gradients ($\mathrm{G_{max}=300\,mT/m}$) in combination with linear, planar, and spherical tensor encoding with up to second-order motion compensation to achieve $\mathrm{b_{max} = 1500\,s/mm^2}$ with a TE of 74 ms.

Results: Estimated diffusion metrics matched the values reported in the literature while a shorter echo time was achieved due to the strong gradients used resulting in increased SNR and therefore image quality.

Impact: We implemented tensor-valued diffusion encoding with ultra-strong gradients for in vivo cardiac diffusion MRI in humans. This allows us to quantify microscopic anisotropy and kurtosis.

1268 13:57 [Enabling high SNR cardiac spin echo DTI with a Cima.X MR System featuring 200 mT/m maximum gradient strength]



Danielle Kara[1], Yuchi Liu[2], Shi Chen[1], Thomas Garrett[1], Xiaoming Bi[3], Deborah Kwon[4], and Christopher T Nguyen[1,4,5,6]

[1]Cardiac Innovation Research Center, Heart Vascular and Thoracic Institute, Cleveland Clinic, Cleveland, OH, United States, [2]Siemens Medical Solutions USA, Cleveland, OH, United States, [3]Siemens Medical Solutions USA, Los Angeles, CA, United States, [4]Cardiovascular Medicine, Heart Vascular and Thoracic Institute, Cleveland Clinic, Cleveland, OH, United States, [5]Biomedical Engineering, Case Western Reserve and Cleveland Clinic, Cleveland, OH, United States, [6]Imaging Institute, Cleveland Clinic, Cleveland, OH, United States

Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging

Motivation: SNR and parameter map accuracy in cardiac DTI are limited by maximum gradient strength related to motion-compensation and diffusion encoding time, precluding evaluation of helical cardiomyocyte structure.

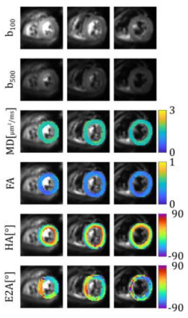
Goal(s): Our goal was to improve SNR and cardiac DTI tissue microstructure characterization using an MR system capable of 200mT/m maximum gradient strength.

Approach: DTI was performed in human and swine subjects using standard (40mT/m), performance (80mT/m), and ultra-high-performance (200mT/m) maximum gradient strengths, with zeroth, first, and second-order motion compensating gradients.

Results: SNR and DTI tissue characterization were improved with ultra-high-performance gradients, however second-order motion compensation continued to be required to prevent motion artifacts.

Impact: Ultra-high performance 200mT/m gradients enable high SNR cardiac DTI with improved characterization of helical cardiomyocytes, potentially addressing the clinical need for noninvasive cardiac microstructure evaluation.

1269 14:09



ZOOM and enhance: ZOnally magnified Oblique Multi-slice for cardiac DTI with ultra-strong gradients

Lars Mueller[1,2], Maryam Afzali[1,2,3], Sam Coveney[1], André Döring[3,4], Fabrizio Fasano[5,6], John Evans[3], Irvin Teh[1], Erica Dall'Armellina[1], Filip Szczepankiewicz[7], Derek K Jones[3], and Jurgen E Schneider[1]

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Keywords: Diffusion Acquisition, Diffusion Tensor Imaging, Cardiac diffusion MRI, strong gradients, ZOOM, reduced field of view, non co-planar rf

Motivation: Cardiac diffusion tensor imaging (cDTI) with echo-planar imaging (EPI) requires long readouts to avoid aliasing artefacts if 2D-selective rf-pulses are not available. These prolong the echo time (TE) and increasing sensitivity to off-resonance artefacts.

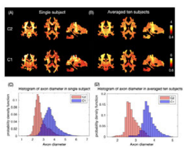
Goal(s): The reduction of the excited and refocused field of view in the phase direction to reduce TE and sensitivity to image artefacts in cDTI.

Approach: We combine ZOnally-magnified Oblique Multi-slice (ZOOM) EPI (i.e. tilting the slice orientation of the refocussing rf-pulse) with ultra-strong gradients.

Results: We were able to reduce TE (from ~70 ms to 59 ms) in cDTI considerably by reducing the FoV and using strong gradients.

Impact: We reduced the echo time in cDTI with ultra-strong gradients which will allow us to use more advanced diffusion acquisitions (higher b-values and/or different gradient waveforms) in the heart in vivo.

1270 14:21



Axon diameter mapping in the living human brain with ultra-high gradient diffusion MRI using 500 mT/m gradient strength

Yixin Ma[1], Hong-Hsi Lee[1], Hansol Lee[1], Gabriel Ramos-Llordén[1], Kowk Shing Chan[1], and Susie Y. Huang[1]

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Keywords: Microstructure, Gradients

Motivation: Noninvasive quantification of axon diameter in the living human brain offers valuable insights into the mesoscopic organization of white matter. Current methods for mapping axon diameter using diffusion MRI are limited by gradient strength.

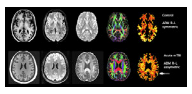
Goal(s): To evaluate the sensitivity of axon diameter mapping to small diameter axons on the Connectome 2.0 scanner (Gmax=500mT/m) compared to the original Connectome scanner (Gmax=300mT/m).

Approach: The AxCaliber-SMT model was fitted to diffusion MRI data in 10 healthy subjects scanned on Connectome 2.0 and Connectome 1.0.

Results: Median axon diameter in the corticospinal tract was 2.63um on Connectome 2.0 and 4.00um on Connectome 1.0.

Impact: Connectome 2.0 pushes the resolution limit and signal-to-noise ratio of axonal diameter mapping, allowing for greater sensitivity toward small diameter axons at the individual level for a variety of neuroscientific and clinical applications.

1271 14:33



Axonal Diameter Mapping as a biomarker for mTBI as detected by ultrahigh-bvalue DWI in a high performance Head-only gradient system, MAGNUS.

H. Douglas Morris[1], Nastaren Abad[2], Chitresh Bhushan[2], Luca Marinelli[2], Gail Kohls[1], Maureen N Hood[1], James Kevin DeMarco[1,3], Robert Shih[1,3], Vincent B Ho[1], and Thomas K F Foo[2]

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Keywords: Microstructure, Diffusion/other diffusion imaging techniques, High-performance head-only Gradient

Motivation: Detect a mild traumatic brain injury with a reliable diagnostic for staging disease state and the testing therapies for treating the malady in acute and long term phase.

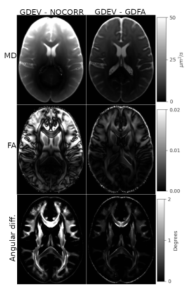
Goal(s): Develop a MRI biomarker that can be repeated used on patients especially in the warfighter population which have more that 500,000 diagnosed mTBI over the past 30 year.

Approach: Use of diffusion MRI to determine the white matter microstructural state namely the axon diameter.

Results: MAGNUS SE-DWI high-B can detect changes in axon diameter and follow these changes in single subject over time.

Impact: High B-value diffusion imaging (b > 30000 mm2/sec) can detect changes in mild TBI subjects that can be seen to progress through the recovery process. The high-performance gradient system, MAGNUS, (200mT/m, 500T/m/s) scanning without peripheral nerve stimulation in the subject.

1272 14:45



Dealing with Gradient Nonlinearities for High-Performance Gradient Diffusion MRI - Application to the Human Connectome Project (HCP) Dataset

M. Okan Irfanoglu[1], Ahmad Beyh[2,3], Anh Thai[1], Carlo Pierpaoli[1], and Flavio Dell'Acqua[2]

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Keywords: Diffusion Analysis & Visualization, Diffusion/other diffusion imaging techniques, Gradient nonlinearity correction

Motivation: Correction of gradient nonlinearity effects on diffusion-sensitization is important. However, not all software packages and/or diffusion models can incorporate spatially-varying bvals/bvecs information.

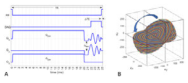
Goal(s): Determine how significant nonlinearities are in the Human Connectome Project(HCP) dataset and investigate the feasibility of a spherical harmonics (SH)-based signal regeneration technique to directly incorporate nonlinearity effects and eliminate the need for additional information sharing.

Approach: FA, MD and angular error maps from 200 subjects were compared using different formats of correction.

Results: Nonlinearities are significant on HCP-dMRI data. The proposed SH-based signal regeneration approach allows the use of spatially invariant diffusion gradient tables with substantially reduced residual error.

Impact: Diffusion models and software not designed to incorporate spatially-varying bvals/bvecs can now take advantage of gradient nonlinearity correction. A reprocessed version of HCP dMRI dataset will be made publicly available in this format, along with the conventional gradient deviation tensors.

1273 14:57 <u>UTE-Based DW-SSFP MRI for 7T</u>



Kwan-Jin Jung[1]

[1]Beckman Institute, Biomedical Imaging Center, University of Illinois at Urbana-Champaign, Urbana, IL, United States

Keywords: Diffusion Acquisition, Diffusion Tensor Imaging, DW-SSFP

Motivation: At 7T the conventional spin-echo EPI diffusion sequence suffers from the B1+ inhomogeneity and geometric distortion due to refocusing RF pulses and EPI readout.

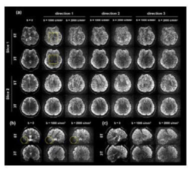
Goal(s): To develop a diffusion imaging sequence without refocusing RF pulses and EPI readout at 7T.

Approach: Develop a 3-dimensional DW-SSFP sequence with a spiral readout to reduce the geometric distortion, to maximize the diffusion gradient time, and to reduce susceptibility effect.

Results: The proposed DW-SSFP sequence was successful in reducing the B1+ inhomogeneity, the geometric distortion, and the susceptibility effect compared to the spin-echo EPI diffusion sequence using cadaveric head specimens at 7T.

Impact: This sequence enables the acquisition of high-resolution diffusion images that do not suffer from the B1+ inhomogeneity and geometric distortion often observed at 7T. It provides good quality fiber tracts and fractional anisotropy maps of the brain.

1274 15:09 <u>High-resolution whole brain multi-shell diffusion MRI at 5.0 Tesla</u>



Fan Liu[1], Diwei Shi[2], Xin Shao[1], Sisi Li[1], Qiyuan Tian[1], and Hua Guo[1]

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Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging

Motivation: In neuroscientific researches, 3T DWI provides limited resolution while 7T DWI suffers from challenges such as shorter relaxation time and increased field inhomogeneity.

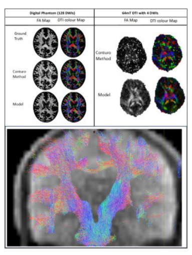
Goal(s): To evaluate the performance of 5T in high-resolution whole brain multi-shell DWI.

Approach: 1.1 mm-isotropic whole brain DWI with 2 shells was acquired using multi-band single-shot 2D EPI on 5T. DTI metrics and MSMT-CSD model were computed. The nearly identical acquisition parameters and data processing were applied to the same subject on 3T.

Results: 5T DWI resolved brain structural connectivity more accurately than 3T. Better FA contrast was observed at 5T, demonstrating higher SNR achieved at 5T.

Impact: The feasibility of simultaneously achieving high spatial resolution and adequate q-space sampling in practical acquisition time at 5T demonstrated its potential as a new tool in DWI-based neuroscientific studies.

1275 15:21 <u>DTI at four directions: an application at ultra-low field</u>



Joshua Mawuli Ametepe[1], James Gholam[1], Álvaro Planchuelo-Gómez[2], Francesco Padormo[3], Leandro Beltrachini[4], Mara Cercignani[1], and Derek Kenton Jones[1]

[1]School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]University of Valladolid, Valladolid, Spain, [3]Hyperfine Inc., Guilford, CT, United States, [4]School of Physics and Astronomy, Cardiff University, Cardiff, United Kingdom

Keywords: DWI/DTI/DKI, Low-Field MRI, Tetrahedral Encoding

Motivation: The project aimed to tackle extended DTI scan durations, worsened by low SNR at low fields, striving to boost efficiency while preserving results' accuracy at lower SNR levels.

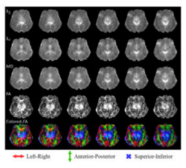
Goal(s): The study sought to create an ML-based approach to shorten DT-MRI scans while ensuring reliable tensor estimation despite low SNR challenges at ULF.

Approach: ML models, trained on synthetic data, predicted diffusivities and principal eigenvectors from four diffusion-weighted images, factoring in simulated noise and gradient rotations for noise and motion.

Results: The models estimated diffusivities and fibre orientations with fewer data, showing promise for ULF tractography. Suggesting shorter DTI scans are possible at ULF.

Impact: Our results are relevant to clinicians and researchers using low-field MRI, potentially enabling faster DT-MRI scans, opening avenues for efficient DTI in challenging settings, and making fibre mapping more accessible with reduced acquisition scan times.

1276 15:33 Diffusion Tensor Imaging at 0.05 T



Ye Ding[1,2], Linfang Xiao[1,2], Shi Su[1,2], Jiahao Hu[1,2], Yujiao Zhao[1,2], and Ed X. Wu[1,2]

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

Keywords: DWI/DTI/DKI, Diffusion Tensor Imaging

Motivation: The employment of DTI in ULF MRI systems demonstrates considerable potential for examining microstructural variations in neuropathology and therapy. Although confronted with the inherent obstacle of low SNR at ULF, incorporating DTI yields an array of benefits. These advantages involve heightened accessibility, diminished costs, and superior patient care, while simultaneously extending the range of application possibilities for this crucial imaging modality throughout diverse healthcare contexts.

Goal(s): The implementation of DTI on an ULF MRI scanner.

Approach: DTI protocol was successfully implemented at 0.05 T.

Results: This study demonstrated the successful implementation of DTI protocol on an ULF MRI system.

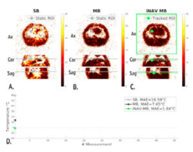
Impact: This study explored the potential of a 0.05 T MRI system to increase MRI accessibility. Successful DTI implementation demonstrated the scanner's capacity to examine microstructural changes, highlighting its promising application in this field.

Oral

Interventional Therapy: Targeting, Monitoring & Evaluation

Room 334-336 Thursday 13:45 - 15:45 *Moderators:* Sébastien Roujol & Steven Allen

1277 13:45 Dynamic 3D Thermometry in Moving Tissue using Accelerated Stack-of-Radial MRI and an Image-Navigated Multi-Baseline PRF Method



Qing Dai[1], Shu-Fu Shih[1], Omar Z. Curiel[2], Jason Chiang[1], David S. K. Lu[1], Tsu-Chin Tsao[2], and Holden H. Wu[1]

[1]Radiology, University of California, Los Aneles, Los Angeles, CA, United States, [2]Mechanical And Aerospace Engineering, University of California, Los Aneles, Los Angeles, CA, United States

Keywords: Thermometry/Thermotherapy, MR-Guided Interventions, Liver, Motion Correction, Radial MRI, Focused Ultrasound

Motivation: MRI thermometry faces challenges in moving tissues: intra- and inter-scan motion, limited spatio-temporal resolution, and constrained spatial coverage. These obstacles result in temperature mis-calculations, compromising treatment safety and efficacy.

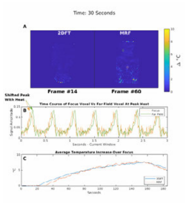
Goal(s): To develop an image-navigated 3D thermometry method to simultaneously track respiratory motion and temperature in moving tissue.

Approach: A stack-of-radial sequence was combined with compressed sensing reconstruction to obtain dynamic 3D images. An image-navigated multi-baseline proton resonance frequency shift (PRF) method was developed to generate motion-resolved temperature maps with tissue tracking.

Results: The proposed method achieved 24-30 slice coverage with a temporal resolution <1 second/volume and mean absolute error <2 degrees during motion.

Impact: The proposed method could improve the safety and efficacy of MRI-guided thermal therapies through reliable temperature monitoring in moving tissues. The capability to simultaneously track motion and temperature evolution enables feedback control, including focused ultrasound beam steering in moving organs.

1278 13:57 [MR Thermometry with High Precision and Temporal Resolution by Quadratic Phase MR Fingerprinting]



Sarah Garrow[1], Rasim Boyacioglu[1], Kathryn E Keenan[2], Mark Griswold[1], and William Grissom[1]

[1]Case Western Reserve University, Cleveland, OH, United States, [2]National Institute of Standards and Technology, Boulder, CO, United States

Keywords: Thermometry/Thermotherapy, Thermometry

Motivation: Proton resonance frequency (PRF)-shift thermometry is the current standard for MR-temperature monitoring in interventional procedures. However, the long TE required for phase contrast induces signal dropout and increases sensitivity to metal and motion artifacts.

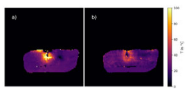
Goal(s): Use quadratic RF phase (qRF) MR fingerprinting to image off-resonance frequency for thermometry at a real time frame rate.

Approach: Because PRF change is much more sensitive to temperature change in aqueous tissue than T1/T2, we propose a "lightweight" constant low-flip-angle MRF sequence optimized for 3s or less frame rate to measure temperature from the PRF shift.

Results: We implemented qRF-MRF thermometry with high spatiotemporal resolution.

Impact: A thermometry method with high temporal resolution that does not suffer from signal dropout at high temperatures can enable more accurate temperature monitoring for MR-guided interventional procedures. Additionally, it has potential to be more robust to motion artifacts.

1279 14:09 [An MRF approach for Simultaneous T1- and PRFS-based 3D MR-Thermometry]



Moritz Gutt[1], Dominik Horstmann[1], Frank Wacker[1], Bennet Hensen[1], and Marcel Gutberlet[1]

[1]Department of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany

Keywords: Thermometry/Thermotherapy, Thermometry

Motivation: The classical PRFS-based approach to MR-thermometry cannot be used in adipose tissue and is vulnerable to susceptibility artifacts. Nonetheless, the PRFS-based method is quite accurate in aqueous tissue when no severe susceptibility artifacts occur.

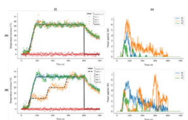
Goal(s): A simultaneous measurement of T1 could be used to account for susceptibility artifacts and perform thermometry in adipose tissue.

Approach: An MRF sequence was designed to measure T1 and the PRF at the same time. It was tested during a microwave ablation on a liver phantom.

Results: The PRFS-based temperature maps had a higher temperature accuracy while the T1-based temperature maps performed better in predicting the ablation zone.

Impact: It was shown that simultaneous T1- and PRFS-based 3D-Thermometry is possible using MRF. While the T1 proved to be more robust to susceptibility-induced errors, the PRF had a better temperature accuracy. A combined approach could provide a more accurate MR-thermometry.

1280 14:21 [Real-time automatic multipoint temperature regulation during MRI-guided Laser-induced Thermotherapy (MR-LITT)]



Manon Desclides[1,2], Valéry Ozenne[1], Pierre Bour[2], Guillaume Machinet[3], Christophe Pierre[3], Stéphane Chemouny[2], and Bruno Quesson[1]

[1]University of Bordeaux, CNRS, CRMSB, UMR 5536, IHU Liryc, Bordeaux, France, [2]Certis Therapeutics, Pessac, France, [3]ALPhANOV, Talence, France

Keywords: MR-Guided Interventions, MR-Guided Interventions, LITT, laser, ablation, thermometry

Motivation: Current Laser devices used during MR-guided LITT can use single or multiple fibers to create coagulation necrosis, but do not provide opportunities for precise temperature control in tissue.

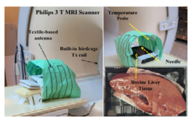
Goal(s): We present an automatic control algorithm combined with a multi-source laser that allows the temperature to be forced to follow predefined temperature profiles.

Approach: Fast, multi-slice thermometric data are processed on the fly to achieved efficient volumetric temperature regulation of multiple laser sources simultaneously.

Results: We offer a precise and rapid volumetric temperature control solution combined with multi-source LITT to create conformal ablation volumes larger than those achieved with a single fiber.

Impact: Automatic volumetric temperature regulation of multisource LITT combined with real-time multislice MRI thermometry allows better control of local thermotherapies in soft tissues.

1281 14:33



[Evaluation of Magnetic Resonance Mediated Radiofrequency Ablation in Bovine Liver Tissue Using Textile Antenna-Enhanced MR Thermometry.]

Sana Ullah[1], Sukhoon Oh[2], and Hyoungsuk Yoo[3]

[1]Seoul Institute of Technology, School of Electrical and Biomedical Engineering, Hanyang University, Seoul, Korea, Republic of, [2]Bio-chemical Analysis Team, Korea Basic Science Institute, Cheongju, 28119, South Korea, Cheongju, Korea, Republic of, [3]Department of Biomedical Engineering and Department of Electronic Engineering, Hanyang University, Seoul, Korea, Republic of

Keywords: Non-Array RF Coils, Antennas & Waveguides, Thermometry, Magnetic resonance-mediated radiofrequency ablation, antenna

Motivation: Magnetic resonance-mediated radiofrequency ablation (MR-RFA) combines diagnostic and therapeutic functions within MRI scanners, and its significance has grown rapidly, particularly in tumor treatment diagnosis.

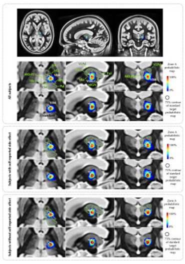
Goal(s): In this study, a 3T Philips MRI scanner is channeled toward the ablation site in the bovine liver by means of an antenna and a needle, with the objective of generating RF heating at the tumor location.

Approach: MR thermometry was used to evaluate the MR-RFA procedure and predict local specific absorption rate (SAR) escalation and temperature increase.

Results: Our research demonstrated that temperature maps with a 73 ^{o}C peak value were observed at the needle tip.

Impact: In contrast to existing ablation designs, this design provides enhanced patient comfort, localized heating, minimal skin burns, and avoids the use of external RF power sources, all while ensuring there is no distortion in MR images.

1282 14:45



[Patient-specific targeting of VIM using THOMAS segmentation predicts post-MRgFUS side effects: a retrospective evaluation]

Sonoko Oshima[1,2], Asher Kim[1,3], Xiaonan Richard Sun[4], Ziad Rifi[4], Katy A. Cross[5], Katherine A. Fu[5], Benjamin M. Ellingson[1,2,3,4,6], Noriko Salamon[2], Ausaf A. Bari[4], and Jingwen Yao[1,2,3]

[1]UCLA Brain Tumor Imaging Laboratory (BTIL), Center for Computer Vision and Imaging Biomarkers, University of California, Los Angeles, Los Angeles, CA, United States, [2]Department of Radiological Sciences, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Bioengineering, Henry Samueli School of Engineering and Applied Science, University of California, Los Angeles, Los Angeles, CA, United States, [4]Department of Neurosurgery, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, United States, [5]Department of Neurology, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, United States, [6]Department of Psychiatry and Biobehavioral Sciences, David Geffen School of Medicine, University of California, Los Angeles, Los Angeles, CA, United States

Keywords: MR-Guided Focused Ultrasound, MR-Guided Interventions

Motivation: Precise and personalized targeting for MR-guided focused ultrasound (MRgFUS) is desired to ensure treatment efficacy and avoid side effect.

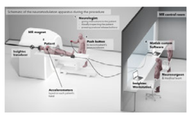
Goal(s): To assess THalamus Optimized Multi Atlas Segmentation (THOMAS) on white-matter nulled MRI for targeting of the ventral intermediate (VIM) thalamic nucleus in MRgFUS for tremor patients.

Approach: We retrospectively assessed the relationships of standard indirectly targeted coordinates, post-FUS lesions, and THOMAS segmentation with post-FUS side effects and tremor scores in patients who underwent VIM-MRgFUS.

Results: In patients who exhibited side effects, FUS lesions had a smaller overlap with THOMAS-based VIM segmentation and were located more inferiorly.

Impact: THOMAS is a novel automated thalamic segmentation tool which may aide in the targeting of the VIM nucleus, potentially reducing side effects and improving treatment outcomes in MRgFUS for patients with tremor.

1283 14:57 First Evidence of sustained reduction of Essential Tremor with MR-Guided Low-Energy Ultrasound Neuromodulation



Nadya Pyatigorskaya[1,2], Thomas Bancel[3], Benoit Beranger[4], Melanie Didier[4], Maxime Daniel[3], Eric Bardinet[4], Mathieu Santin[4], Sara Fernandez Vidal[4], Cécile Galléa[1], Itay Rachmilevitch[5], Yeruham Shapira[5], Alexandre Dizeux[3], David Attali[3], Mickael Tanter[3], David Grabli[6], Marie Vidailhet[1], Stephane Lehericy[1], Carine Karachi[6], Elodie Hainque[1], and Jean-Francois Aubry[3]

[1]MOVIT team, Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, ICM, Paris, France, [2]Neuroradiology, APHP, Sorbonne universite, Paris, France, [3]Inserm U1273, ESPCI Paris, CNRS UMR8361, PSL University, Physics for Medicine Paris, Paris, France, [4]Centre de NeuroImagerie de Recherche – CENIR, Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, ICM, Paris, France, [5]Insightec, Tirat Carmel, Israel, [6]Sorbonne Université, Inserm U1127, CNRS 7225, Hôpital Pitié-Salpêtriere, ICM, Paris, France

Keywords: MR-Guided Focused Ultrasound, Focused Ultrasound, MRgFUS, neuromodulation, essential tremor, thermometry

Motivation: Transcranial Ultrasound Stimulation (TUS) is a non-invasive technology for brain stimulation, particularly suited for the neuromodulation of deep brain structures.

Goal(s): We investigated the behavioral effects of low-energy TUS in the thalamus in Essential Tremor patients scheduled for MR-guided ultrasound treatment.

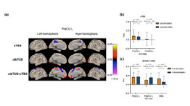
Approach: Two targets were tested: the ventral intermediate nucleus of the thalamus (VIM) and the dentato-rubro-thalamic tract (DRT). MRI was used for procedure guidance and monitoring. The effect was recorded using MR-compatible accelerometers.

Results: VIM low-energy neuromodulation induced transient change in tremor power (p-value< 0.001). DRT neuromodulation reduced tremor power (p-value<0.001) with a sustained post-effect, without MR-thermometry exhibiting any significant thermal rise.

Impact: High precision focusing enhanced by state of the art transcranial aberration correction allowed unprecedent transient tremor reduction in Essential Tremor patients following low-energy thalamic ultrasound stimulation under MRI guidance.

1284 15:09 Low-intensity focused ultrasound with continuous theta burst stimulation induces human primary motor cortex functional connectivity changes

MERIT AWARD MAGNA CUM LAUDE



Wei-Chih Yang[1], Kai-Hsiang Stanley Chen[2], Yih-Chih Jacinta Kuo[2], Yan-Siou Dong[2], Gin-Shin Chen[3], and Yao-Chia Shih[1]

[1]Graduate Institute of Medicine, Yuan Ze University, Taoyuan City, Taiwan, [2]Department of Neurology, National Taiwan University Hospital Hsin-Chu Branch, Hsin-Chu, Taiwan, [3]Institute of Biomedical Engineering and Nanomedicine, National Health Research Institutes, Miaoli, Taiwan

Keywords: Other Interventional, fMRI (resting state)

Motivation: Combining low-intensity transcranial focused ultrasound stimulation (TUS) akin to continuous theta burst stimulation (cTBS) setting (ctbTUS) with cTBS over M1 can be a potential strengthening non-invasive neuromodulatory method.

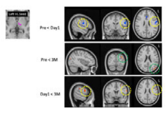
Goal(s): To understand the neuroplasticity in response to ctbTUS or simultaneous ctbTUS+cTBS.

Approach: Resting-state fMRI with seed-based analysis with seeds of M1 and its first dorsal interosseous (FDI) muscle representation ($M1_{FDI}$) was used to assess functional connectivity (FC) changes due to cTBS, ctbTUS, or ctbTUS+cTBS.

Results: We replicated M1-FC degradations in ipsilateral sensorimotor regions due to cTBS, and verified the potential synergic effect of ctbTUS+cTBS on M1-FC decreases in supplementary motor area.

Impact: Our study is the first to use resting-state fMRI to investigate FC changes within motor network due to either cTBS, ctbTUS, or ctbTUS+cTBS stimulations on left M1. The results help understand the potential of ctbTUS+cTBS to be a novel therapy.

1285 15:21 [Acute versus chronic ventral lateral thalamus intrinsic connectivity after MR-guided focused ultrasound thalamotomy for essential tremor]



Darren Laree Clark[1], Conrad Rockel[1], Samuel Pichardo[1], Tejas Sankar[2], Fady Girgis[3], Camila Aquino[4], Davide Martino[4], Zelma H.T Kiss[3], and G. Bruce Pike[1]

[1]Departments of Radiology and Clinical Neurosciences, University of Calgary, Calgary, AB, Canada, [2]Department of Surgery, University of Alberta, Edmonton, AB, Canada, [3]Department of Clinical Neurosciences, University of Calgary, Calgary, AB, Canada, [4]Departments of Community Health Sciences and Clinical Neurosciences, University of Calgary, Calgary, AB, Canada

Keywords: Functional Connectivity, Focused Ultrasound, Essential Tremor, fMRI, Longitudinal

Motivation: To address the gap in understanding the longitudinal impact of MR-guided focused ultrasound (MRgFUS)-thalamotomy on motor network connectivity in essential tremor (ET).

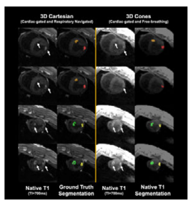
Goal(s): To elucidate the changes in functional connectivity within the motor network following MRgFUS thalamotomy, distinguishing between acute and chronic phases.

Approach: Connectivity changes in the ventrolateral (VL) thalamus of 19 ET patients were tracked using fMRI at three intervals—pre-operation, one day, and three months post-MRgFUS.

Results: Initially, both VLs showed diminished connectivity with sensorimotor regions. By three months, left VL had enhanced connections with associative and visual areas, while right VL demonstrated sustained reduced sensorimotor connectivity, reflecting hemisphere-specific functional reorganization.

Impact: Mapping evolving connectivity of ventrolateral thalamus after MR-guided focused ultrasound (MRgFUS) thalamotomy enables tailored essential tremor treatments, potentially yielding better outcomes and informing treatment parameters, while also providing putative biomarkers for treatment efficacy and broader insights into neurological network management.

1286 15:33 [3D Whole-heart T1-weighted Imaging in a Two-minute Free-breathing Scan for Radiofrequency Ablation Lesion Assessment]



Jaykumar H. Patel[1,2], Philippa R.P. Krahn[1,2], Terenz Escartin[1,2], Calder D. Sheagren[1,2], Labonny Biswas[2], Jen Barry[2], Melissa Larsen[2], and Graham A. Wright[1,2]

[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences Platform, Sunnybrook Research Institute, Toronto, ON, Canada

Keywords: MR-Guided Interventions, Data Acquisition, Lesion Characterization, Radiofrequency ablation, 3D High-resolution Imaging, 3D Cone Trajectory

Motivation: MRI-guided arrhythmia interventions require fast, high-resolution 3D images for comprehensive intraprocedural assessment of radio-frequency ablation lesion size and depth.

Goal(s): Demonstrate similar volumetric lesion quantification between ground-truth respiratory-navigated Cartesian imaging and a novel free-breathing 3D cone-trajectory sequence.

Approach: 4 healthy Yorkshire swine were ablated inside the MRI scanner, with 12 lesions prescribed in total. Volumetric analysis was performed for both Cartesian and 3D cones imaging.

Results: Non-contrast T1-weighted 3D cones imaging with a highly accelerated scan time less than two minutes demonstrated similar lesion volumes to the slower 3D Cartesian sequence.

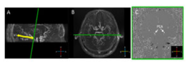
Impact: Currently, non-contrast ablation lesion assessment in patients requires 5-10 minutes, depending on breathing patterns. The free-breathing 3D cone trajectory sequence presented here is a time-efficient method for lesion characterization that is feasible for intraprocedural applications.

Oral

Novel fMRI Methods & Applications

Summit 2 | Thursday 13:45 - 15:45 | *Moderators:* Peter Bandettini & João Jorge

1287 13:45



[Visual stimulus-evoked blood velocity responses at far upstream branches of the Posterior Cerebral Artery measured with phase-contrast fMRA]

Zhangxuan Hu[1,2], Sebastien Proulx[1,2], Daniel E. P. Gomez[1,2], Divya Varadarajan[1,2], Saskia Bollmann[3], Can Ozan Tan[4], Elif Gokcal[5,6], M. Edip Gurol[5,6], and Jonathan R. Polimeni[1,2,7]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]School of Information Technology and Electrical Engineering, Faculty of Engineering, Architecture and Information Technology, The University of Queensland, Brisbane, Australia, [4]Department of Electrical Engineering, Mathematics, and Computer Science, University of Twente, Enschede, Netherlands, [5]J. Philip Kistler Stroke Research Center, Massachusetts General Hospital, Boston, MA, United States, [6]Department of Neurology, Harvard Medical School, Boston, MA, United States, [7]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: fMRI Acquisition, fMRI

Motivation: Neuronal activity induces vasodilation in local arterioles that propagates to upstream large arteries, but the furthest detectable arterial dilation from the site of neuronal activity remains unknown.

Goal(s): Detecting blood velocity responses at far upstream branches of the Posterior Cerebral Artery induced by a visual stimulus.

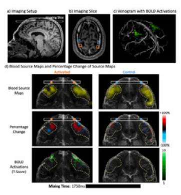
Approach: In this study, a functional phase-contrast MRA technique was combined with a commonly used block-design stimulation paradigm to detect blood velocity responses.

Results: About 10–20% velocity increases at the P2 segments of the Posterior Cerebral Artery were robustly observed.

Impact: We demonstrate that neuronal activity-induced velocity response can propagate to large feeding arteries 6–7 cm from the visual cortex. The spatial and temporal properties of this propagation are important for understanding neurovascular coupling, autoregulation, and human fMRI.

1288 13:57

MERIT AWARD
SUMMA CUM LAUDE



[DiSpect Consistently and Repeatably Reveals Modulation and Redistribution of Venous Blood Flow Caused by Functional Brain Activation]

Ekin Karasan[1], Chunlei Liu[1,2], and Michael Lustig[1]

[1]Department of Electrical Engineering and Computer Science, University of California, Berkeley, Berkeley, CA, United States, [2]Helen Wills Neuroscience Institute, Berkeley, CA, United States

Keywords: fMRI Acquisition, fMRI

Motivation: DiSpect can trace blood draining from the capillary bed through the cerebral venous system and map venous territories.

Goal(s): Determine whether DiSpect can detect blood flow changes in the veins during neural activation.

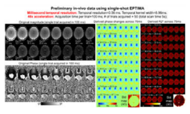
Approach: DiSpect was performed during a motor cortex task and at baseline for two subjects, each with two repeats to ensure consistency and repeatability.

Results: Modulation and redistribution of flow were observed during the task, specifically in veins near the BOLD fMRI activated regions. The measurements showed good repeatability for both subjects.

Impact: BOLD contrast is affected by a complex interplay of several physiological processes. DiSpect measures changes in venous blood flow dynamics during neural activation and can potentially help to better understand the venous sources of the BOLD signal.

1289 14:09 [EPTIMA: Echo Planar Time-resolved Imaging derived Millisecond-scale temporal resolution Acquisition]

MERIT AWARD SUMMA CUM LAUDE



Zijing Dong[1,2], Abbas Sohrabpour[1,2], Lawrence L. Wald[1,2,3], Jonathan R. Polimeni[1,2,3], Padmavathi Sundaram[1,2], and Fuyixue Wang[1,2]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Harvard-MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

Keywords: fMRI Acquisition, Data Acquisition, fMRI

Motivation: Achieving millisecond-scale temporal resolution MRI has the potential to provide exciting insights into fast functional/physiological processes of the brain.

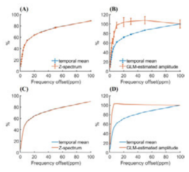
Goal(s): Develop a new acquisition method, EPTIMA, that can achieve millisecond-scale temporal resolution, while improving efficiency by acquiring a time-series trial of 2D-images in a single excitation for high robustness to physiological-noise/motion.

Approach: EPTIMA captures fast temporal dynamics occurring within the readout by measuring the rate at which the baseline signal evolution is changing, and employs spatiotemporal encodings to acquire a complete time-series trial in a single-excitation.

Results: EPTIMA can image rapid electric current changes in a phantom and resolve stable phase/magnitude changes in-vivo.

Impact: A new acquisition, EPTIMA, was developed to achieve millisecond-scale temporal resolution and to image ultra-fast dynamic processes of human brain. It improves efficiency by acquiring a time-series trial of 2D-images in a single excitation with high robustness to motion/physiological noises.

1290 14:21 [Chemical Exchange Saturation Transfer-Based Functional Magnetic Resonance Imaging (CEST-fMRI) in the Human Brain at 3T]



Qicheng Lu[1] and Yi Zhang[1]

[1]Key Laboratory for Biomedical Engineering of Ministry of Education, Department of Biomedical Engineering, College of Biomedical Engineering & Instrument Science, Zhejiang University, HangZhou, China

Keywords: fMRI Acquisition, CEST & MT, CEST-fMRI

Motivation: Conventional fMRI techniques indirectly map neural activity through the BOLD effect, but there is a need for a methodology to directly detect dynamic changes in neurotransmitter levels.

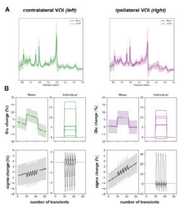
Goal(s): Our goal was to detect the increase in glutamate concentration in the human brain during a visual task based on CEST.

Approach: We performed two tailored experiments on a 3T scanner and used a 4-regressor general linear model (GLM) analysis to extract the metabolite effects from CEST-fMRI signals.

Results: A ~0.12% metabolite effect was detected at glutamate-proximal frequency offsets, consistent with our simulation under a 3% increase in glutamate concentrations during brain activity.

Impact: Our study successfully revealed the mechanism behind CEST-fMRI and demonstrated its ability to detect dynamic changes in glutamate concentrations during visual stimulation. The CEST-fMRI methodology enables the investigation of neurotransmitter changes, potentially becoming an imaging modality that guides neuroscience research.

1291 14:33 [Simultaneous two-voxel functional magnetic resonance spectroscopy of the motor cortex at 7T]



Anouk Schrantee[1] and Adam Berrington[2]

[1]Department of Radiology and Nuclear Medicine, Amsterdam University Medical Center, University of Amsterdam, Amsterdam, Netherlands, [2]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom

Keywords: Spectroscopy, Spectroscopy, functional MRS

Motivation: Functional magnetic resonance spectroscopy (fMRS) shows promise in studying task-related metabolite changes but has been largely confined to single-voxel.

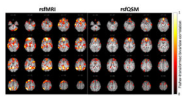
Goal(s): To evaluate two-voxel fMRS at 7 T to measure simultaneous bilateral metabolite changes during a unilateral motor task.

Approach: A modified Hadamard-encoded MRS scheme with dynamic fMRS spectral-temporal fitting for analysis was employed.

Results: Distinct patterns of BOLD activation in contra- and ipsilateral VOIs were detected with significant increases in Glutamate (Glu) in either VOI during a unilateral task

Impact: We demonstrate the feasibility of simultaneous two-voxel MRS to detect bilateral glutamate changes in response to a unilateral motor task. This approach holds promise to increase our understanding of the neurochemical underpinnings of fMRI signals across interconnected brain regions.

1292 14:45 [Resting-State Functional Quantitative Susceptibility Mapping (rsfQSM)]



Jannette Nassar[1], Oliver C Kiersnowski[1], Patrick Fuchs[1], Rimona S Weil[2], and Karin Shmueli[1]

[1]Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]Dementia Research Center, Institute of Neurology, University College London, London, United Kingdom

Keywords: Functional Connectivity, Quantitative Susceptibility mapping, Brain connectivity, resting-state fQSM

Motivation: Task-based functional Quantitative Susceptibility Mapping (fQSM) shows more localized brain activations than fMRI. Resting-state fMRI reveals brain connectivity networks but resting-state analysis of QSM has not yet been performed and may provide complementary information.

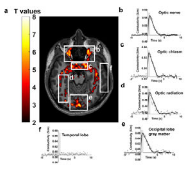
Goal(s): To perform a resting-state functional analysis using QSM (rsfQSM) and compare it to rsfMRI, focusing on the Default Mode Network (DMN).

Approach: We used seed-based and ICA-based analyses for rsfQSM and assessed the similarity of the DMN to that in rsfMRI with quantitative metrics.

Results: The DMN was detected in rsfQSM with spatial similarities to the DMN in rsfMRI. rsfQSM showed weaker and less extensive functional connectivity.

Impact: We computed resting-state functional connectivity from magnetic susceptibility maps for the first time, revealing similarities in the default-mode network compared to rsfMRI. This paves the way for new QSM-based explorations of brain function to potentially deepen understanding of neurological diseases.

1293 14:57 **Functional conductivity imaging: quantitative mapping of brain activity**



Caroline D Rae[1], Jun Cao[1], Ben Cassidy[2], and Iain K Ball[3]

[1]Neuroscience Research Australia, UNSW, Randwick, Australia, [2]4. Pathfinder Exploration LLC, Reno, NV, United States, [3]Philips Australia and New Zealand, Sydney, Australia

Keywords: Task/Intervention Based fMRI, Brain

Motivation: Theory and modelling suggest that detection of neuronal activity may be feasible using phase sensitive MRI methods.

Goal(s): To demonstrate successful application of phase-based MREPT to functional tasks in brain

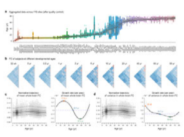
Approach: Using bFFE optimised for fast acquisition, data were acquired from 5 participants undertaking visual stimulation or somatosensory stimulation. Electrical conductivity values extracted from phase images were fitted with the measured stimulus response function.

Results: Images showed consistent activation of visual circuitry (~0.1 S/m) in both grey and white matter with similar circuit responses to somatosensory stimulation. Conductivity increased with stimulus duration or increased contrast and was faster, temporally, than BOLD.

Impact: Functional conductivity imaging (funCI) reveals activity in both grey and white matter. The sensitivity, repeatability and time course of funCI shows that MRI can detect brain activation beyond changes in blood supply.

1294 15:09 **Functional connectome through the human life span**

MERIT AWARD
MAGNA CUM LAUDE



Lianglong Sun[1], Tengda Zhao[1], Xinyuan Liang[1], Mingrui Xia[1], Qiongling Li[1], Xuhong Liao[1], Gaolang Gong[1], Qian Wang[1], Chenxuan Pang[1], Qian Yu[1], and Yong He[1]

[1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China

Keywords: Functional Connectivity, Brain Connectivity, brain chart, brain atlas, lifespan, connectomics

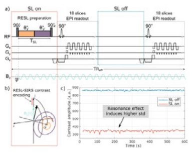
Motivation: The normative developmental and aging trajectory of the functional connectome in the human brain remains unknown.

Goal(s): To establish the normative growth trajectory of functional connectome from the largest, quality-controlled multimodal neuroimaging dataset.

Approach: We aggregated 33,809 task-free fMRI scans from 32,328 individuals aged 32 postmenstrual weeks to 80 years from 119 global sites, and quantified lifespan growth charts using generalized additive models for location, scale, and shape (GAMLSS).

Results: We uncovered nonlinear connectome growth at the whole cortex, system, and regional levels, identified critical developmental inflection points, and demonstrated substantial individual heterogeneities in patients with ASD and patients with MDD.

Impact: Our findings elucidate for the first time the lifespan evolution of the functional connectome and serve as a normative reference for quantifying individual variation in patients with neuropsychiatric disorders.

1295 15:21 

[High-Frequency Oscillation-Based Rotary Saturation: a functional imaging technique for epilepsy lateralization in MRI-negative patients]

Milena Capiglioni[1], Pedro Lima Cardoso[2], Simon Daniel Robinson[2], Claus Kiefer[1], Siegfried Trattnig[2], Ekaterina Pataraia[3], Roland Beisteiner[3], and Roland Wiest[1]

[1]Institute for Diagnostic and Interventional Neuroradiology, Support Center for Advanced Neuroimaging (SCAN), University of Bern, Bern, Switzerland, [2]High Field MR Center, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [3]Department of Neurology, Functional Brain Diagnostics and Therapy, High Field MR Center, Medical University of Vienna, Vienna, Austria

Keywords: Epilepsy, Bioeffects & Magnetic Fields, Spin-lock, Novel Contrast Mechanisms

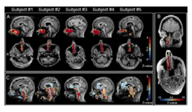
Motivation: Delineation of the seizure onset zone (SOZ) in surgical planning for drug-resistant epilepsy requires invasive procedures. The Stimulus-Induced Rotary Saturation (SIRS) sequence targets biomagnetic field associated with epileptic discharges.

Goal(s): To evaluate the efficiency of SIRS in epilepsy lateralization using high-frequency oscillations (HFOs) as biomarkers and compare it with EEG and clinical seizure semiology.

Approach: We investigated 11 epilepsy patients using SIRS at a 120 Hz spin-lock frequency, assessing the localizing value at hemispheric and lobar levels.

Results: SIRS-identified activations were above threshold in 8 of 11 patients, offering potential for improved SOZ localization. Hemispheric concordance was found with EEG in 7 cases.

Impact: Spin-lock based rotary saturation imaging lateralized brain areas in epilepsy patients with negative MRI findings in concordance with EEG and seizure semiology. Combined with state-of-the-art non-invasive methods such as EEG, it offers potential for improved seizure lateralization.

1296 15:33 

[Functional MRI of the nose]

Sara Ponticorvo[1], Jaakko Paasonen[2], Petteri Stenroos[2], Ekaterina Paasonen[2], Pavel Filip[1,3], Douglas Rothman[4], Edward Auerbach[1], Michael Garwood[1], Gregory J Metzger[1], Olli Gröhn[2], Shalom Michaeli[1], and Silvia Mangia[1]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]A. I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland, [3]Neurology, First Faculty of Medicine and General University Hospital, Charles University, Prague, Czech Republic, [4]Department of Radiology and Biomedical Imaging, Magnetic Resonance Research Center (MRRC), Yale University, New Haven, CT, United States

Keywords: Head & Neck/ENT, fMRI (resting state)

Motivation: Standard fMRI techniques are unable to image the nasal cavity due to strong susceptibility artefacts.

Goal(s): Our goal is to exploit ultrashort or zero echo time imaging to study functional connectivity of the nose.

Approach: Resting-state fMRI was performed on 5 humans at 7T and 1 mouse at 9.4T. Independent component analysis (ICA) was performed, and ICA signals were analyzed within the context of other physiological signals.

Results: Highly reproducible nose networks were observed in humans. The signal of one network strongly correlated with the autonomic nervous system activity. A pronounced nose network was also observed in the mouse.

Impact: Ultrashort and zero echo time fMRI enables unprecedented performance for detecting functional nose networks providing the means to study nose activity and system-wide connections between central and peripheral nervous systems not currently possible with standard fMRI for the first time.

Power Pitch

Pitch: Relaxometry & Novel Quantification Methods

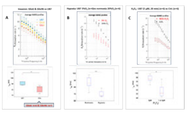
Power Pitch Theatre 1

Thursday
Pitches: 13:45 - 14:45
Posters: 14:45 - 15:45

Moderators: Olivier Girard & James Ross

(no CME credit)

1297 Pitch: 13:45 Poster: 14:45 Screen 1



Bumetanide drug effect on the transmembrane water exchange by T1 relaxation at ultra-low field

Michele El Atifi[1], François Berger[1], and Hana Lahrech[1,2]

[1]BrainTech Lab, Inserm U1205, Grenoble, France, [2]Biomedical Imaging Centre, University of Aberdeen, Aberdeen, United Kingdom

Keywords: Relaxometry, Low-Field MRI, transmemebrane water exchange, cancer invasion/migration, bumetanide drug

Motivation: The transmembrane water exchange (t-Wex) in cancers was demonstrated modulating T_1 relaxation at ultra-low field.

Goal(s): Our goal was to demonstrate T_1 changes under the administration of drugs that act on cell membrane transports.

Approach: U87 glioma cells sustained H_2O_2 stimuli before the administration of the bumetanide drug, a NKCC1 inhibitor. T_1 changes were measured by FFC-NMR.

Results: At very low field, by comparison to control cells (without H_2O_2), relaxation rates were found significantly lower under H_2O_2 stimuli which has been correlated to t-Wex acceleration and higher with the bumetanide addition, that suggests the slowdown of t-Wex.

Impact: Using the bumetanide drug, we show at ultra-low field, the potential of the relaxation T_1 as biomarker to evaluate the efficiency of drugs that can target t-Wex, a mechanism that has been connected to cancer invasion/migration pathophysiology

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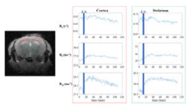
1298 Pitch: 13:45 Poster: 14:45 Screen 2



Monitoring brain glucose metabolism using magnetic resonance fingerprinting at 9.4 T

Mou Jiang[1,2], Yaping Yuan[1], Lei Zhang[1], Shizhen Chen[1], and Xin Zhou[1]

[1]Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, WuHan, China, [2]Huazhong University of Science and Technology, WuHan, China

Keywords: Relaxometry, Metabolism, High-Field MRI； Magnetic Resonance Fingerprinting

Motivation: The monitoring of brain glucose metabolism plays an important role in the diagnosis of neurological diseases.

Goal(s): The glucose uptake and clearance in the mouse brain were monitored following intravenous administration of glucose using magnetic resonance fingerprinting.

Approach: A magnetic resonance fingerprinting imaging sequence was developed to simultaneously measure the T_1, T_2 and $T_{1\rho}$ of tissue.

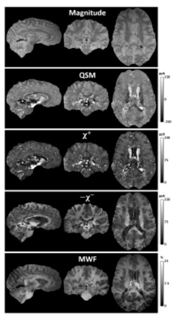
Results: With the intravenous administration of glucose, there was a rapid increase followed by a gradual decrease in R_1, R_2 and $R_{1\rho}$ values in the brain.

Impact: The application of magnetic resonance fingerprinting in the study of brain glucose metabolism facilitates rapid and simultaneous measurement of multiple parameters, thereby yielding valuable information for the diagnosis of brain-related diseases.

1299 Pitch: 13:45

Poster: 14:45

Screen 3



Histopathological Validation of Microstructure-Informed Susceptibility Source Separation (MI-SSS) for Brain Iron and Myelin Quantification

Mert Şişman[1,2], Thanh D. Nguyen[2], Kelly Gillen[2], Alexey V. Dimov[2], Pascal Spincemaille[2], David Pitt[3], Susan A. Gauthier[4], and Yi Wang[2,5]

[1]Electrical and Computer Engineering, Cornell University, Ithaca, NY, United States, [2]Department of Radiology, Weill Cornell Medicine, New York, NY, United States, [3]Department of Neurology, Yale Medicine, New Haven, CT, United States, [4]Department of Neurology, Weill Cornell Medicine, New York, NY, United States, [5]Biomedical Engineering, Cornell University, Ithaca, NY, United States

Keywords: Novel Contrast Mechanisms, Microstructure, Multiple Sclerosis

Motivation: Myelin and iron carry significant roles in several neurodegenerative disease processes. The development of noninvasive imaging modalities for myelin and iron quantification and validation of these modalities are important steps in clinical MRI research.

Goal(s): MI-SSS is developed for the improved estimation of brain myelin and iron and here it is aimed to validate MI-SSS maps with histopathological quantification techniques.

Approach: An ex vivo whole brain is scanned; myelin and iron biomarkers maps are reconstructed and the results are correlated against histopathological findings.

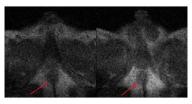
Results: Both susceptibility maps showed significant correlation with histopathological myelin and iron quantifications presenting accurate performance of MI-SSS.

Impact: Myelin and iron quantification carry significant clinical importance for diagnosis and monitoring of neurodegenerative diseases. MI-SSS is developed to provide an improved and practical framework for this purpose. Here, the MI-SSS is validated against gold standard histopathological findings.

1300 Pitch: 13:45

Poster: 14:45

Screen 4



Enhanced prostate imaging in ultra-low field MRI using a passive LC-resonator.

Fangge Chen[1] and Zheng Xu[1]

[1]Chongqing University, Chongqing, China

Keywords: Novel Contrast Mechanisms, Contrast Mechanisms

Motivation: As gold standard, MRI indeed matters in prostate imaging. The relative low image quality in ultra-low field MRI precludes its application in prostate imaging.

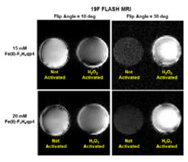
Goal(s): Our goal was to improve prostate image quality in ultra-low field MRI, particularly emphasizing the target prostate region.

Approach: We utilized an additional specially designed passive LC-resonator in imaging process.

Results: By using the LC-resonator, the prostate image quality in ultra-low field MRI was improved, giving a higher image contrast to the prostate region.

Impact: Adopting passive LC-resonator in imaging process is of highly cost effective, not only highlighting the target region, but offering a new imaging idea for other organs when it comes to bad SNR situations.

1301 Pitch: 13:45 Poster: 14:45 Screen 5



A Hydrogen Peroxide-Responsive Multinuclear 1H and 19F MRI Contrast Agent for Quantitative Application – Preliminary Phantoms Validation

Ronald J. Beyers[1], Sana Karbalaei[2], Adil Bashir[1], Christian R. Goldsmith[2], and Thomas S. Denney[1]

[1]MRI Research Center, Auburn University, Auburn University, AL, United States, [2]Chemistry and Biochemistry, Auburn University, Auburn University, AL, United States

Keywords: Multi-Contrast, Preclinical, Multinuclear

Motivation: Multinuclear contrast agents (CAs) may provide improved sensitivity and specificity for the detection/quantification of biomolecular processes.

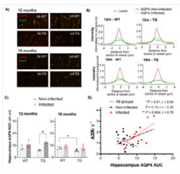
Goal(s): To develop a multinuclear ^{1}H and ^{19}F agent that shortens the T_1 relaxation times for both the ^{1}H and ^{19}F signals only when hydrogen peroxide (H_2O_2) is present.

Approach: Developed the CA: Fe(II)-F_2H_4qp4 -- an iron(II) complex with a fluorinated quinol-containing macrocyclic ligand. This T_1-shortening CA is designed to activate only in the presence of H_2O_2.

Results: Initial phantom tests with an ^{1}H/^{19}F frequency-selectable Inversion Recovery Look Locker sequence demonstrate a dual capability to quantify changes of both ^{1}H and ^{19}F signal T_1 values.

Impact: The multinuclear Fe(II)-F_2H_4qp4 agent's ability to quantify changes of both ^{1}H and ^{19}F signal T_1 values in an H_2O_2 environment improves the sensitivity and specificity to superoxide-related pathologies and may allow expanding to other biomarkers.

1302 Pitch: 13:45 Poster: 14:45 Screen 6



Lung infection alters perivascular aquaporin-4 in rat model of Alzheimer’s Disease detected by filter exchange imaging (FEXI)

Yolanda Ohene[1,2], William J Harris[2,3], Elizabeth Powell[4], Katherine F Smethers[3], Nadim Luka[2,3], Kieron South[2,3], Michael Berks[5], Catherine B Lawrence[2,3], Geoff J. M Parker[4,6], Laura M Parkes[1,2], Hervé Boutin[3,7], and Ben R Dickie[2,5]

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Keywords: Novel Contrast Mechanisms, Alzheimer's Disease, Blood-brain barrier

Motivation: Pneumonia is more prevalent in Alzheimer’s Disease (AD) patients than in healthy elderly people, which may be due to blood-brain barrier (BBB) vulnerability.

Goal(s): We assess whether filter exchange imaging (FEXI) can be used to understand the comorbid mechanisms occurring at the BBB with pneumonia and AD.

Approach: We apply the FEXI technique to a TgF344-AD rat model of AD with induced *Streptococcus pneumoniae* lung infection.

Results: FEXI detects significantly higher BBB water exchange in infected rats, with greater increase in the AD group, which significantly correlates to upregulation of hippocampus aquaporin-4 water channels, demonstrating the sensitivity of non-invasive FEXI to BBB alterations.

Impact: This work could be translated to a clinical study using filter exchange imaging to assess whether Alzheimer’s Disease patients suffering with pneumonia also exhibit worse blood-brain barrier alterations than patients without pneumonia and healthy elderly people.

1303 Pitch: 13:45

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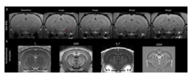
Poster: 14:45

Screen 7



<u>in vivo longitudinal imaging unravels the origin of neuromelanin-MRI contrast in a rat model of Parkinson's disease</u>

Jean-Baptiste Perot[1], Anthony Ruze[2], Sana Rebbah[3], Capucine Cadin[1], Arnaud Le Troter[4], Lucas Soustelle[4], Laura Mouton[2], Romain Valabregue[2], Annabelle Parent[5], Mathieu D Santin[2], Miquel Vila[5], and Stéphane Lehéricy[1,2]

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Keywords: Novel Contrast Mechanisms, Contrast Mechanisms

Motivation: Neuromelanin-MRI contrast is a promising biomarker for Parkinson's disease, but still needs investigation as the biological and physical origins of the contrast are still unclear.

Goal(s): The objective was to unravel the mechanisms behind neuromelanin-MRI contrast, both biologically and physically, and to better understand the role of neuromelanin in Parkinson's disease.

Approach: We performed in vivo longitudinal neuromelanin-MRI coupled with quantitative multiparametric imaging on a rat model of Parkinson's disease based on accumulation of neuromelanin, with histological validation.

Results: Results show that contrast increases with neuromelanin accumulation and decreases with neuronal loss. The contrast arises from T_1 reduction due to paramagnetic neuromelanin-iron complexes.

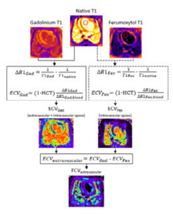
Impact: We provide first in vivo validation and better understanding of neuromelanin-MRI as a biomarker of neuronal loss in Parkinson's disease. Results also suggest a pathogenic threshold of neuromelanin accumulation triggering neurodegeneration. Investigating this hypothesis may lead to new therapeutic window.

1304 Pitch: 13:45

MERIT AWARD MAGNA CUM LAUDE

Poster: 14:45

Screen 8



<u>Quantification of extravascular lung water using a dual contrast extracellular volume approach</u>

Felicia Seemann[1], Rim Halaby[1], Andrea Jaimes[1], Haiyan Wang[1], Kendall O'Brien[1], Petre Kellman[1], Daniel A Herzka[1,2], Robert J Lederman[1], and Adrienne E Campbell-Washburn[1]

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Keywords: Novel Contrast Mechanisms, Multi-Contrast, Lung water, Heart failure, Translational studies

Motivation: Extravascular lung water is a feature in heart failure. Current lung water MRI methods cannot distinguish between intravascular and extravascular fluid, and therefore cannot fully isolate the pathology.

Goal(s): To isolate and quantify extravascular lung water by developing a dual-contrast extracellular volume (ECV) method, leveraging different extracellular compartmentalization of gadolinium and ferumoxytol.

Approach: We calculated $ECV_{extravascular}$=$ECV_{gadolinium}$-$ECV_{ferumoxytol}$ from lung T1-maps with native, gadolinium and ferumoxytol contrast. Validation was performed in porcine models of increased extravascular and intravascular lung water.

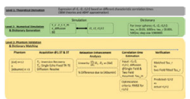
Results: As expected, $ECV_{extravascular}$ differed between baseline and the extravascular intervention (27±4.1% vs 32±1.6%, p=0.005), but not for the intravascular model (22±4.7% vs 22±4.4%, p=0.91).

Impact: Dual contrast extracellular volume measurements, leveraging the different compartment uptakes of gadolinium and ferumoxytol contrasts, is a promising method for extravascular lung water quantification, and may enable mechanistic studies of lung water accumulation in patients with dyspnea.

1305 Pitch: 13:45

Poster: 14:45

Screen 9



Quantifying Rotational Correlation Time in Clinical MRI Scanners: A Novel Framework for Enhanced Tissue Characterization

Shengwen Deng[1], Walter Zhao[2,3], David W. Jordan[1,3], Chris A. Flask[1,2,3,4], Mark Griswold[1,2,3], Chaitra Badve [1,3,5], and Dan Ma[2,3]

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Keywords: Relaxometry, Contrast Mechanisms, Paramagnetic Relaxation Enhancement; Rotational Correlation Time; Clinical MR Relaxometry

Motivation: This study exploits the underexplored potential of paramagnetic relaxation enhancement (PRE) in clinical MR scanners to characterize molecular interactions and tissue microenvironments in vivo, leveraging Gadolinium-based contrast agents (GBCAs).

Goal(s): Develop and validate methodology for estimating Gadolinium-based contrast agent (GBCA) correlation time via relaxivity ratio measurements at 1.5 and 3 Tesla.

Approach: Applying relaxation models, we devised a dictionary-matching framework correlating GBCA relaxivities with correlation times, and validated our methods using phantom experiments.

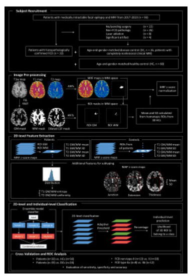
Results: Our framework accurately estimates GBCA correlation times at a single field strength showing <5% error (1.5T to 3T) and <11% (3T to 1.5T) in cross-field relaxivity predictions.

Impact: This framework leverages MR Relaxometry for precise estimation of GBCA rotational correlation time at single field strengths, offering insights in tissue characteristics. There is significant potential to improve tumor imaging and diagnosis through insights into pH, viscosity, and protein interactions .

1306 Pitch: 13:45

Poster: 14:45

Screen 10



Multiparametric Characterization of Focal Cortical Dysplasia Using Three-Dimensional MR Fingerprinting

Ting-Yu Su[1,2], Joon Yul Choi[1,3], Siyuan Hu[2], Xiaofeng Wang[4], Ingmar Blümcke[1,5], Katherine Chiprean[1], Balu Krishnan[1], Zheng Ding[1,2], Ken Sakaie[6], Hiroatsu Murakami[1], Imad Najm[1], Stephen Jones[6], Dan Ma[2], and Zhong Irene Wang[1]

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Keywords: Epilepsy, MR Fingerprinting, Surgery, Focal cortical dysplasia

Motivation: Focal cortical dysplasia (FCD) is a common pathology in medically intractable focal epilepsy. Detecting and subtyping FCD through visual inspection of conventional MRI can be challenging.

Goal(s): We aimed to develop a multiparametric, quantitative approach for FCD characterization, based on MR fingerprinting (MRF).

Approach: High-resolution 3D MRF scans were performed in 33 epilepsy patients with FCD, 60 normal controls and 26 disease controls. A machine-learning (ML) framework based on MRF was developed to automatically classify FCD from normal cortex and separating FCD subtypes.

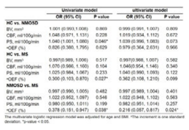
Results: MRF-based ML models showed high accuracies, with performances superior to the yields of clinical review.

Impact: Our approach contributes to noninvasive epilepsy presurgical evaluation, as well as an integrated clinical-pathological-imaging understanding of the FCD spectrum.

1307 Pitch: 13:45

Poster: 14:45

Screen 11



Comparison of multiple sclerosis and neuromyelitis optica spectrum disorder: A physiological and quantitative MRI study

Shuwan Yu[1], Zixuan Lin[2], Hualu Han[1], Ning Xu[1], Jiachen Liu[1], Xinyu Tong[1], Huiyu Qiao[1], Zihan Ning[1], Rui Shen[1], Mangsuo Zhao[3], and Xihai Zhao[1]

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Keywords: Novel Contrast Mechanisms, Brain, blood brain barrier permeability to water, oxygen extraction fraction, neuromyelitis optica spectrum disorder, multiple sclerosis

Motivation: Accurate differentiation of multiple sclerosis (MS) and neuromyelitis optica spectrum disorder (NMOSD) is essential for treatment decisions and thus affects prognosis.

Goal(s): This study aimed to determine the differences of MS and NMOSD using physiological and quantitative MRI.

Approach: blood brain barrier permeability to water (PS) and oxygen extraction fraction (OEF) of all subjects were measured by physiological and quantitative MRI.

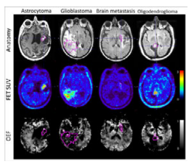
Results: The results showed that compared with healthy subjects, water PS was significantly higher in NMOSD patients, while OEF was significantly lower in MS patients. In addition, OEF was also significantly different between NMOSD patients and MS patients.

Impact: Our study demonstrated that BBB permeability to water and whole-brain oxygen extraction fraction (OEF) might be potential imaging indicators for NMOSD and MS, respectively. In addition, OEF is the key to distinguish MS from NMOSD.

1308 Pitch: 13:45

Poster: 14:45

Screen 12



Evaluating simultaneously derived T2, T2*, vCBV and OEF from GE-SE EPIK in brain tumour patients

Fabian Küppers[1], Mohamed Kassem[1,2], Seong Dae Yun[1], Christian Filss[1,3], Gabriele Stoffels[1], Felix Mottaghy[3,4], Eline Kooi[2,4], Karl-Josef Langen[1], Philipp Lohmann[1], and Nadim Jon Shah[1,5,6,7]

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Keywords: Multi-Contrast, Oxygenation, Brain Tumors, Cancer, Oxygen Extraction Fraction, hybrid MR-PET

Motivation: Multi-contrast GE/SE acquisitions provide versatile, simultaneously acquired MR parameters, with fast, non-invasive OEF quantification proving potentially exceptionally valuable in clinical practice.

Goal(s): The tumour characterisation capability of 10-echo GE-SE EPIK-derived MR parameters was evaluated in standardised tumour VOIs compared to healthy brain tissue.

Approach: A full-brain 2-minute protocol was acquired from 18 tumour patients during hybrid 3T MR and FET-PET acquisitions. Quantified MR parameters were analyzed in tumour VOIs defined by FET-PET.

Results: The increased T_2/T_2* values and decreased vCBV/OEF obtained using 2-minute GE-SE EPIK acquisitions were in agreement with literature values.

Impact: Whole-brain T_2, T_2*, vCBV, and OEF quantification can be obtained within a 2-minute TA using 10-echo GE-SE EPIK MRI, revealing changes in tumour VOIs in agreement with literature values, potentially providing fast clinical access to MR parameters, especially OEF.

1309 Pitch: 13:45

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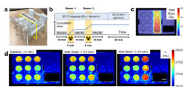
Screen 13



Real-time radiation beam imaging on an MR linear accelerator using quantitative T1 mapping

Brandon T.T. Tran[1,2], Liam S.P. Lawrence[1,2], Shawn Binda[3], Brige P. Chugh[3], and Angus Z. Lau[1,2]

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Keywords: Novel Contrast Mechanisms, Radiotherapy, MR-Linac, radiation dosimetry

Motivation: Direct imaging of radiation beam effects could enable more accurate dosimetry and *in vivo* dose verification.

Goal(s): Our goal was to detect immediate changes in T_1 relaxation due to water radiolysis induced oxygen depletion.

Approach: We used dynamic T_1 mapping on an MR-Linac to simultaneously irradiate and image water phantoms.

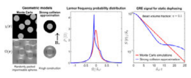
Results: We observed real-time changes in T_1 with a T_1/Dose slope of 0.71 ms/Gy. The current sensitivity limit was estimated to be 3 Gy for a 10 min scan. Three-dimensional spatial patterns in T_1 were consistent with the predicted dose profile.

Impact: Real-time visualization of radiation beam effects using quantitative T_1 mapping may enable new radiation dosimetry methods. This study may lead to volumetric in vivo dose verification and imaging of transient oxygen depletion in high dose rate ("FLASH") radiotherapy.

1310 Pitch: 13:45

Poster: 14:45

Screen 14



Estimating microstructural parameters from gradient-echo and spin-echo data: a test of the strong collision approximation

Pippa Storey[1,2] and Dmitry S. Novikov[1,2]

[1]*Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States,* [2]*Center for Advanced Imaging Innovation and Research, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States*

Keywords: Microstructure, Susceptibility

Motivation: To develop noninvasive methods to interrogate magnetic microstructure.

Goal(s): To test whether the strong collision approximation can accurately characterize microstructure of known geometry and magnetic susceptibility from gradient-echo and spin-echo signals.

Approach: Experimental data were acquired from phantoms containing polystyrene microbeads of 10$$$\mu$$$m, 20$$$\mu$$$m and 40$$$\mu$$$m diameter suspended in gadolinium-doped gelatin. Data were fitted using a published model based on the strong collision approximation and a lookup table prepared from Monte Carlo simulations.

Results: The strong collision approximation overestimated bead size and underestimated magnetic susceptibility from gradient-echo data. For spin-echo data, it yielded poor estimates of susceptibility and was insensitive to bead size.

Impact: The strong collision approximation is a non-perturbative approach for predicting gradient-echo and spin-echo signals in the presence of magnetic microstructure. It employs the Krogh construction and a simplified diffusion propagator. We show how those simplifications affect estimates of microstructural parameters.

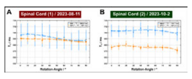
1311 Pitch: 13:45

Poster: 14:45

Screen 15

[Anisotropy of Longitudinal Relaxation in White Matter: Comparison of T1 and Magnetization Transfer]

Niklas Wallstein[1], André Pampel[1], Carsten Jäger[2,3], Roland Müller[1], Jens Stieler[3], Sven Martin[3], Markus Morawski[2,3], and Harald E. Möller[1,4]



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Keywords: Relaxometry, Relaxometry, T1 Relaxation, Magnetization Transfer, Orientation Dependence

Motivation: Studies on the orientation dependence of T_1 have led to contradictory observations, indicating that this effect is not well understood.

Goal(s): Our primary objective was to meticulously explore the orientation dependency of T_1 under precisely controlled and stable conditions.

Approach: Comprehensive T_1 (inversion recovery) and magnetization-transfer (MT) experiments were performed in fixed spinal-cord samples, with systematic variation of the fiber-to-field angle θ_{FB} .

Results: No relevant T_1 variation with θ_{FB} was observed in the IR experiments. However, a clear orientation dependence was consistently observed in all MT experiments,

Impact: Precise quantitative MR measurements in spinal cord with varying fiber-to-field angle showed no consistent orientation dependence of T_1 but a clear effect for the MT saturation, indicating the MT effects may be responsible for the previously observed T_1 anisotropy.

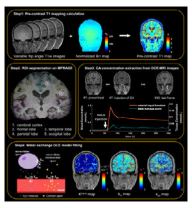
1312 Pitch: 13:45

Poster: 14:45

Screen 16

[Blood-brain barrier breakdown in Alzheimer's disease and dementia with Lewy Bodies based on water exchange DCE-MRI]

Ziming Xu[1], Jiaqi Dou[1], Jinghuan Gan[2], Zhichao Chen[2], Yajie Wang[1], Yong Ji[3], and Huijun Chen[1]



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Keywords: Microstructure, DSC & DCE Perfusion, blood-brain barrier; Alzheimer's disease; dementia with Lewy bodies

Motivation: Transfer rate of contrast agent and water plays complementary role in assessing the integrity of blood-brain barrier, however there is currently no means of evaluating them simultaneously in dementia patients.

Goal(s): We aimed to develop a new pharmacokinetic model to comprehensively evaluate the blood-brain barrier damage in dementia patients.

Approach: Transfer rate of contrast agent and water was calculated based on a new pharmacokinetic model by simultaneous fitting of the Bloch–McConnell equation and the Patlak model.

Results: The proposed model was able to exhibit distinct patterns of blood-brain barrier damage in different types of dementia, which was significantly associated with cognitive impairment.

Impact: The transfer rate of contrast agent and water based on water exchange DCE-MRI demonstrated distinct patterns of blood-brain barrier damage in patients with Alzheimer’s disease and dementia with Lewy bodies, providing promising new non-invasive imaging biomarkers for dementia.

1313 Pitch: 13:45

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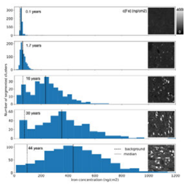
Poster: 14:45

Screen 17



Lifespan Iron Accumulation in Dopaminergic Neurons Studied by Quantitative MRI and X-ray Fluorescence

Felix Büttner[1], Tilo Reinert[1,2], Carsten Jäger[1,2], Malte Brammerloh[1], Markus Morawski[2], Ilona Lipp[1], Gerald Falkenberg[3], Dennis Brückner[3], Pierre-Louis Bazin[4], Catherine Crockford[5], Roman Wittig[5,6], Evgeniya Kirilina[1], and Nik Weiskopf[1,7,8]

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Keywords: Microstructure, Quantitative Imaging, Iron, Substantia nigra, R2*

Motivation: Dopaminergic neurons require iron for their function but suffer from iron overload in age.

Goal(s): To non-invasively monitor the age-related iron accumulation in dopaminergic neurons, we investigated mechanisms of iron-induced MR contrast in the substantia nigra across the lifespan.

Approach: We combined quantitative MRI, X-ray fluorescence imaging and biophysical modelling in a unique animal model: ethically collected *postmortem* chimpanzee brains.

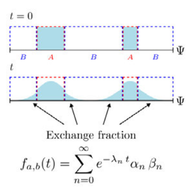
Results: The iron load of dopaminergic neurons and the effective transverse relaxation rates in the substantia nigra increased with age. The biophysical model accurately links the relaxation rate to the iron load and neuronal density, which demonstrated its suitability for ages above puberty.

Impact: Monitoring cell-specific iron concentrations of dopaminergic neurons and neuronal densities in the substantia nigra throughout the lifespan holds potential of an early neuroimaging biomarker for Parkinson's disease.

1314 Pitch: 13:45

Poster: 14:45

Screen 18



Derivation of a suitable exchange fraction expression to model diffusion-driven exchange with MR measurements.

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Keywords: Relaxometry, Relaxometry, Water exchange, diffusion physics

Motivation: Transmembrane water exchange in brain tissue is a process often modelled via the first order kinetics reaction (1OKR) expression. However, this expression does not account for diffusion dynamics, suggesting it is not suitable to describe diffusion-driven exchange.

Goal(s): Assess the difference between the 1OKR expression and the exchange fraction derived from a generally defined system.

Approach: The exchange fraction was derived considering geometry, and compartment-specific relaxation processes of a system via the diffusion-reaction equation.

Results: The derived exchange fraction features a multi-exponential recovery at short times and a mono-exponential decay at long times, both of which are not captured by the 1OKR expression.

Impact: The two additional features of the exchange fraction found in this work provide additional insight on a system's microstructure and properties. This expression can therefore be the basis of new biophysical models which more accurately describe the water exchange process.

1315 Pitch: 13:45 Poster: 14:45 Screen 19

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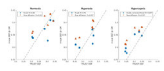

Robust Estimation of Venous Cerebral Blood Volume Using Flow-Diffusion Modeling Combined with R2' and Perfusion Measurements

Stefano Zappalà[1], Eleonora Patitucci[2], Ian Driver[1], Fabian Küppers[3], Seong Dae Yun[3], Jon Nadim Shah[3], Richard Wise[4], and Michael Germuska[1]

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Keywords: Relaxometry, Metabolism, Oxygen metabolism

Motivation: Factoring out venous cerebral blood volume (vCBV) and oxygen extraction fraction (OEF) from the relaxation of R2' poses a significant challenge.

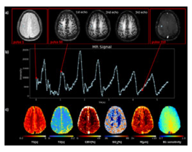
Goal(s): We combined robust measurements of R2' relaxation from GE-SE EPIK and perfusion from VSI-ASL with a flow-diffusion model of oxygen transport to improve estimation of vCBV and OEF.

Approach: The proposed method was tested in normoxia, hyperoxia and hypercapnia against validated TRUST measurements of OEF.

Results: Maps of OEF and vCBV accurately depicted the oxygen metabolism at baseline as well as during the gas challenges without the need of any calibration, with high resolution and within reasonable acquisition time.

Impact: The integration of the oxygen flow-diffusion model with GE-SE EPIK measurements of R2' relaxation and VSI-ASL measurements of perfusion gives high resolution parametric maps of oxygen metabolism within reasonable acquisition time, ultimately reducing the gap between research and clinical practise.

1316 Pitch: 13:45 Poster: 14:45 Screen 20



Contrast-free Blood Volume, Microvascular Properties and Relaxometry mapping using bSSFP MR Fingerprinting

Thomas Coudert[1], Aurélien Delphin[2], Loïc Legris[1,3], Antoine Barrier[1], Jan M Warnking[1,2], David Chechin[4], Laurent Lamalle[2], Peter Mazurkewitz[5], Peter Koken[5], Emmanuel L Barbier[1,2], Mariya Doneva[5], and Thomas Christen[1]

[1]Univ. Grenoble Alpes, INSERM U1216, Grenoble Institut Neurosciences, GIN, Grenoble, France, [2]Univ. Grenoble Alpes, INSERM US17, CNRS, UAR 3552, CHU Grenoble Alpes, IRMaGe, Grenoble, France, [3]Univ. Grenoble Alpes, Service de Neurologie, CHU Grenoble Alpes, Grenoble, France, [4]Philips France Commercial, Suresnes, France, [5]Philips Research Hamburg, Roentgenstrasse 24, Hamburg, Germany

Keywords: Novel Contrast Mechanisms, Perfusion, blood volume, oxygenation, relaxometry

Motivation: Most MR methods for quantifying microvascular properties involve the injection of exogenous contrast agents (CA).

Goal(s): We propose an innovative MRI method that simultaneously maps the deoxygenated cerebral blood volume (CBV), microvascular geometry (averaged vessel radius), and relaxometry (T_1&T_2) without CA injection.

Approach: Acquisitions are made using a multi-echo, phase-cycled, bSSFP-sequence acquired in transient and pseudo-steady-state regimes. Reconstruction of the maps is made under the MRFingerprinting framework using realistic 3D microvessel representations. Magnetic field distributions (B_1&B_0) are also taken into account.

Results: Preliminary results on five healthy volunteers are in line with previous measurements made with MRF and PWI with gadolinium injection.

Impact: We propose a contrast-free quantification technique of microvascular properties and relaxation times. It could be useful for functional experiments as well as clinical investigations of several cerebrovascular pathologies including stroke and cancer.

Power Pitch

Pitch: Cutting-Edge Phantoms & Multimodal Imaging

Power Pitch Theatre 2

Thursday
Pitches: 13:45 - 14:45
Posters: 14:45 - 15:45

Moderators: Hua Guo

(no CME credit)

1317

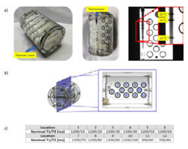
MERIT AWARD

MAGNA CUM LAUDE

Pitch: 13:45

Poster: 14:45

Screen 21



Development of a musculoskeletal relaxometry phantom for T1, T2, and T1rho measurements

Jeehun Kim[1,2], Stephen E. Russek[3], Karl F. Stupic[3], Cassandra M. Stoffer[3], Kathryn E. Keenan[3], David Rutkowski[4], Jeff Kammerman[4], Jean H. Brittain[4], and Xiaojuan Li[1]

[1]Program of Advanced Musculoskeletal Imaging (PAMI), Cleveland Clinic, Cleveland, OH, United States, [2]Department of Electrical, Computer, and Systems Engineering, Cleveland ClinicCase Western Reserve University, Cleveland, OH, United States, [3]National Institute of Standards and Technology (NIST), Boulder, CO, United States, [4]Calimetrix, Madison, WI, United States

Keywords: Phantoms, Phantoms

Motivation: There is not a commercially available musculoskeletal (MSK) relaxometry phantom.

Goal(s): Develop a dedicated MSK relaxometry phantom for T1, T2, and T1rho measurement quality assurance.

Approach: A cylindrical phantom with 12 vials containing modulated T1 and T2 samples was created, with an MR-visible thermometer for temperature tracking. Phantom stands were used for consistent positioning. MRI/NMR measurements were collected for longitudinal stability and temperature dependence.

Results: MRI measurements were in good agreement between two vendors with CVs<3% and demonstrated longitudinal stability with CVs<3% over a 3-month period. NMR measurements showed clear changes in T1, T2, and T1rho with changing temperature.

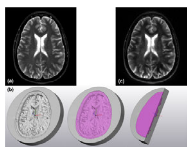
Impact: A stable MSK relaxometry phantom prototype was successfully developed and characterized, including changes with temperature. With harmonized measurement protocols, this phantom will facilitate the use of quantitative relaxometry MRI in large-scale multi-site multi-vendor trials.

1318

Pitch: 13:45

Poster: 14:45

Screen 22



A novel 3D printed anthropomorphic phantom for evaluation of MR image characteristics

Shengzhen Tao[1], Chen Lin[1], Carleigh Eagle[1], Xiangzhi Zhou[1], and Robert A Pooley[1]

[1]Mayo Clinic, Jacksonville, FL, United States

Keywords: Phantoms, Phantoms, image quality evaluation

Motivation: The typical MRI phantoms with simple geometric inserts in homogenous background do not allow in-depth evaluation of MR image characteristics necessary for assessing advanced imaging and reconstruction techniques.

Goal(s): To develop phantoms that can produce images with realistic anatomical structure that are more suitable for thorough evaluation of MR image characteristics.

Approach: We developed an approach to construct novel anthropomorphic phantoms using 3D-printing technique and use an example to demonstrate the utilization of this phantom for image quality evaluation.

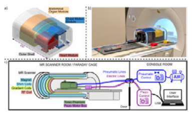
Results: The phantom created with this approach can produce images resembling original MRI images acquired on human subjects.

Impact: The phantom generated using the proposed approach allows in-depth evaluation of MR image characteristics utilizing images with realistic anatomical structure, which may be especially beneficial for developing and evaluating advanced data acquisition and reconstruction techniques.

1319 Pitch: 13:45

Poster: 14:45

Screen 23



Modular Dynamic Torso Motion Phantom for MRI

Ernesto Gomez Tamm[1], Andreas Hodul[2], Markus Ornter[3], Zacharias Chalampalakis[3], Quang Nguyen[2], Onisim Soanca[1], Vivian Janicaud[1], Elmar Laistler[1], Ivo Rausch[3], and Roberta Frass-Kriegl[1]

[1]High Field MR Center, Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria, [2]Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria, [3]QIMP Team, Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria

Keywords: Phantoms, Phantoms, Motion

Motivation: The development of motion tracking and correction methods requires suitable motion phantoms.

Goal(s): The design, fabrication, assembly and testing of a modular dynamic torso phantom.

Approach: The phantom consists of a saline-filled acrylic shell, with dimensions comparable to a human torso and three distinct interior motion modules. Two linear piezo stages are used to mimic breathing motion of the chest wall and the abdominal organs including the heart, respectively. A pneumatic system is used to move a heart mock-up to represent cardiac motion.

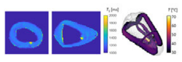
Results: The motion capabilities and MR compatibility of the phantom are validated in 3 T MRI experiments.

Impact: This work presents the development of a dynamic torso phantom for MR applications, i.e. a scientific instrument that can serve as ground truth for the investigation and characterization of novel motion compensation and tracking methods.

1320 Pitch: 13:45

Poster: 14:45

Screen 24



A Dynamic PVA Cryogel based Cardiac Phantom for 3D Temperature Validation of Radiofrequency Ablation

Wyger Brink[1], Shanne Doest[1], Maria Rocchi[2], Libera Fresiello[2], Tim Boers[3], Giulio Dagnino[4], and Marco Götte[5]

[1]Magnetic Detection and Imaging group, TechMed Centre, University of Twente, Enschede, Netherlands, [2]Cardiovascular and Respiratory Physiology group, TechMed Centre, University of Twente, Enschede, Netherlands, [3]Multi-Modality Medical Imaging group, TechMed Centre, University of Twente, Enschede, Netherlands, [4]Robotics and Mechatronics group, University of Twente, Enschede, Netherlands, [5]Department of Cardiology, Amsterdam University Medical Centers, Amsterdam, Netherlands

Keywords: Phantoms, Phantoms, Validation, Temperature mapping, Dynamic

Motivation: MRI-guided radiofrequency ablation of cardiac arrhythmias holds promise to monitor the lesion formation process, however lacks validation tools.

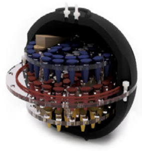
Goal(s): To develop a phantom for quantitative validation of catheter ablation procedures.

Approach: In this study, a phantom composed of polyvinyl alcohol (PVA) with temperature sensitive properties has been developed for validation of the attained ablation temperature.

Results: Post-ablation T_1 maps were acquired and converted into temperature maps, based on the characterization of the reference phantoms.

Impact: This work demonstrates a validation phantom for temperature validation after radiofrequency ablation procedures. This can offer an effective tool for MR methods development as well as procedural training, shortening procedural times and improving patient outcomes.

1321 Pitch: 13:45 Poster: 14:45 Screen 25



[Modular open-source imaging phantom]

Igor Tyshchenko[1,2], Youheng Zeng[3], Yasmin Blunck[1,2], Bradford A. Moffat[1], Rebecca Glarin[1], and Leigh A. Johnston[1,2]

[1]Melbourne Brain Centre Imaging Unit, The University of Melbourne, Melbourne, Australia, [2]Department of Biomedical Engineering & Graeme Clark Institute, The University of Melbourne, Melbourne, Australia, [3]School of Science and Engineering, The University of Dundee, Dundee, United Kingdom

Keywords: Phantoms, Phantoms

Motivation: Overcome the high cost, lack of customisation and low global uptake of standard MRI imaging phantoms.

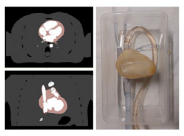
Goal(s): Design an affordable open-source MRI imaging phantom, imaging protocols and analysis tools demonstrated, showcasing their efficacy through the evaluation of slice profile and spatial resolution assessment.

Approach: A complex, multilayered phantom is designed with careful material selection aimed at low cost (US$500 worth of materials) and accessible construction principles. Slice profile and resolution measurements were performed using a double-wedge and a coarse resolution grid, respectively.

Results: This study has successfully produced an affordable open-source imaging phantom with detailed MRI assessment protocols.

Impact: This project's affordable, open-source MRI phantom and specialised assessment protocol benefit researchers by reducing costs and encouraging collaboration. The findings on slice profiles and resolution parameters enhance MRI research, improving imaging outcomes and accessibility.

1322 Pitch: 13:45 Poster: 14:45 Screen 26



[An Anthropomorphic Cardiac Phantom based on MR-Visible Additive Manufacturing for Development and Training of Interventional CMR Procedures]

Sara Nuvoli[1], Quentin Sablé[2], Giulio Dagnino[2], Marco Götte[3], Dennis Kundrat[2], and Wyger Brink[1]

[1]Magnetic Detection and Imaging group, TechMed Centre, University of Twente, Enschede, Netherlands, [2]Robotics and Mechatronics group, University of Twente, Enschede, Netherlands, [3]Department of Cardiology, Amsterdam University Medical Center, Amsterdam, Netherlands

Keywords: Phantoms, Phantoms, Phantom, 3D Printing, Cardiac Interventions

Motivation: Both technological development as well as procedural training of interventional cardiac MR (iCMR) procedures require anatomically realistic models. Animal studies are undesirable and becoming virtually impossible due to legal and ethical restrictions.

Goal(s): To develop a realistic cardiac phantom that can be 3D printed using standard MR-visible support material.

Approach: Material properties were determined and an anatomically realistic cardiac model was developed and constructed using 3D printing. Imaging features were assessed and an MR-guided cardiac intervention was simulated experimentally.

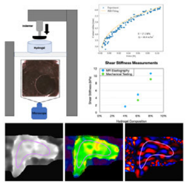
Results: A simple and realistic MR-visible cardiac phantom has been presented for technological development and training purposes, to improve MR-guided cardiac interventions.

Impact: The proposed phantom facilitates the development, testing and validation of novel technologies to improve MR-guided cardiac interventions, can be used for procedural training purposes, and may ultimately contribute to the improvement of clinical outcome.

1323 Pitch: 13:45

Poster: 14:45

Screen 27



[Characterization of a Pseudo-Tissue Liver Flow Phantom for Use in Magnetic Resonance Elastography Validation Experiments]

James Rice[1,2], Srijyotsna Volety[3], Wonhyeok Lee[1], Melih Eriten[1], Diego Hernando[4], and Alejandro Roldan-Alzate[1,2,5]

[1]Mechanical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [3]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [4]University of Wisconsin-Madison, Madison, WI, United States, [5]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States

Keywords: Phantoms, Elastography, MRE, Hydrogel, Phantoms

Motivation: MRE is utilized to assess tissue stiffness in vivo, however, robust validation in tissue-mimicking phantoms is needed.

Goal(s): Create hydrogel liver phantoms of varying stiffness, characterize them with MRE and compare MRE with a mechanical reference standard. Utilize pulsatile flow to mimic cardiac motion.

Approach: Flow phantoms of varying stiffness were created. Stiffness from mechanical test was compared to MRE. Cardiac tagging visualized motion inside each phantom.

Results: MRE shear stiffness showed agreement with indenter stiffness and cardiac motion decreased with stiffness.

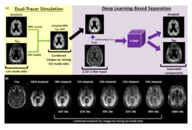
Impact: Advances in MRE have led to its increasing use to determine tissue stiffness in vivo, however, robust validation in tissue mimicking phantoms has yet to be achieved. The proposed methodology may help to assess the quantitative performance of MRE.

1324 Pitch: 13:45

MERIT AWARD MAGNA CUM LAUDE

Poster: 14:45

Screen 28



[Deep Learning-based Disambiguation for Multiple AD Radiotracers using PET/MRI]

Ashwin Kumar[1], Donghoon Kim[1], Elizabeth Mormino[2], Akshay Chaudhari[1], Christina Young[2], Kevin Chen[3], Mehdi Khalighi[1], and Greg Zaharchuk[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Neurology, Stanford University, Stanford, CA, United States, [3]Biomedical Engineering, National Taiwan University, Taipei, Taiwan

Keywords: PET/MR, PET/MR

Motivation: AD patients must undergo repeated visits for amyloid and tau radiotracer imaging, leading to high costs and dose concerns due to PET's inability to simultaneously acquire multiple radiotracers during a single session.

Goal(s): Using PET/MRI scans, we used deep learning to create separate amyloid and tau PET images from a simulated combined dual-tracer image.

Approach: We simulated a combined amyloid-tau image by blending co-registered list-mode data and employed a 2.5D U-Net architecture for effective separation.

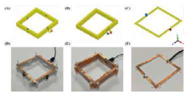
Results: Mixed-dose models, incorporating physics-inspired data augmentation and MR information, exhibited enhanced anatomical preservation and reduced variability in quantitative metrics.

Impact: The demonstrated separation of a simulated combined amyloid and tau PET/MRI study into its individual components using DL may allow for simultaneous injection of multiple radiotracers in a single acquisition, streamlining the imaging process for AD patients.

1325 Pitch: 13:45

Poster: 14:45

Screen 29



Multimodal surface coils for low-field MR imaging

Yunkun Zhao[1], Aditya Ashok Bhosale[1], and Xiaoliang Zhang[1,2]

[1]Department of Biomedical Engineering, State University of New York at Buffalo, Buffalo, NY, United States, [2]Department of Electrical Engineering, State University of New York at Buffalo, Buffalo, NY, United States

Keywords: Multimodal, Non-Array RF Coils, Antennas & Waveguides

Motivation: By the need to address the limitations of low-field MRI, such as low SNR and insensitive frequency tuning.

Goal(s): We proposed a design of multimodal surface coil that can enhance the B1 efficiency while reducing the associated electric field.

Approach: Through both electromagnetic simulation and bench testing, the performance of this novel coil design technique was evaluated and compared with the conventional surface coil and solenoid coil.

Results: The results affirmed the superior performance of the proposed multimodal surface coil design in terms of B1 efficiency and frequency tuning over the surface coil and solenoid coil at the low field of 0.5T.

Impact: The proposed multimodal surface coil design improves B1 efficiency compared with the conventional surface coil and solenoid coil at 0.5T. It also mitigates frequency tuning challenges and has the potential to enhance the quality of low-field MRI in clinical diagnosis.

1326 Pitch: 13:45

Poster: 14:45

Screen 30

Preliminary investigation of BOLD dependence on EEG-TMS using a closed-loop TMS-EEG-fMRI setup

Joonas Petteri Laurinoja[1,2], Umair Hassan[3], Mikko Nyrhinen[2], Matilda Makkonen[2], Pantelis Lioumis[2], Fa-Hsuan Lin[4], Christoph Zrenner[5], Risto Ilmoniemi[2], and Dogu Baran Aydogan[6]

[1]A.I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, HELSINKI, Finland, [2]Dept. of Neuroscience and Biomed. Engineering, Aalto University, Espoo, Finland, [3]Department of Psychiatry & Behavioral Sciences, Stanford University, Stanford, CA, United States, [4]Sunnybrook Research Institute, University of Toronto, Toronto, ON, Canada, [5]Centre of Addiction and Mental Health, University of Toronto, Toronto, ON, Canada, [6]A.I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland

Keywords: Hybrid & Novel Systems Technology, Multimodal, TMS, EEG, fMRI

Motivation: The motivation for this research study is to improve the efficacy of transcranial magnetic stimulation.

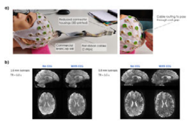
Goal(s): The specific goals of this study are to establish a closed-loop TMS-EEG-fMRI system and to investigate brain state-dependent EEG-TMS responses in relation to concurrent fMRI measurements.

Approach: 150 single TMS pulses are delivered while monitoring TMS-elicited network activity using interleaved fMRI acquisition. Data processing involves extracting EEG phase information, preprocessing of fMRI data, and statistical analysis using SPM12.

Results: Significantly increased fMRI signal was detected in the M1 and SMA under specific EEG phase conditions. These results illustrate the relationship between TMS, EEG phases, and BOLD responses

Impact: The results of this study have important implications for the field of non-invasive brain stimulation and neuroimaging. The development of a closed-loop TMS-EEG-fMRI system holds the potential to revolutionize the treatment of various brain disorders by personalizing TMS interventions.

1327 Pitch: 13:45
Poster: 14:45
Screen 31



Simultaneous EEG-fMRI at 7T with adapted EEG leads and reference sensors for high-quality, high-resolution imaging: human evaluation

Cristina Sainz Martinez[1,2], Jonathan Wirsich[3], Serge Vulliémoz[3], Mathieu Lemay[1], Jessica Bastiaansen[4,5], Roland Wiest[6], and João Jorge[1]

[1]CSEM - Swiss Center for Electronics and Microtechnology, Bern, Switzerland, [2]CIBM Center for Biomedical Imaging, Lausanne, Switzerland, [3]EEG and Epilepsy Unit, Department of Clinical Neurosciences, University Hospitals and University of Geneva, Geneva, Switzerland, [4]Department of Diagnostic, Interventional and Pediatric Radiology, Bern University Hospital, University of Bern, Bern, Switzerland, [5]Translational Imaging Center (TIC), Swiss Institute for Translational and Entrepreneurial Medicine, Bern, Switzerland, [6]Institute of Diagnostic and Interventional Neuroradiology, Bern University Hospital, University of Bern, Bern, Switzerland

Keywords: Multimodal, High-Field MRI, EEG, fMRI, EEG-fMRI, 7T, laminar

Motivation: The combination of BOLD-fMRI at 7T with EEG could bring novel insights to neuroscience. However, the combination has remained challenging due to accentuated artifacts and RF-coil constraints.

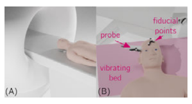
Goal(s): To implement a first-of-its-kind 7T EEG-fMRI framework combining key developments from recent studies, and assess its safety, data quality and functional sensitivity in humans.

Approach: Extensive tests in phantom and humans(N=8) including field mapping, structural MRI and fMRI (1.6 and 0.8mm-resolution) acquired with+without EEG. Comparisons of data quality and functional sensitivity.

Results: The framework proved safe and feasible with fMRI down to sub-mm resolution, with moderate quality losses and potentially negligible impact on functional sensitivity.

Impact: This study characterizes the feasibility of 7T-EEG-fMRI with high sensitivity and acceleration capabilities, which could bring valuable insights to research in e.g. laminar functional connectivity, or localization of epileptogenic sources and their propagation pathways, for clinical diagnostic and pre-surgical planning.

1328 Pitch: 13:45
Poster: 14:45
Screen 32



Cross-validating magnetic resonance elastography and ultrasound time-harmonic elastography of the brain by using a 3D optical tracker

Stefan Klemmer Chandía[1], Jakob Schattenfroh[1], Spencer Brinker[2], Heiko Tzschätzsch[1], Tom Meyer[1], and Ingolf Sack[1]

[1]Department of Radiology, Charité - Universitätsmedizin Berlin, Corporate Member of Freie Universität Berlin, Humboldt-Universität zu Berlin, and Berlin Institute of Health, Berlin, Germany, [2]Department of Anesthesiology, Yale School of Medicine, New Haven, CT, United States

Keywords: Multimodal, Elastography, Cross-validation

Motivation: Magnetic resonance elastography (MRE) and ultrasound time-harmonic elastography (USE-THE) have not been cross-validated yet. Since their results are in 3D and 2D, respectively, aligning them is difficult.

Goal(s): To cross-validate MRE and USE-THE in the brain based on a common atlas space.

Approach: An optical system tracked the position of fiducial markers derived from MRE during USE-THE measurements. Consequently, the resulting spatial alignment of both measurements allowed direct comparison.

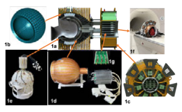
Results: Stiffness was averaged over the whole field-of-view and over five anatomical regions. Globally, agreement was good (ICC=0.6982) and regionally, it was acceptable based on a Wilcoxon signed test (p>0.05).

Impact: Agreement between cerebral MRE and USE will facilitate multi-modal neural tissue characterization. Combined MRE-USE could benefit from high spatial resolution of MRE and high temporal resolution of USE-THE.

1329 Pitch: 13:45

Poster: 14:45

Screen 33



A 16-channel MR-PET array coil for high-resolution parallel transmit brain imaging at 7T

Azma Mareyam[1], John E Kirsch[1,2], Ehsan Kazemivalipour[1,2], Michele Scipioni[1,2], Magdelena Suriano Allen[1,3], Jeffrey Short[1], Hammodi Almurani[1], Ciprian Catana[1,2], and Lawrence L Wald[1,2,4]

[1]Radiology, A.A.Martinos Center of Biomedical Imaging/Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Department of Physics, Massachusetts Institute of Technology, Cambridge, MA, United States, [4]Harvard-MIT Division of Health Sciences Technology, Cambridge, MA, United States

Keywords: PET/MR, Parallel Imaging, MR-PET 7T array

Motivation: We are developing the Human Dynamic NeuroChemical Connectome, a high spatio-temporal resolution brain PET (HSTR-BrainPET) scanner integrated with a 7T MR system

Goal(s): To build a 16-channel PET-compatible RF coil with parallel transmit capability based on an 8-channel test array for high-resolution imaging.

Approach: We designed and built multi-channel transmit-receive coils with RF screen that fits inside the spherical geometry of the PET camera. Coil performance was characterized with and without PET modules present.

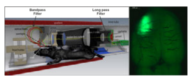
Results: The performance of the 8-channel coil was satisfactory. Preliminary tests with the 16-channel array showed some loss in sensitivity in the CP mode.

Impact: By designing a 16-channel transmit-receive RF head coil and RF screen that both conform to the novel spherical geometry PET camera, we can acquire high-quality MR data simultaneously with PET data while also minimizing 511 keV photon attenuation.

1330 Pitch: 13:45

Poster: 14:45

Screen 34



Concurrent ultra-high field fMRI and optical imaging of hemodynamic parameters and intracellular calcium

Rebekka Bernard[1], Klaus Scheffler[1,2], and Rolf Pohmann[1]

[1]Magnetic Resonance Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Department for Neuroimaging, University of Tübingen, Tübingen, Germany

Keywords: Hybrid & Novel Systems Technology, Multimodal, Optical Imaging, Calcium

Motivation: BOLD fMRI is widely used as an indirect measure of neuronal activity. However, the spatial and temporal specificity of the BOLD signal is still under debate.

Goal(s): Being able to measure both hemodynamics and neuronal activity simultaneously with fMRI can help to improve interpretation of the BOLD signal.

Approach: A combined in-bore setup for concurrent intrinsic optical imaging, calcium imaging and ultra-high field fMRI in rats was designed.

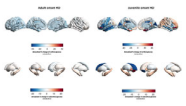
Results: Measurements of BOLD, intrinsic hemodynamic and calcium signals with high temporal and spatial resolution reveal high correlation between these signals with specific characteristics regarding localization, vascularization and fMRI sequence.

Impact: A combined in-bore setup for concurrently recording calcium, intrinsic optical signals and fMRI was developed, which can be used to investigate spatial and temporal characteristics and correlations between brain activation, hemodynamic changes and BOLD signals.

1331 Pitch: 13:45

Poster: 14:45

Screen 35



Brain structure and glucose metabolism in juvenile and adult-onset Huntington disease: a cross-sectional and longitudinal PET/MR study

Maria Eugenia Caligiuri[1], Maria Celeste Bonacci[1], Giuseppe Lucio Cascini[2], Aldo Quattrone[1], Ferdinando Squitieri[3,4], and Umberto Sabatini[1]

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Keywords: PET/MR, PET/MR

Motivation: Juvenile-onset Huntington Disease (JoHD) represents 4-10% of HD cases, has worse prognosis and psychiatric rather than motor symptomatology, compared to the adult form (AoHD). No study has yet investigated morphological and metabolic changes comparing these two forms with PET-MRI.

Goal(s): Are brain structural and metabolic changes different between patients with JoHD and AoHD? Do they evolve differently?

Approach: PET/MRI was acquired on AoHD and JoHD patients. Cortical and subcortical hybrid characteristics were compared between groups and overtime.

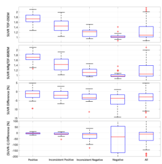
Results: POHD had the most remarkable striatum volume loss at baseline. Interestingly, POHD brain cortex volume was relatively spared at baseline if compared to AOHD patients.

Impact: This study provides first evidence that disease-related degeneration in JoHD first affects subcortical regions, where atrophy is more severe compared to AoHD, and ultimately spreads to the cortex, with faster rates of thinning and glucose metabolism changes compared AoHD.

1332 Pitch: 13:45

Poster: 14:45

Screen 36



PET Recon with MR Priors: Application in Ambiguously Rated Amyloid PET Scans

Mehdi Khalighi[1], Greg Zaharchuk[1], Michael Zeineh[1], Guido Davidzon[1], Christina Young[1], Kathleen Poston[1], and Elizabeth Mormino[1]

[1]Stanford University, Stanford, CA, United States

Keywords: PET/MR, PET/MR, MR Priors, Motion Correction

Motivation: Uptake in the supratentorial cortex defines clinical amyloid positivity. Because of PET's low spatial resolution, there is a spill-in effect from adjacent white-matter to gray-matter in amyloid PET scans, which may cause inconsistent rating between trained readers.

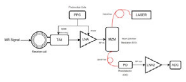
Goal(s): Reduce the spill-in effect by using MR priors in PET recon to improve the consistency of reading amyloid PET scans.

Approach: A recently developed PET recon with MR-priors and motion correction is applied to a set of 18F-florbetaben (amyloid) PET/MRI scans and is compared with regular TOF-OSEM PET recon using SUVR.

Results: PET recon with MR priors improves reading of negative amyloid PET scans.

Impact: PET-recon with MR-priors can make identifying negative cases more consistent between readers. Given how common inconsistent ratings are for amyloid-PET, methods that improve the ability to distinguish intermediate amyloid levels may be valuable for the widespread use of this modality.

1333 Pitch: 13:45 Poster: 14:45 Screen 37



Implementation of an Optical System for Signal and Power Transmission in Light Coils

Zining Liu[1], Nan Yin[1], Çağlar Ataman[2], Henning Helmers[3], Michael Bock[1], and Ali Caglar Özen[1]

[1]Division of Medical Physics, Department of Diagnostic and Interventional Radiology, University Medical Center Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany, [2]Microsystems for Biomedical Imaging Laboratory, Department of Microsystems Engineering, University of Freiburg, Freiburg, Germany, [3]Fraunhofer Institute for Solar Energy Systems ISE, Freiburg, Germany

Keywords: New Devices, New Devices, Optics

Motivation: RF-induced heating and reduced image signal-to-noise ratio (SNR) due to crosstalk between adjacent cables are problematic in dense receive arrays. RF coils with fiber-optical connection can overcome these problems associated with metallic wires.

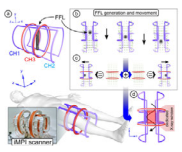
Goal(s): To develop optical signal and power transmission units for MRI.

Approach: An analog photonic link with Mach-Zehnder modulator was constructed for optical signal transmission, and GaAs-based photonic power converters were used for power-over-fiber supply of low-noise-amplifiers (LNA).

Results: Image SNR and signal dynamic range of the photonic link are comparable with coaxial cable connection. Photonic power convertors can supply up to 10 LNAs in the receive chain.

Impact: Fully optical signal and power transmission is feasible for RF coils. It enables extremely dense modular receive arrays by eliminating cable-crosstalk and overcoming RF induced heating problems.

1334 Pitch: 13:45 Poster: 14:45 Screen 38



Magnetic Particle Imaging goes clinical routine? – first step to human-sized MPI-guided intervention in realtime

Patrick Vogel[1,2], Martin A. Rückert[1], Johanna Günther[1], Teresa Reichl[1], Thomas Kampf[1,3], Thorsten A. Bley[4], Volker Christian Behr[1], and Stefan Herz[4,5]

[1]Experimental Physics 5, University of Würzburg, Würzburg, Germany, [2]Pure Devices GmbH, Rimpar, Germany, [3]Diagnostic and Interventional Neuroradiology, University Hospital Würzburg, Würzburg, Germany, [4]Diagnostic and Interventional Radiology, University Hospital Würzburg, Würzburg, Germany, [5]Radiologie Augsburg Friedberg, Augsburg, Germany

Keywords: Hybrid & Novel Systems Technology, Hybrid & Novel Systems Technology, Magnetic Particle Imaging, MPI

Motivation: The gold-standard for guiding minimally invasive cardiovascular interventions is X-ray (digital subtraction angiography - DSA). Can we reduce the radiation exposure for clinical staff and patients?

Goal(s): The use of alternative radiation-free imaging methods providing all necessary features can reduce the radiation exposure dramatically.

Approach: The imaging modality Magnetic Particle Imaging (MPI) uses iron-oxide-based nanoparticles as tracer for realtime visualization of dynamic processes. In a first step, this technique could be used to support clinical DSA treatment.

Results: In a first study, a lightweight and portable human-sized MPI scanner has been built and successfully tested under realistic conditions with vascular phantoms within a catheter-lab.

Impact: First simultaneous MPI/DSA hybrid imaging in human-sized phantoms demonstrates the feasibility of scaling-up the MPI technology. With a clinical approved tracer, MPI could be ready for clinical routine.

Power Pitch

Pitch: Flow, Fluid Exchange & Microvasculature in the Human Brain

Power Pitch Theatre 3

Thursday
Pitches: 13:45 - 14:45
Posters: 14:45 - 15:45

Moderators: Sung-Hong Park & Toshiaki Taoka

(no CME credit)

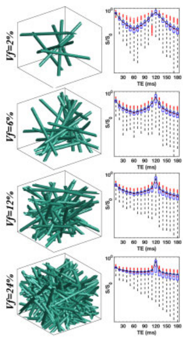
1335 Pitch: 13:45

Poster: 14:45

Screen 41

[Deep Learning-based Voxel-wise Estimation of Vessel Size Distribution from MR Gradient Echo Sampling of the Free Induction Decay and Spin Echo]

Natenael B. Semmineh[1], Indranil Guha[1], Jerrold L. Boxerman[2,3], and C. Chad Quarles[1]



[1]Cancer Systems Imaging, The University of Texas MD Anderson Cancer Center, Houston, TX, United States, [2]Alpert Medical School - Brown University, Providence, RI, United States, [3]Department of Diagnostic Imaging, Rhode Island Hospital, Providence, RI, United States

Keywords: Blood Vessels, Blood vessels

Motivation: DSC-MRI is vital for diagnosing brain pathologies. Our goal is to harness GESFIDE MR signal evolution through deep learning (DL) to estimate vessel size distribution (VSD), which would allow us to explore deeper into the complexities of tumor vascular microstructure and other pathologies.

Goal(s): Our objective is to assess the capabilities of GESFIDE in providing voxel-wise VSD estimate.

Approach: We simulated GESFIDE signals with the FPFDM method. A DL network, VSD estimator (VSDE), was trained to estimate VSDs.

Results: Our validation demonstrates GESFIDE's promise in assessing VSD as a distinct contrast mechanism, offering insights into tumor microstructure and pathologies.

Impact: Our study reveals GESFIDE's potential for VSD estimation. Leveraging this unique contrast mechanism allows in-depth exploration of tumor microstructure and other pathologies through histogram analysis. Ongoing research aims to broaden VSD applicability and optimize GESFIDE parameters.

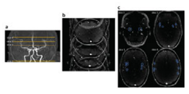
1336 Pitch: 13:45

Poster: 14:45

Screen 42

[Simultaneous assessment of arterial pulsatility at different segments of cerebral arteries using multiband dual-VENC Phase-Contrast MRI]

Jianing Tang[1,2], Ning Jing[3], Xiaoming Bi[3], and Lirong Yan[1,2]



[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Department of Biomedical Engineering, Northwestern University, Chicago, IL, United States, [3]Siemens Medical Solutions USA, Chicago, IL, United States

Keywords: Blood Vessels, Blood vessels

Motivation: Arterial pulsatility is used for assessing cerebral vascular dysfunction. However, 2D PC-MRI and 4D flow have limitations including multiple separate scans, prolonged scan time, and flow saturation effects.

Goal(s): Our study aims to develop a Multi-band Dual-Venc PC-MRI (MB-DV) senquence to measure pulsatility for larger and distal small vessels within short scan time.

Approach: MB-DV scans were performed on 8 subjects to image velocity waveforms from ICA, M2, M3, LSA, and M4 simultaneously. For comparison, multiple standard single-slice PC-MRI were performed.

Results: MB-DV PC-MRI successfully measured flow waveforms and provided reliable PI measurements with no significant difference from PI measured by standard PC-MRI.

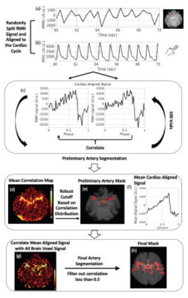
Impact: MD-DV PC-MRI enables simultaneously assessing arterial pulsatility at multiple vessel segments in the brain within a short scan time, which could be a potentially useful imaging tool to study pulsatility in the cerebral vascular tree for cerebrovascular and neurodegenerative diseases.

1337

Pitch: 13:45

Poster: 14:45

Screen 43



Robust data-driven cerebral artery segmentation using functional magnetic resonance imaging

Tianyin Xu[1], Adam M Wright[1,2], John Koo[3], Yi Zhao[3], Yunjie Tong[1], and Qiuting Wen[2]

[1]Weldon School of Biomedical Engineering, Purdue University, West Lafayette, IN, United States, [2]Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, IN, United States, [3]Department of Biostatistics and Health Data Science, Indiana University, Indianapolis, IN, United States

Keywords: Blood Vessels, Segmentation

Motivation: In this work, we address the challenge of cerebral artery segmentation when time-of-flight (TOF) imaging is unavailable.

Goal(s): Develop an automatic data-driven segmentation of large cerebral arteries.

Approach: Arteries were identified within the fMRI signal by leveraging large pulsation-driven fluctuations.

Results: In the local subjects with TOF images, the approach displayed high levels of agreement with TOF-derived segmentation. Additionally, the segmentation demonstrated high scan-to-scan reproducibility in 430 subjects with four repeated fMRI scans from the HCP aging cohort. Lastly, the segmentation performed robustly across two different scanning protocols supporting its potential to be used for datasets with various acquisition parameters.

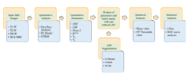
Impact: Our robust data-driven approach reliably automatically segments the large cerebral arteries of fMRI datasets. This work enables more accessible large cerebral artery segmentation in existing MRI datasets, independent of TOF images.

1338

Pitch: 13:45

Poster: 14:45

Screen 44



Automatic Segmentation of Large Blood Vasculature in DCE-MRI Data of Brain Tumor Using Different Clustering Algorithms

Anshika Kesari[1], Rakesh Kumar Gupta[2], and Anup Singh[1,3,4]

[1]Centre for Biomedical Engineering, Indian Institute of Technology Delhi, New Delhi, India, [2]Department of Radiology, Fortis Memorial Research Institute, Gurugram, India, [3]Department of Biomedical Engineering, All India Institute of Medical Sciences, New Delhi, India, [4]Yardi School of Artificial Intelligence, , Indian Institute of Technology Delhi, New Delhi, India

Keywords: Blood Vessels, Blood vessels, Clustering algorithms, Brain tumor

Motivation: The presence of normal large-blood-vessels(LBV) in tumor region can impact the evaluation of quantitative DCE-MRI parameters and tumor classification.

Goal(s): To develop an automated framework for segmenting LBVs present within or around the tumor region using different clustering algorithms and compare their accuracy in tumor grading.

Approach: LBV masks were generated using three different clustering algorithms on the DCE-MRI derived maps CBV and Slope-2. Generated tumor mask using AI tool on FLAIR images. Statistical analysis was performed.

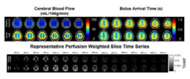
Results: Overall, k-means clustering based algorithm provided superior performance in segmentation of LBV and tumor grading in less computational time.

Impact: The proposed automatic LBV segmentation algorithm can assist radiologists in objective and accurate assessment of tumor including tumor grading. This will reduce errors in tumor assessment.

1339 Pitch: 13:45

Poster: 14:45

Screen 45



Feasibility of Detecting White Matter Perfusion using Arterial Spin Labeling in Patients with Sickle Cell Disease

Wesley Thomas Richerson[1], Megan Aumann[1], Alex Song[1], Jarrod Eisma[1], Samantha Davis[2], Lauren Milner[2], Lori Jordan[1,2,3], and Manus Donahue[1,4,5]

[1]Neurology, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Pediatrics, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Radiology, Vanderbilt University Medical Center, Nashville, TN, United States, [4]Psychiatry, Vanderbilt University Medical Center, Nashville, TN, United States, [5]Electrical and Computer Engineering, Vanderbilt University, Nashville, TN, United States

Keywords: Blood Vessels, Arterial spin labelling, Sickle Cell Disease, White Matter Perfusion

Motivation: Accurate white matter (WM) perfusion quantification is difficult but likely critical for assessing infarct risk in Sickle Cell Disease (SCD).

Goal(s): To evaluate the feasibility of detecting regional WM perfusion using arterial spin labeling (ASL) under conditions of high perfusion and reduced bolus arrival time (BAT) in SCD patients.

Approach: A multi-inversion time (TI; range=200-3200 ms), pulsed ASL sequence was applied to quantify perfusion detectability in SCD (n=35) and healthy (n=15) participants.

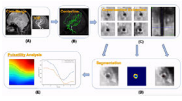
Results: WM perfusion was significantly detected for TI=800-1800 ms in SCD patients. BAT in SCD was more closely related to hematocrit (rho=0.43; p=0.01) than was WM perfusion (rho=-0.13; p=0.47).

Impact: We provide evidence in support of perfusion detection with ASL in SCD patients, which is attributable to higher perfusion and reduced BAT.

1340 Pitch: 13:45

Poster: 14:45

Screen 46



Reproducibility of intracranial vascular pulsatility on 3D cine black-blood MRI

Kaiyu Zhang[1], William Kerwin[2], Xiaodong Ma[3], Xin Wang[4], Yin Guo[1], Thomas Hatsukami[5], Mahmud Mossa-Basha[2], Chun Yuan[2,3], and Niranjan Balu[2]

[1]Department of Bioengineering, University of Washington, Seattle, WA, United States, [2]Department of Radiology, University of Washington, Seattle, WA, United States, [3]Department of Radiology and Imaging Sciences, University of Utah, Salt Lake City, UT, United States, [4]Electrical and Computer Engineering, University of Washington, Seattle, WA, United States, [5]Department of Surgery, University of Washington, Seattle, WA, United States

Keywords: Vessel Wall, Vessels, Cine Vessel Wall Imaging

Motivation: This research investigates the lesser-explored domain of lumen area changes in intracranial vascular pulsatility, providing insight into cerebral vasculature's mechanical behavior.

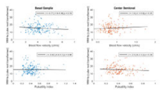
Goal(s): To employ cine black-blood MRI for delineating and quantifying intracranial artery pulsatility by monitoring cardiac cycle-induced lumen variations.

Approach: We utilized a sophisticated vessel analysis system to discern pulsatility within the lumen and adjacent tissues, validating our findings with reproducibility scans.

Results: Cine black-blood imaging successfully visualized intracranial vascular pulsatility. The method displayed robust reproducibility in detecting lumen area changes, proving comparable to velocity pulsatility measurements.

Impact: This study illuminates the often-overlooked aspect of lumen area pulsatility, with implications for a holistic assessment of vascular health and disease.

1341 Pitch: 13:45
Poster: 14:45
Screen 47



Determinants of 7T MRI microvascular function and link with small vessel disease burden in an ageing population

Stanley Pham[1], Madouc Linders[1], Anna Streiber[2], Nikki Dieleman[3], Jaco Zwanenburg[1], Julia Neitzel[2,4], Arfan Ikram[5], Meike Vernooij[2,4], and Geert Jan Biessels[3]

[1]Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [2]Radiology and Nuclear Medicine, Erasmus Medical Center, Rotterdam, Netherlands, [3]Neurology, University Medical Center Utrecht, Utrecht, Netherlands, [4]Epidemiology, Erasmus Medical Center, Rotterdam, Netherlands, [5]Erasmus Medical Center, Rotterdam, Netherlands

Keywords: Blood Vessels, Blood vessels, Small vessel disease, white matter hyperintensities, 7T MRI, small vessel function, Rotterdam Study

Motivation: Novel 7T MR techniques allow non-invasive assessment of cerebral small vessel function, potentially relevant to small vessel disease (SVD), a common cause of stroke and dementia.

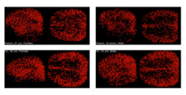
Goal(s): Assess determinants of small vessel function and its link to SVD lesion burden.

Approach: Perforating artery blood flow velocity and pulsatility were measured with 7T MRI in 200 participants >60 years from a population-based sample and linked to vascular risk factors and white matter hyperintensity (WMH) volume using linear regression.

Results: Age, blood pressure, and BMI were determinants of small vessel function. In turn, vessel function did not relate to WMH burden.

Impact: In the general aging population, perforating artery blood flow velocity and pulsatility do not relate to whole-brain SVD-lesion load. Other complementary small vessel function measures should be investigated as a potential early marker of SVD.

1342 Pitch: 13:45
Poster: 14:45
Screen 48



Changes in vessel density in genetic cerebral small vessel disease (CADASIL) revealed by high-resolution black-blood MRI: A pilot study

Zidong Yang[1], Steve Mendoza[1], Yingying Li[2], Yunqing Ying[3], Xin Cheng[3], Yonggang Shi[4], Qi Yang[2], and Danny JJ Wang[4]

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Keywords: Blood Vessels, Dementia, Black Blood, CADASIL, small vessel disease

Motivation: Cerebral small vessel disease (cSVD) is a leading cause of vascular dementia in the elderly worldwide. No existing MRI methods can directly visualize cerebral small vessels.

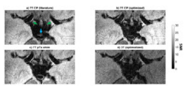
Goal(s): Evaluation of a novel pipeline for mapping small blood vessels using high-resolution black-blood MRI in genetic cSVD (CADASIL) patients.

Approach: Small blood vessels were segmented and quantified in 10 CADASIL patients and 10 matched healthy controls.

Results: Significantly lower vessel density has been found in the hippocampus of the patients, whereas the vessel density is significantly higher in cortical white matter of patients compared to the control.

Impact: Visualization and quantification methods of small cerebral blood vessels from high-resolution black blood MRI which would facilitate the study of cSVD mechanisms.

1343 Pitch: 13:45 Poster: 14:45 Screen 49



Simulation-based optimization and experimental comparison of intracranial T2-weighted DANTE-SPACE vessel wall imaging at 3T and 7T

Matthijs H.S. de Buck[1,2,3,4], Aaron T. Hess[1], and Peter Jezzard[1]

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Keywords: Blood Vessels, Vessels, Vessel Wall; Neurovascular; Ultra-high field

Motivation: T2-weighted DANTE-SPACE is a promising sequence for intracranial black-blood vessel wall imaging at 7T. However, it is limited by signal and contrast variations and its performance versus 3T remains unclear.

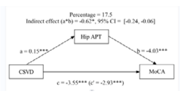
Goal(s): To optimize T2-weighted DANTE-SPACE at both 3T and 7T, and to quantitatively compare their performance.

Approach: A recently introduced DANTE-SPACE simulation framework was used for protocol optimization. Data acquired from six healthy volunteers at 3T and 7T were then quantitatively compared.

Results: Optimization of DANTE-SPACE parameters at 7T provides a 24% increase in vessel visibility over a literature protocol. Contrasts at 7T are 90% higher than at 3T.

Impact: Through simulation-based optimization, the vessel wall contrasts from T2-weighted DANTE-SPACE at 7T were improved by 24% versus a literature protocol. When optimized and implemented at 3T, in-vivo data showed a much lower vessel wall contrast-to-noise relative to 7T.

1344 Pitch: 13:45 Poster: 14:45 Screen 50



Hippocampal amide proton transfer value is associated with the imaging marker and total burden of cerebral small vessel disease

Ronghua Mu[1], Xiaoyan Qin[1], Wei Zheng[1], Peng Yang[1], Bingqin Huang[1], Kan Deng[2], Zhiwei Shen[3], and Xiqi Zhu[1]

[1]*Department of Radiology, Nanxishan Hospital of Guangxi Zhuang Autonomous Region, Guilin, China,* [2]*Philips Healthcare, Guangzhou, China,* [3]*Philips Healthcare, Beijing, China*

Keywords: Blood Vessels, CEST & MT

Motivation: Exploring the CSVD imaging markers can provide insights into the pathophysiology of CSVD, which is crucial for understanding its etiology, development, and clinical interventions.

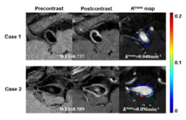
Goal(s): To investigate potential variations in hippocampal APT values among individuals with CSVD imaging markers and varying degrees of CSVD total burden.

Approach: All the participants conducted the cognitive assessment and the MRI scans. And statistical analysis was used for evaluation.

Results: The hippocampal APT values among different CSVD total load groups were significantly different (p<0.001). The mediation models demonstrated that the APT values of the hippocampus partially mediated the association between CSVD total load and MoCA score.

Impact: Hippocampal APT values may serve as a biomarker for the early detection of neurodegeneration in CSVD patients.

1345 Pitch: 13:45 Poster: 14:45 Screen 51



Aneurysm Wall Permeability in Assessing Non-Saccular Intracranial Aneurysms Rupture Risk Based on DCE-MRI

Yan Li[1], Ziming Xu[1], Linggen Dong[2], Yajie Wang[1], Peng Liu[2], Ming Lv[2], and Huijun Chen[1]

[1]Center for Biomedical Imaging Research, Tsinghua University, Beijing, China, [2]Department of Neurosurgery, Beijing Tiantan Hospital, Beijing Neurosurgical Institute, Capital Medical University, Beijing, China

Keywords: Blood Vessels, Permeability

Motivation: Evaluating intracranial aneurysm (IA) risk holds significant clinical importance. Recent studies have proposed wall permeability (K^{trans}) as a significant risk predictor, but its validity in non-saccular aneurysms remains unclear.

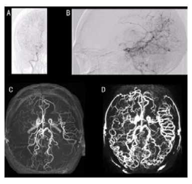
Goal(s): Our study aims to predict non-saccular IA rupture by K^{trans} from DCE-MRI.

Approach: K^{trans} was derived from the extended Kety/Tofts model. We analyzed correlation between K^{trans} and IA size, the Population, Hypertension, Age, Size, Earlier Subarachnoid Hemorrhage, and Site (PHASES) score and other clinical factors.

Results: K^{trans} significantly related to IA size and PHASES score, but there was no correlation between K^{trans} and intramural hematoma (IMH) and wall enhancement index (WEI).

Impact: By analyzing correlation between aneurysm wall permeability (K^{trans}) and other risk factors of non-saccular aneurysms rupture, we found that K^{trans} might be a risk indicator for rupture of non-saccular IAs.

1346 Pitch: 13:45 Poster: 14:45 Screen 52



Enhanced Leptomeningeal Collateral Visualization in Moyamoya Disease: A 5.0-T 4D NCEMRA Study

Yining Wang[1], Yijun Zhou[1], Shihai Zhao[1], YuXin Yang[2], Shuo Chen[3], Ke Xue[2], Dong Wang[3], Mingli Li[1], Jun Ni[4], Dong Zhang[5,6,7,8], and Feng Feng[1]

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Keywords: Blood Vessels, Blood vessels, 5.0-T magnetic resonance angiography

Motivation: Moyamoya disease necessitates precise visualization of cerebral vessels for management, but current imaging may be inadequate.

Goal(s): To ascertain if 5.0-T 4D NCEMRA offers superior imaging of collateral circulation in Moyamoya disease compared to traditional TOF MRA.

Approach: Utilized 5.0-T MRI to compare 4D NCEMRA and TOF MRA in visualizing leptomeningeal collateral anastomoses in 19 patients.

Results: 5.0-T 4D NCEMRA outperformed TOF MRA, particularly in identifying leptomeningeal collaterals, with significant statistical support.

Impact: The study underscores 5.0-T 4D NCEMRA's potential to enhance cerebral vascular mapping in Moyamoya disease, prompting advancements in diagnostic and therapeutic strategies, possibly leading to more personalized patient care.

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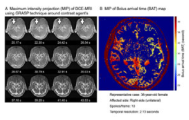
Screen 53



Analysis of Bolus Arrival Time in Moyamoya Disease Using Ultra-Fast 3D Dynamic Contrast-Enhanced MR Imaging by GRASP technique

Shuichi Ito[1], Sachi Okuchi[1], Yasutaka Fushimi[1], Koji Fujimoto[2], Satoshi Nakajima[1], Akihiko Sakata[1], Sayo Otani[1], Azusa Sakurama[1], Hiroshi Tagawa[1], Yang Wang[1], Satoshi Ikeda[1], Masaki Umehana[1], Yongping Ma[1], Takeshi Funaki[3], and Yuji Nakamoto[1]

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Keywords: Blood Vessels, DSC & DCE Perfusion, GRASP technique, Moyamoya disease

Motivation: To better understand the hemodynamics in moyamoya disease (MMD), high temporal and spatial resolution DCE-MRI using GRASP technique could estimate bolus arrival time (BAT) in MMD.

Goal(s): To find optimal condition for measuring BAT and to elucidate clinical value of BAT on MMD.

Approach: Thirty-seven MMD patients were included. Images with 5, 8, 13, and 21 spokes/frame were post-processed to derive time-intensity curves and estimate BATs.

Results: Using the optimal 13 spokes/frame, BATs were delayed on the side with severe stenosis/occlusion and were in the order of MCA M2, basal ganglia, thalamus, and choroid plexus.

Impact: Bolus arrival time in moyamoya disease estimated by using high temporal and spatial resolution 3D dynamic contrast-enhanced MR imaging using GRASP technique facilitates our understanding of the hemodynamics in moyamoya disease by elucidating regional difference.

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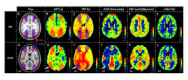

Non-invasive segmentation of individual watershed areas allows detection of hemodynamic impairments in internal carotid artery stenosis

Gabriel Hoffmann[1,2], Christine Preibisch[1,2,3], Franziska Richter[1], Matthias JP van Osch[4,5], Lena Václavů[4], Jan Kufer[1], Jannis Bodden[1], Michael Kallmayer[6], Jens Göttler[1], Claus Zimmer[1,2], Stephan Kaczmarz[1,2,7], and Lena Schmitzer[1,2]

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Keywords: Blood Vessels, Atherosclerosis, Vascular Territories

Motivation: Internal carotid artery stenosis (ICAS) accounts for ≈10% of strokes. Individual watershed areas (iWSA) are especially susceptible to hemodynamic impairments. Currently, iWSA are segmented from contrast agent-based time-to-peak (TTP), limiting applicability.

Goal(s): We aimed towards non-invasive iWSA segmentation based on arterial transit time (ATT) from Hadamard-encoded pseudo-continuous ASL.

Approach: Overlap of iWSA from ATT and TTP was investigated and agreement of extracted hemodynamic parameter values such as cerebrovascular reactivity (CVR) was evaluated and ICAS-induced parameter-lateralization was investigated.

Results: ATT-based and TTP-based iWSAs overlapped well, with excellent agreement in quantitative parameters and significant lateralization of hemodynamic parameters in ICAS within both iWSA delineation approaches.

Impact: We successfully segmented iWSA from non-invasive ATT and demonstrated sensitivity to ICAS-related impairments, in agreement with TTP-based iWSA segmentation. ATT-based iWSAs facilitate longitudinal investigation without contrast application in cerebrovascular diseases such as ICAS or Moyamoya.

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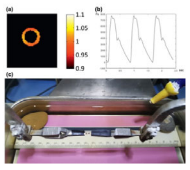

Identification of constitutive parameters of carotid atherosclerotic plaques by CINE MR imaging

Rui Shen[1], Xinyu Tong[1], Huiyu Qiao[1], Ran Huo[2], Tao Wang[3], Zuoguan Chen[4], Ning Xu[1], Jiachen Liu[1], Shuwan Yu[1], and Xihai Zhao[1]

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Keywords: Vessel Wall, Atherosclerosis, mechanical constitutive property, inverse problem

Motivation: Beyond structural features of carotid plaque and hemodynamic parameters, the hemodynamic and structural metrics were determined by image-based computer simulations and the constitutive characteristics of carotid plaques were ignored.

Goal(s): We aimed to propose a method for identification of carotid plaque constitutive parameters using CINE MR images.

Approach: A novel MRI-based method to identify constitutive parameters of carotid plaque compositions was proposed and the calculated values from the proposed method were compared with the reference and ex-vivo validation.

Results: We found that calculated values were consistent with the reference and experimental results. The constant D_2 could identify plaque compositions with different stiffness.

Impact: Our study proposed a novel MRI-based method for identifying constitutive parameters of carotid plaque compositions. The constant D2 could indicate different components of carotid plaques.

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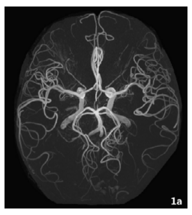

3D-TOF MRA at 5.0T MR:Visualization of Superior Cerebellar Artery

Ning Tian[1], Jie Gan[1], Dan Yu[2], Dong Zu Yin[1], Sen Xiang Jiang[1], and Lei Yu[1]

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Keywords: Blood Vessels, Blood vessels

Motivation: To improve non-invasive visualization of the superior cerebellar artery (SCA) for better clinical outcomes.

Goal(s): To assess the feasibility of using 3D-TOF MRA at 5.0 T MR for detailed imaging of the SCA.

Approach: Retrospective analysis of high-resolution 5.0T MR images from patients with suspected cerebrovascular diseases, focusing on the SCA's anatomical details.

Results: The study confirmed that 5.0T MRA provides accurate SCA imaging, consistent with anatomical and CTA results, crucial for diagnosing and managing related cerebrovascular conditions.

Impact: The study provides a new non-invasive benchmark for SCA imaging, potentially reducing iatrogenic risks in neurosurgery and informing the etiology of trigeminal neuralgia, paving the way for safer surgical practices and targeted treatments.

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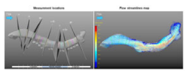

Different distribution patterns of blood flow velocity in venous stenosis segment in idiopathic intracranial hypertension using 7T 4D flow MRI

Xue Zhang[1,2], Xun Pei[1,2], Qingle Kong[3], Yuan Li[4], Dapeng Mo[5], and Binbin Sui[1]

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Keywords: Blood Vessels, Velocity & Flow

Motivation: The distribution pattern of blood flow velocity in venous sinus stenosis is worth exploring, and its screening value for venous stenting is unknown yet.

Goal(s): To explore velocity distribution pattern in idiopathic intracranial hypertension (IIH) patients with venous stenosis and its relationships with clinical characteristics.

Approach: Fifteen IIH patients with venous stenosis were scanned through 4D flow MRI with 7.0T scanner, and data was processed for the velocity distribution patterns.

Results: Steady, ascending, and descending distribution patterns were identified. TPG, CSF pressure and stenosis rate were significantly different among three patterns, with significantly higher value in ascending velocity group.

Impact: As a noninvasive imaging technique, 4D flow MRI may provide some support from a hemodynamic perspective for screening IIH patients who would benefit from venous manometry and venous stenting.

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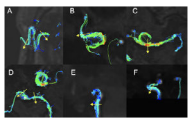

Cerebral Blood Flow Pulsatility Predicts the Cerebral Hyperperfusion Syndrome after direct revascularization surgery—A pilot study

Luo mingfang[1], Wang Yuting[1], Wang Zhenyu[2], Hu Xiao[2], Wang Yishuang[1], and He Bo[1]

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Keywords: Blood Vessels, Blood vessels, 4D flow, cerebral hyperperfusion syndrome

Motivation: Little is known about cerebral hemodynamics after bypass surgery in patients with chronic arterial stenosis (CAS) and its role in the development of cerebral hyperperfusion syndrome (CHS).

Goal(s): The purpose of this study was to explore the hemodynamic characteristics of patients with CAS and occlusion before and after surgery and its relationship with CHS.

Approach: We used 4D flow MRI sequence to obtain the hemodynamic characteristics of patients with CAS and occlusion before and after bypass surgery.

Results: Postoperative total cerebral blood flow increased and resistance index and pulsatility index decreased maybe a higher risk factor of CHS events in bypass surgery patients.

Impact: This study provides a new insight into the hemodynamic characteristics of patients with chronic arterial stenosis, and holds a promising marker for marker for identifying CHS patients.

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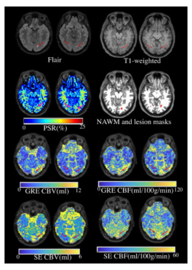

Investigating the relationship between multi-scale perfusion and myelin content in MS

Mohammadreza Soltany Sadrabadi[1], Lauren R. Ott[1], Aimee Borazanci[1], Richard Dortch[1], and Ashley M. Stokes[1]

[1]Barrow Neurological Institute, Phoenix, AZ, United States

Keywords: Multiple Sclerosis, Multiple Sclerosis

Motivation: This study investigates the complex pathology of multiple sclerosis (MS), focusing on the relationship between cerebral perfusion and myelin integrity.

Goal(s): Utilizing selective inversion recovery (SIR) to determine myelin content through the macromolecular (PSR), and a combined spin- and gradient-echo (SAGE) sequence to assess micro- and macrovascular perfusion,

Approach: This study aims to uncover the interplay of hemodynamic impairments and myelin repair in MS.

Results: In a cohort of individuals with RRMS and healthy controls, we found significant correlations between PSR and microvascular perfusion within lesions, suggesting a possible link between myelin integrity and cerebral blood flow.

Impact: Uncovering specific pathological changes in MS lesions may enhance diagnostic accuracy and disease monitoring. Such insights could also drive the creation of new therapies focused on remyelination and neuroprotection, potentially altering the treatment landscape for MS.

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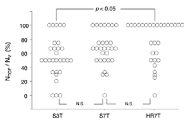

Depicting ability of 7 Tesla MRA for lenticulostriate arteries: practical assessment based on intraoperative video of aneurysm neck clipping

Wataru Yanagihara[1], Takahiro Koji[1], Yoshitaka Kubo[1], Yosuke Akamatsu[1], Makoto Sasaki[2], Tsukasa Wada[1], Shunrou Fujiwara[1], and Kuniaki Ogasawara[1]

[1]Department of Neurosurgery, Iwate Medical University School of Medicine, Shiwa, Japan, [2]Division of Ultrahigh Field MRI, Institute for Biomedical Sciences, Iwate Medical University School of Medicine, Shiwa, Japan

Keywords: Blood Vessels, Neuro

Motivation: To clear the depicting ability for the lenticulostriate arteries at 7 Tesla in patients with unruptured the middle cerebral artery aneurysm.

Goal(s): MRA at 7 Tesla can depict the lenticulostriate arteries more than that at 3 Tesla in assessment using the intraoperative video.

Approach: Comparison of accuracy of identification of LSAs at standard 3D TOF imaging at 3T, standard 3D TOF imaging at 7Tand high-resolution 3D TOF at 7T, using the findings of intraoperative video as the reference.

Results: LSAs were identified more accurately by HR7T 3D TOF than by S3T 3D TOF.

Impact: In patients with an unruptured MCA aneurysm, LSAs were identified more accurately by HR7T 3D TOF than by S3T 3D TOF; however, the ability to depict the vessels could depend on the resolution rather than the signal-to-noise ratio.

Member-Initiated Session

Abbreviated MRI: The Time Has Come, but How Do We Get There?

Room 325-326 Thursday 13:45 - 15:45

(no CME credit)

13:45 Applications & Challenges of Abbreviated MRI for Breast Imaging

Catherine Moran

Stanford University, Stanford, CA, United States

14:05 Applications & Challenges of Abbreviated MRI for Abdominal Imaging

Jeong Hee Yoon

Seoul National University Hospital, Seoul, Korea, Republic of

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14:25 Applications & Challenges of Abbreviated MRI for Pelvic Imaging

Kristina Ringe

Hannover Medical School, Hannover, Germany

14:45 Applications & Challenges of Abbreviated MRI for MSK Imaging
Xiaojuan Li
Case Western Reserve University, Cleveland, OH, United States

15:05 Applications & Challenges of Abbreviated MRI for Brain Imaging
Laura Eisenmenger
University of Wisconsin, Madison, WI, United States

15:25 Applications & Challenges of Abbreviated MRI for Spinal Imaging
Laura Eisenmenger
University of Wisconsin, Madison, WI, United States

Study Group Business Meeting
Hyperpolarized Agents & Applications Business Meeting

Room 303-304 — Thursday 14:45 - 15:45

(no CME credit)

Study Group Business Meeting
Pediatric MR Business Meeting

Room 324 — Thursday 14:45 - 15:45

(no CME credit)

Study Group Business Meeting
Renal MRI Business Meeting

Room 324 — Thursday 16:00 - 17:00

(no CME credit)

Weekday Course
MR Artifacts Game Show

Organizers: Diego Hernando, Janine Lupo

Summit 1 — Thursday 16:00 - 18:00 — *Moderators:* Rebecca Feldman & Gigi Galiana

16:00 MR Artifacts Game Show
Gigi Galiana[1]

[1]Yale University, United States

16:30 MR Artifacts Game Show
Michael Abram Ohliger[1]

[1]University of California, San Francisco, United States

17:00 MR Artifacts Game Show
Rebecca Feldman[1]

[1]University of British Columbia, Canada

Weekday Course
2016-2024: The Evolution of Ideas from Singapore 2016

Organizers: Akshay Chaudhari, Brian Hargreaves

Room 334-336 — Thursday 16:00 - 18:00 — *Moderators:* Akshay Chaudhari & James Pipe

16:00 Successes, Failures & Directions for Deep Learning & AI in MR Image Acquisition/Reconstruction
Jonathan Tamir[1]

[1]The University of Texas at Austin, United States

16:25 The MR Value Initiative: Progress since 2016

Yoshimi Anzai[1]

[1]*Radiology, University of Utah, Salt Lake City, UT, United States*

In this presentation, we will discuss the progress made on the MR Value initiative ignited in 2016, in part due to the increasing pressure to contain the costs of "expensive technology" such as MRI. The COVID-19 pandemic accelerated some of the progress in the last several years. In this presentation, we will discuss past progress, current challenges, and future directions.

16:50 Population Neuroimaging: An Awfully Big Adventure

Karla Miller[1]

[1]*University of Oxford, United Kingdom*

17:15 Quantitative MRI & Biomarkers: What Has Worked? What Has Not?

Vikas Gulani[1]

[1]*University of Michigan, United States*

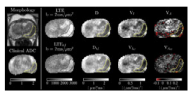
17:40 Discussion

Oral

Emerging Diffusion Methodologies in the Body

Hall 606 Thursday 16:00 - 18:00 *Moderators:* Jurgen Schneider & Kumi Ozaki

1355 16:00 High Fidelity Imaging of Tissue Heterogeneity, Micro-Anisotropy and Diffusion-Time Effects in Prostate Cancer



Malwina Molendowska[1,2], Maria Engel[2], Lars Müller[2,3], Samo Lasic[4,5], Derek K Jones[2], Chantal MW Tax[2,6], and Filip Szczepankiewicz[1]

[1]*Medical Radiation Physics, Lund University, Lund, Sweden,* [2]*Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom,* [3]*Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, United Kingdom,* [4]*Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Amager and Hvidovre, Copenhagen, Denmark,* [5]*Diagnostic Radiology, Clinical Sciences Lund, Lund University, Lund, Sweden,* [6]*Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands*

Keywords: Microstructure, Microstructure, Signal Representations, Prostate

Motivation: Clinical diffusion MRI for prostate cancer diagnosis has limited sensitivity and specificity to heterogenous microstructural changes.

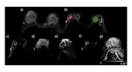
Goal(s): Quantify time-dependent diffusion and diffusional variance at a high spatial resolution in human prostate in vivo.

Approach: The diffusion encoding waveforms were tailored to probe micro-anisotropy and diffusion time effects at high b-values. Ultra-strong gradients and spiral readout enabled high-resolution and high image fidelity at a high SNR.

Results: Significant time-dependent diffusion was observed in all diffusion parameters in three volunteers, including prostate cancer patients.

Impact: The proposed methodology enables evaluation of microscopic anisotropy and time-dependent diffusion in the prostate and provides insights into how dMRI should be interpreted at low and high b-values. The produced diffusion parameters may serve as biomarker candidates in future studies.

1356 16:12 [Discrimination Between Malignant and Healthy Breast Tissue Using Restriction Spectrum Imaging and MultiBand in a Screening Population]



Stephane Loubrie[1], Nicole Howard[1], Summer Joyce Batasin[1], Sheida Ebrahimi[1], Hon J Yu[1], Joshua Kuperman[1], Tyler M Seibert[1,2,3], Arnaud Guidon[4], Haydee Ojeda-Fournier[1], and Rebecca Rakow-Penner[1,3]

[1]Radiology, UCSD, San Diego, CA, United States, [2]Radiation oncology, UCSD, San Diego, CA, United States, [3]Bioengineering, UCSD, San Diego, CA, United States, [4]Global MR Application and Workflow, GE Healthcare, Boston, MA, United States

Keywords: Breast, Breast, Diffusion, RSI

Motivation: Diffusion weighted imaging (DW-MRI) holds great potential in improving specificity of findings detected on contrast enhanced breast MRI. A breast-specific Restriction spectrum imaging (BS-RSI) has been developed and proved to be able to discriminate cancers from benign lesions and healthy breast tissue.

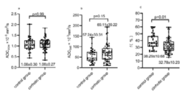
Goal(s): To evaluate BS-RSI's performance in differentiating malignant from healthy fibroglandular tissue in a breast cancer screening dataset (BCS).

Approach: We prospectively scanned 14 BCS patients with high-resolution multishell DWI added to standard BCS clinical protocol.

Results: The BS-RSI model was able to discriminate healthy tissue from cancers in all C-compartments.

Impact: Differences were observed between healthy tissue and malignant lesions in all C-compartments (p<0.01). ADC values were also significantly different in cancers than in healthy issue (p=0.044).

1357 16:24 [Intravoxel Incoherent Motion Diffusion-weighted imaging for evaluating the pancreatic perfusion in cirrhotic patients]



Ran Hu[1], Hua Yang[1], and Lisha Nie[2]

[1]Radiology, Chongqing Hospital of Traditional Chinese Medicine, Chongqing, China, [2]MR Research China, GE Healthcare, Beijing, China

Keywords: IVIM, Liver, liver cirrhosis, perfusion

Motivation: Pancreatic perfusion disturbances is found in cirrhotic patients with portal hypertension, which is correlated with reduced insulin secretion. Intravoxel incoherent motion (IVIM) can noninvasively reflect tissue microcapillary perfusion.

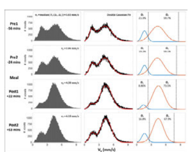
Goal(s): To assess the characteristics of pancreatic perfusion in normal pancreas vs. cirrhotic patients using IVIM.

Approach: 67 cirrhotic patients and 33 healthy subjects underwent IVIM on a 3.0 T MRI scanner.

Results: The f value of pancreas in cirrhotic was lower than that in normal group (p = 0.01). In cirrhotic group, the f value of pancreas decreased with the increase of the Child-Pugh classification (R = -0.49, p = 0.00).

Impact: IVIM-derived perfusion-related parameter (f value) could be helpful to evaluate pancreatic perfusion in liver cirrhosis. Pancreatic perfusion decreased is present in liver cirrhosis, and pancreatic perfusion tends to decrease with the increasing severity of hepatic function.

1358 16:36 [Prandial Effects on 2D (b-M1) Optimized Intravoxel Incoherent Motion Quantification in the Liver]



Gregory Simchick[1] and Diego Hernando[1,2]

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

Keywords: IVIM, Velocity & Flow, Liver, Perfusion, Quantitative Imaging

Motivation: Food ingestion is known to increase blood flow in the liver. However, detection of prandial effects using conventional quantitative intravoxel incoherent motion (IVIM) methods is confounded by large measurement variability of the perfusion-related IVIM parameters.

Goal(s): Detect prandial-induced changes in IVIM estimates in the liver.

Approach: 2D (*b*-value and first-order motion moment (M_1)) noise-optimized IVIM acquisitions were acquired pre- and postprandial. IVIM estimates were obtained using a recently proposed advanced fitting technique. Pre- vs postprandial IVIM estimates were compared.

Results: The optimized IVIM methods detected prandial-induced changes in the blood velocity standard deviation (mean relative change=9.4±7.8%; preprandial coefficient of variation=5.6%).

Impact: Quantitative IVIM is capable of detecting prandial-induced changes in blood perfusion in the liver. Liver IVIM data may need to be acquired in a fasting state, and evaluating prandial effects may provide insight into various diseases' pathophysiological changes.

1359 16:48

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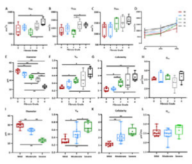


Time-Dependent Diffusion MRI for Quantitative Microstructural Mapping of Liver fibrosis to cirrhosis

Lijie Zhang[1], Xiaoming Liu[1], Xiaoxiao Zhang[2], Peng Sun[2], and Heshui Shi[1]

[1]Department of Radiology, Wuhan union hospital, Wuhan, China, [2]Clinical & Technical Support, Philips Healthcare, Wuhan, China

Keywords: Microstructure, Liver

Motivation: The potential of characterizing cellular tissue microstructures using recently developed time-dependent diffusion MRI has been examined.

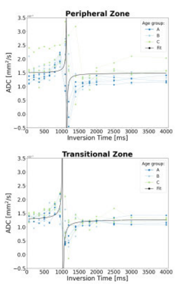
Goal(s): However, its value in imaging liver fibrosis to cirrhosis remains unknown.

Approach: In this study, we conducted a preclinical investigation using a dietondiethylnitrosamine (DEN)-induced rat liver fibrosis model with temporal diffusion spectroscopy (TDS) MRI

Results: Our findings revealed that the diameter, intracellular volume fraction (V_{in}), and cellularity were associated with varying degrees of liver fibrosis. Moreover, the diameter and V_{in} demonstrated better discrimination ability in the model. Overall, these prognostic indicators exhibit significant potential for clinical application.

Impact: This research highlighted the promising applications of temporal diffusion spectroscopy MRI in evaluating liver fibrosis. Our results indicated innovative noninvasive indicators for liver fibrosis, so as to early identify those who need to be referred to clinics for further assessment.

1360 17:00



Importance of Prostatic Fluid on the Apparent Diffusion Coefficient: An IR-Prepared Diffusion-Weighted Investigation of Healthy Prostates

Dominika Skwierawska [1], Sebastian Bickelhaupt[1], Maximilian Bachl[1], Rolf Janka[1], Martina Murr[1,2], Felix Gloger[1], Tristan Anselm Kuder[3,4], Dominique Hadler[1], Michael Uder[1], and Frederik Laun[1]

[1]Institute of Radiology, University Hospital Erlangen, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [2]Section for Biomedical Physics, Department of Radiation Oncology, University of Tübingen, Tübingen, Germany, [3]Division of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]Faculty of Physics and Astronomy, Heidelberg University, Heidelberg, Germany

Keywords: Diffusion Modeling, Quantitative Imaging, Signal Modeling, Inversion Recovery, Data Analysis, Contrast Mechanisms, Cancer

Motivation: The apparent diffusion coefficient (ADC) of prostate tissue is generally higher than that of prostate cancer. We hypothesized that the presence of prostatic fluid is partly responsible for the higher ADC.

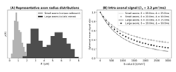
Goal(s): To elucidate the value of this hypothesis with diffusion-T_1-relaxation experiments.

Approach: Diffusion-weighted data of ten healthy participants' prostates were sampled with a range of IR times and fitted to a two-compartment model (tissue & fluid).

Results: The ADC(TI) dependency was characteristic of the two-compartment model. ADC(TI) increased with TI from 0 to roughly 1,200 ms, then flipped to smaller ADC values and then approached an asymptotic value at large TI.

Impact: This study contributes to a better understanding of prostate DWI contrast. The observed ADC(TI) dependence may be exploited for improved DWI-based prostate cancer diagnostics.

1361 17:12 [Two-axon population (TAP) modelling for large axon diffusion imaging in the peripheral nervous system]



Francesco Grussu[1,2], Ratthaporn Boonsuth[1], Marco Battiston[1], Claudia A. M. Gandini Wheeler-Kingshott[1,3,4], and Marios C. Yiannakas[1]

[1]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Queen Square Institute of Neurology, Faculty of Brain Sciences, University College London, London, United Kingdom, [2]Radiomics Group, Vall d'Hebron Institute of Oncology, Vall d'Hebron Barcelona Hospital Campus, Barcelona, Spain, [3]Department of Brain and Behavioural Sciences, University of Pavia, Pavia, Italy, [4]Digital Neuroscience Centre, IRCCS Mondino Foundation, Pavia, Italy

Keywords: Diffusion Modeling, Microstructure, Sciatic nerve, axon radius, Multiple Sclerosis

Motivation: The stick (zero-radius cylinder), a standard diffusion MRI model for the intra-axonal brain white matter signal, may not be suitable in the peripheral nervous system (PNS), due to co-existence of small and large axons.

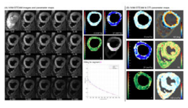
Goal(s): To test the feasibility of replacing the stick model with a two-axon population (TAP) approach, accounting for large axons, in the PNS.

Approach: We compared TAP versus standard stick modelling in simulations, and derived TAP metrics in the sciatic nerve *in vivo*.

Results: TAP enables more accurate parameter fitting than stick modelling, and is shown to be feasible *in vivo* in healthy controls and multiple sclerosis patients.

Impact: We propose two-axon population (TAP) diffusion-weighted MRI, a method tailored for imaging of the peripheral nervous system, characterised by co-existence of small and large axons. TAP may enable more accurate microstructural imaging than standard approaches, providing non-invasive markers of neurophysiology.

1362 17:24 [Intravoxel incoherent motion imaging with phase-cycled stimulated-echoes for simultaneous cardiac diffusion tensor and perfusion imaging]



Camila Munoz[1,2], Eunji Lim[1,2], Pedro F Ferreira[1,2], Dudley J Pennell[1,2], Sonia Nielles-Vallespin[1,2], and Andrew D Scott[1,2]

[1]National Heart and Lung Institute, Imperial College London, London, United Kingdom, [2]Royal Brompton and Harefield Hospitals, Guy's and St Thomas' NHS Foundation Trust, London, United Kingdom

Keywords: IVIM, Cardiovascular

Motivation: Intravoxel incoherent motion (IVIM) imaging can provide information about cardiac microstructure and microvascular perfusion from a single examination. Current spin-echo based approaches for cardiac IVIM suffer from low perfusion sensitivity.

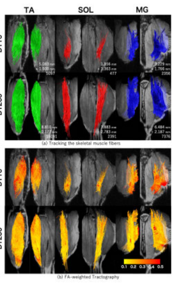
Goal(s): We implemented a stimulated-echo (STEAM)-based method for cardiac IVIM and diffusion tensor imaging to enable accurate cardiac diffusion and perfusion imaging in vivo in the human heart.

Approach: We introduced a novel IVIM-STEAM sequence incorporating phase cycling to obtain true b=0 s/mm^2 images.

Results: We tested the feasibility of our approach in 9 healthy subjects and obtained homogeneous perfusion and diffusion tensor maps, with values in the range described in the literature.

Impact: Phase-cycled IVIM-STEAM provides good quality images that enable reliable fitting of cardiac diffusion tensor and perfusion parameters in healthy subjects. This approach may identify areas of microstructural aberration and perfusion abnormalities in patients with cardiovascular disease without exogenous contrast agents.

1363 17:36 Effects of Diffusion Time-dependent Tractography Focused on Skeletal Muscles



Keiya Kandori[1], Junichi Hata[1,2], Hinako Oshiro[1,2], Natsumi Kubo[1], Daisuke Yoshimaru[2], and Hideyuki Okano[2]

[1]Tokyo Metropolitan University, Tokyo, Japan, [2]RIKEN Center for Brain Science, Saitama, Japan

Keywords: Tractography, Diffusion Tensor Imaging

Motivation: In the skeletal muscles, the effects of varying diffusion times have rarely been investigated, and to what extent they are affected is unclear.

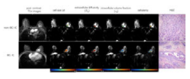
Goal(s): This study aimed to determine the effect of diffusion time on skeletal muscle delineation and anisotropy.

Approach: Tensor analysis and tractography measurements were performed on the hind legs of mice to investigate the relationship between diffusion time and myofiber delineation and anisotropy in skeletal muscles.

Results: Longer diffusion times allowed us to assess diffusion movements within muscle fibers and capture the precise organization of the skeletal muscles.

Impact: The effect of varying diffusion times on skeletal muscle myofibers was clarified. The results suggested that this method could be applied to human skeletal muscles for the examination of intramuscular tissues.

1364 17:48 Time-dependent diffusion MRI-based microstructural mapping for preoperative prediction of intraductal component in invasive breast cancer



Hao Xu[1], Heping Deng[1], Jieke Liu[1], Meining Chen[2], Thorsten Feiweier[3], and Peng Zhou[1]

[1]Department of Radiology, Sichuan Clinical Research Center for Cancer, Sichuan Cancer Hospital & Institute, Sichuan Cancer Center, Chengdu, China, [2]MR Research Collaboration, Siemens Healthineers Ltd, Chengdu, China, [3]Siemens Healthineers AG, Erlangen, Germany

Keywords: Microstructure, Quantitative Imaging

Motivation: Conventional MRI falls short in detecting specific imaging markers for an intraductal component(ductal carcinoma in situ) in invasive breast cancer (IBC-IC), thus affecting breast-conserving surgery. Advanced MRI techniques can help in preoperative evaluations.

Goal(s): We evaluated the efficacy of td-dMRI for preoperatively identifying IBC-IC for surgical planning.

Approach: We used td-dMRI to examine microstructural mapping in IBC patients by IMPULSED model, focusing on the parameters D_{ex}, d, and v_{in} to differentiate IBC-IC from IBC.

Results: We revealed that elevated d and D_{ex} and reduced v_{in} are distinct microstructural markers of IBC-IC, which might facilitate surgical planning for IBC-IC patients.

Impact: Parameters derived from td-dMRI have the potential to act as imaging biomarkers for distinguishing IBC-IC, thereby enhancing the precision of breast-conserving surgery planning.

Oral

AI-Driven Robustness: Noise, Artifacts & More

Nicoll 1 Thursday 16:00 - 18:00 *Moderators:* Xiaobo Qu & Jennifer Steeden

16:00 Introduction

Xiaobo Qu

Xiamen University, Xiamen, China

1365 16:12

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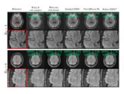
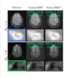



Simultaneous self-supervised reconstruction and denoising for low SNR, sub-sampled training data with Robust SSDU

Charles Millard[1] and Mark Chiew[1,2,3]

[1]Wellcome Centre for Integrative Neuroimaging, University of Oxford, Oxford, United Kingdom, [2]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada

Keywords: Image Reconstruction, Image Reconstruction, Deep learning, Self-supervised

Motivation: For low SNR training data, such as from low-field scanners, sub-sampled images reconstructed via deep learning can be susceptible to errors due to measurement noise.

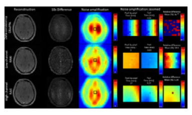
Goal(s): To evaluate the performance of the proposed Robust Self-Supervised Learning via Data Undersampling (Robust SSDU), which removes corruptions due to aliasing and measurement noise in an entirely self-supervised manner.

Approach: On the fastMRI dataset and low-field dataset M4Raw, Robust SSDU was compared with a number of benchmarks including supervised training.

Results: Robust SSDU exhibited a substantially higher fidelity image restoration than standard SSDU and sharper reconstructions than competing methods that remove measurement noise.

Impact: This study demonstrates that high quality image reconstruction with deep learning is achievable when only sub-sampled, low SNR data is available for training. The proposed method could particularly impact the diagnostic potential of images acquired from low field scanners.

1366 16:24



Explicit network noise amplification penalty in loss function for k-space interpolation networks through fast backpropagation

Istvan Homolya[1], Peter Dawood[2], Jannik Stebani[3], and Martin Blaimer[3]

[1]Molecular and Cellular Imaging, Comprehensive Heart Failure Center, University Hospital Würzburg, Würzburg, Germany, [2]Department of Physics, University of Würzburg, Würzburg, Germany, [3]Magnetic Resonance and X-ray Imaging Department, Fraunhofer Institute for Integrated Circuits IIS, Division Development Center X-Ray Technology, Würzburg, Germany

Keywords: Image Reconstruction, Machine Learning/Artificial Intelligence

Motivation: GRAPPA and RAKI optimize purely for data consistency, completely lacking physics-driven or model-based loss terms.

Goal(s): Recurrently feed noise amplification information into k-space interpolation networks by penalizing the online computed g-factor.

Approach: JAX-implemented GRAPPA and RAKI g-factors were estimated online in each training iteration and incorporated into the optimization as an inherent network noise amplification penalty.

Results: Networks including g-factor loss outperformed implementations optimizing only for the data consistency term. Inclusion of g-factor loss terms manifested Tikhonov regularization-like effects on image noise distribution, as revealed by difference maps to the fully sampled gold standard.

Impact: Incorporating the penalty of inherent noise amplification into k-space interpolation networks reduces reconstruction noise levels compared to implementation that optimize only for data consistency. G-factor-informed reconstructions manifest Tikhonov regularization-like effects, as revealed by noise distribution on difference maps.

1367 16:36

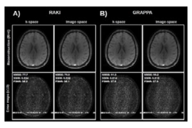


Image space formalism of k-space interpolation networks for analytical expression of noise characteristics

Peter Dawood[1], Felix Breuer[2], István Homolya[3], Peter Michael Jakob[1], and Martin Blaimer[2]

[1]Experimental Physics 5, University of Würzburg, Würzburg, Germany, [2]Magnetic Resonance and X-ray Imaging Department, Fraunhofer Institute for Integrated Circuits IIS, Division Development Center X-Ray Technology, Würzburg, Germany, [3]Molecular and Cellular Imaging, Comprehensive Heart Failure Center, University Hospital Würzburg, Würzburg, Germany

Keywords: Machine Learning/Artificial Intelligence, Parallel Imaging, complex-valued convolutional neural networks, RAKI, GRAPPA, ReLU

Motivation: Robust Artificial Neural Networks for k-space Interpolation (RAKI) exhibit superior image reconstructions compared to traditional Parallel Imaging. It is crucial to thoroughly characterize RAKI to gain insights into its functionality and stimulate further enhancements.

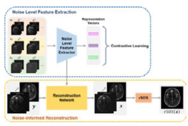
Goal(s): Exploring how k-space interpolation with convolutional neural networks can be transformed into image domain to obtain an analytical description of noise characteristics.

Approach: The nonlinear activation in k-space is expressed as elementwise multiplication. This can be transformed into convolution in image space.

Results: The proposed image space formalism yields image reconstructions quasi-equivalent to k-space interpolation. The analytical expression of noise characteristics is in correspondence with Monte Carlo simulations.

Impact: We propose an image space formalism for k-space interpolation with convolutional neural networks. This enables an analytical expression of the noise characteristics, analogous to g-factor maps in traditional parallel imaging methods.

1368 16:48



Noise-Robust Reconstruction for Accelerated MRI using Contrastive Learning

Seonghyuk Kim[1], Sung-Hong Park[1], and HyunWook Park[1]

[1]KAIST, Daejeon, Korea, Republic of

Keywords: Image Reconstruction, Image Reconstruction, Noise-robust method

Motivation: Deep learning-based accelerated MRI reconstruction methods have shown outstanding performance but do not consider noise. Corruption due to noise may lead to wrong diagnosis in clinical practices.

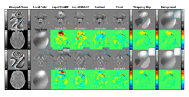
Goal(s): Propose a noise-robust reconstruction method, which reconstructs noise-free full-sampled images from noisy undersampled data.

Approach: A noise-robust reconstruction method is proposed using contrastive learning framework consisting of two stages. The first stage extracts feature representations related to the noise level, which is used in the second stage to reconstruct alias-free image.

Results: Experiment results show that the proposed method provides robust reconstruction with limited training data, yielding superior image reconstruction compared to other reconstruction methods.

Impact: The encoder trained in the first stage extracts representation features that contain content-invariant noise level information. Therefore, the trained encoder can be applied to other downstream tasks with limited amount of training data.

1369 17:00



[A Positive and Negative Learning based Image Decomposition Network for Phase Unwrapping and Background Removal]

Lijun Bao[1] and Zijun Zhao[1]

[1]Department of Electronic Science, Xiamen University, Xiamen, China

Keywords: Quantitative Imaging, Quantitative Imaging, phase processing, background removal, deep learning, image decomposition, phase unwrapping

Motivation: Phase images contain important information useful in many fields. However, the phase data is often wrapped into a specific range, while background or noise signal in imaging scene may bring significant interference.

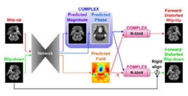
Goal(s): To obtain the exact information, phase images need an accurate processing that includes the unwrapping and the background removal.

Approach: In this paper, we propose a positive and negative learning based image decomposition network (PNnet) to accomplish the phase processing by a single network.

Results: Experimental results demonstrate that PNnet can achieve excellent performance and efficient generalization, even for complex wrapping and inhomogeneous background.

Impact: Except magnitude images, phase data in MRI also contain important information that is useful in many fields and scenarios. This work proposed a SOTA method for phase processing with high accuracy and excellent performance.

1370 17:12



[A Phase-Injected Complex Forward-Distortion Approach for Deep Unsupervised Correction of Susceptibility Artifacts in EPI]

Abdallah Zaid Alkilani[1,2], Tolga Çukur[1,2,3], and Emine Ulku Saritas[1,2]

[1]Department of Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey, [2]National Magnetic Resonance Research Center (UMRAM), Bilkent University, Ankara, Turkey, [3]Neuroscience Graduate Program, Bilkent University, Ankara, Turkey

Keywords: Artifacts, Artifacts, susceptibility artifacts, echo planar imaging, reversed phase-encoding, deep learning, unsupervised learning

Motivation: Classical susceptibility-artifact correction methods are impractical in clinical settings given their computational burden.

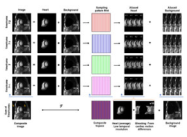
Goal(s): Fast and effective correction of susceptibility artifacts in EPI via physics-driven unsupervised deep learning by utilizing phase-injected complex-valued forward-distortion.

Approach: Previous methods apply distortion correction on magnitude images, potentially yielding suboptimal performance near regions of signal dropout/pileup. We propose a novel model, compFD-Net, employing phase-injected complex forward-distortion that leverages a predicted phase image, additionally to the magnitude image and displacement field estimates, for improved capture of signal dropout/pileup artifacts in EPI images.

Results: The proposed model boosts susceptibility-artifact correction performance, notably improving predicted image and field quality.

Impact: Robust emulation of signal-dropout/pileup via the complex forward-distortion formulation boosts reliability in unsupervised artifact correction. compFD-Net facilitates rapid and performant correction of susceptibility artifacts in EPI, with possible impact in time-sensitive applications in clinical settings.

1371 17:24



Revisiting outer volume subtraction with deep-learning tools for highly-accelerated real-time cine CMR

Merve Gulle[1], Peter Kellman[2], and Mehmet Akcakaya[3]

[1]University of Minnesota, Saint Paul, MN, United States, [2]National Heart-Lung and Blood Institute, Bethesda, MD, United States, [3]University of Minnesota, Minneapolis, MN, United States

Keywords: Image Reconstruction, Cardiovascular, real-time, cardiac cine, heart, outer volume subtraction

Motivation: Real-time cine CMR provides a free-breathing ECG-free approach for heart function assessment. Nevertheless, commercially available real-time cine CMR methods without temporal regularization have limited acceleration and spatio-temporal resolutions.

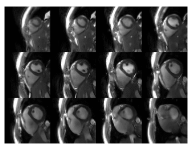
Goal(s): Use deep learning (DL) to remove extra-cardiac volume that aliases into the heart and improve acceleration rates for real-time cine CMR using only spatial regularization.

Approach: We characterize pseudo-periodic ghosting artifacts arising from cardiac motion in time-interleaved sequences, then use DL to detect and remove them. This is followed by self-supervised physics-driven DL reconstruction.

Results: Proposed technique effectively estimates and removes background signal, leading to substantial image quality improvement.

Impact: We characterize and use deep learning (DL) to estimate pseudo-periodic ghosting artifacts arising from cardiac motion in time-interleaved real-time cine sequences. Background removal followed by physics-driven DL reconstruction substantially improves reconstruction at nominal R=8 for higher spatio-temporal resolution acquisitions.

1372 17:36



3D Free-Breathing Ungated Spiral bSSFP Functional Cardiac Imaging Using a Deep Image Prior

Jesse Ian Hamilton[1,2], Gastao Lima da Cruz[1], and Nicole Seiberlich[1,2]

[1]Radiology, University of Michigan, Ann Arbor, MI, United States, [2]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

Keywords: Machine Learning/Artificial Intelligence, Cardiovascular, deep learning; spiral; real-time CMR

Motivation: Real-time imaging methods are useful for patients with limited breathhold capacity or arrhythmias, but are typically limited to 2D scans that prevent evaluation of wall motion in 3D over the heart.

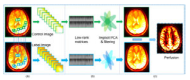
Goal(s): The goal of this project is to develop a technique for **3D real-time (free-breathing ungated)** cine imaging.

Approach: The proposed method combines a highly undersampled 3D stack-of-spirals trajectory with a deep image prior reconstruction, which does not require ground truth training data.

Results: Real-time 3D imaging is demonstrated in healthy subjects with temporal resolutions of 36ms per volume at 1.5T and 58ms per volume at 0.55T.

Impact: Real-time 3D imaging could enable streamlined cardiac MRI exams, with whole-heart 3D cine images obtained in 10s without breathholds or gating. This technique may also simplify quantification compared to 2D real-time methods, since motion is synchronized over all partitions.

1373 17:48 [Locally Adaptive Low Rank Regularization with Collaborative Data Selection for Arterial Spin Labeling MRI Denoising]



Hangfan Liu[1], Bo Li[1], Yiran Li[1], John A Detre[2], and Ze Wang[1]

[1]University of Maryland School of Medicine, Baltimore, MD, United States, [2]Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States

Keywords: Sparse & Low-Rank Models, Arterial spin labelling, Denoising, MRI

Motivation: Address the challenge of low SNR in arterial spin labeling (ASL) MRI that hinders its clinical and research potential.

Goal(s): Develop an advanced ASL denoising algorithm that enhances image quality and overcomes limitations in ASL due to low SNR.

Approach: Propose a Locally Adaptive low rank regularization with Collaborative data Selection (LACS) scheme that utilizes the structural characteristics of ASL images for collaborative data selection to improve low-rank modeling. The proposed low-rank regularization fundamentally performs locally adaptive PCA without explicit training.

Results: Using a single ASL image pair, LACS significantly outperformed state-of-the-art MRI denoising methods and the standard pipeline.

Impact: The proposed scheme has the potential to benefit researchers, clinicians, and patients by setting a new benchmark for ASL MRI denoising. It opens doors to exploring ASL's full clinical potential and offers opportunities for innovative research.

Oral

Imaging Blood Vessels in the Brain

Nicoll 2 | Thursday 16:00 - 18:00 | *Moderators:* Lirong Yan & Zihao Zhang

1374 16:00 [Using water beads as static tissue in a Circle of Willis flow phantom in 4D flow MRI]

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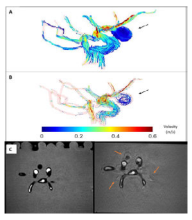


Ali El Ahmar[1], Patrick Winter[1,2], Stephan König[1], Adrian Duckert[1], Marie-Luise Kromrey[3], and Susanne Schnell[1,2]

[1]Department of Medical Physics, University of Greifswald, Greifswald, Germany, [2]Department of Radiology, Northwestern University Feinberg School of Medicine, Chicago, IL, United States, [3]Institute of Diagnostic Radiology and Neuroradiology, University Medicine Greifswald, Greifswald, Germany

Keywords: Blood Vessels, Blood vessels

Motivation: While previous research has focused on realistic vessel and flow replication, the background tissue mimicking in 4D flow MRI remains unexplored despite its significant impact on phase correction accuracy.

Goal(s): Aims to identify a suitable material for a Circle of Willis flow phantom that can mimic background static tissue, ensure transparency, and constrain vessel motion.

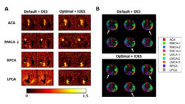
Approach: Transparent water beads soaked in a Gd-doped solution were used as background static tissue in a flow phantom. A MATLAB tool was used for the post-processing of the 4D-flow data.

Results: Water beads effectively minimized motion artifacts, and increased the number of time-averaged streamlines and their quality.

Impact: This study introduces a practical solution, to enhance the accuracy of in-vitro 4D Flow MRI of complex vessel phantoms by mitigating motion artifacts. The transparent water beads offer a cost-effective and easily exchangeable alternative for mimicking background static tissue.

1375 16:12

MERIT AWARD MAGNA CUM LAUDE



Achieving Robust Labeling Above the Circle of Willis with Vessel-Encoded Arterial Spin Labeling

Hongwei Li[1], Yang Ji[2], He Wang[1,3], Zhensen Chen[1,3], Yuriko Suzuki[2], and Thomas W. Okell[2]

[1]Institute of Science and Technology for Brain-inspired Intelligence, Fudan University, Shanghai, China, [2]University of Oxford, Wellcome Centre for Integrative Neuroimaging, FMRIB Division, Nuffield Department of Clinical Neurosciences, Oxford, United Kingdom, [3]Key Laboratory of Computational Neuroscience and Brain-Inspired Intelligence (Fudan University), Ministry of Education, Shanghai, China

Keywords: Blood Vessels, Perfusion, ASL

Motivation: The ability to distinguish arterial blood supply above CoW is crucial in the study of collateral circulation, but it is challenging due to the complex positioning of arteries around the CoW.

Goal(s): To achieve a robust vascular territories separation above CoW.

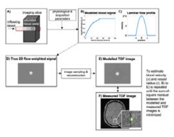
Approach: We propose improvements to the original OES method, optimizing its SNR efficiency while minimizing high spatial frequencies to avoid mislabeling. We have also selected a set of PCASL parameters that facilitate thin-slice labeling and ensure high labeling efficiency to overcome issues related to vascular tortuosity.

Results: Combining optimized parameters and improved OES, the vascular territories separation has significantly improved.

Impact: Our study optimized the fully automatic encoding pattern design above the circle of Willis, and achieved a robust vascular territories separation, combining with optimized PCASL parameters.

1376 16:24

MERIT AWARD SUMMA CUM LAUDE



A quantitative 2D time-of-flight (qTOF) MR angiography technique for measuring single-vessel blood flow and diameter

Yuhan Ma[1], Jacob D. Horne[2], and Avery J. L. Berman[1,3]

[1]Department of Physics, Carleton University, Ottawa, ON, Canada, [2]Department of Mechanical & Aerospace Engineering, Carleton University, Ottawa, ON, Canada, [3]University of Ottawa Institute of Mental Health Research, Royal Ottawa Mental Health Centre, Ottawa, ON, Canada

Keywords: Blood Vessels, Blood vessels, Velocity & flow; Vessel size

Motivation: To address the gap in MRI techniques for assessing cerebral small vessels with slow flow non-invasively.

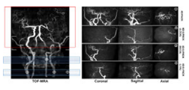
Goal(s): To develop a quantitative 2D time-of-flight (qTOF) technique for measuring blood velocity and the size of cerebral small vessels.

Approach: We developed an analytic qTOF framework to generate realistic TOF model images, which are optimized to match the acquired TOF images for extracting blood velocity and vessel size.

Results: The proposed qTOF framework was validated in simulation and phantom studies, and demonstrated *in vivo*. Incorporating a second acquisition improved blood velocity and vessel size estimation. Flow velocities were comparable to those measured by phase-contrast MRI.

Impact: A quantitative Time-of-Flight technique was developed to provide insights into blood flow and the size of cerebral small vessels, and dynamically in response to changing brain activity, helping to elucidate the role of cerebral small vessels in healthy brain function.

1377 16:36



The value of non- and super-selective 4D-MRA in the assessment of internal carotid artery occlusion: comparison with TOR-MRA and CE-MRA

Jin Zhang[1], Beibei Sun[2], Peng Wu[3], Yongjun Cheng[3], Weibo Chen[3], and Huilin Zhao[2]

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Keywords: Vessel Wall, Vessels

Motivation: 4D-MR angiography techniques have been developed to visualize both luminal stenosis and collateral circulation.

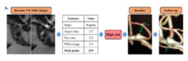
Goal(s): This study aimed to assess whether 4D-MRA (4D-PACK and 4D-S-PACK) can be used as a noninvasive alternative to intraarterial DSA in internal carotid artery occlusion (ICAO).

Approach: We prospective enrolled patients diagnosed as internal carotid artery occlusion by ultrasound or CTA and scheduled for intra-arterial DSA for this study. All patients underwent carotid multi-contrast MR imaging and DSA.

Results: 4D-PACK and 4D-S-PACK can be used to diagnose ICAO, type of Circle of Willis (CoW), collateral circulation via CoW and blood flow direction of cerebral arteries.

Impact: We offered a noninvasive alternative to intraarterial DSA to diagnose ICAO, type of CoW, collateral circulation via CoW and blood flow direction. By using three durations, we could greatly reduce time cost while ensuring the accuracy of 4D-PACK and 4D-S-PACK.

1378 16:48



Intracranial aneurysm wall enhancement predicts aneurysm growth and rupture: a large-scale multi-center longitudinal study

Chengcheng Zhu[1], Qingyuan Liu[2], Mahmud Mossa-basha[1], Michael Levitt[3], and Shuo Wang[2]

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Keywords: Vessel Wall, Stroke, Aneurysm, vessel wall MRI

Motivation: Unruptured intracranial aneurysm (UIA) with wall enhancement identified on vessel wall MRI was considered at high risk of rupture and growth. But previous longitudinal studies were limited by small sample size (n<130).

Goal(s): To evaluate whether wall enhancement can predict UIA growth or rupture in a large-scale multi-center longitudinal study.

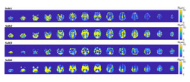
Approach: 709 UIA patients were followed by 2 years. Growth or rupture was recorded as primary outcome.

Results: Size ratio, aspect ratio, irregular shape and wall enhancement index were identified as factors of UIA instability. The final model has an AUC of 0.89, which was superior to traditional risk models (AUC 0.67-0.70, p<0.001).

Impact: To our best knowledge, this is the largest longitudinal study using vessel wall MRI to predict the natural risk of UIA rupture and growth. The model can potentially help select small but high-risk UIAs for early intervention.

1379 17:00

Venous vessel size imaging derived from a breath-hold task



Ke Zhang[1], Artur Hahn[2], Simon M. F. Triphan[1], Mark O. Wielpütz[1], Christian H. Ziener[3], Mark E. Ladd[4], Heinz-Peter Schlemmer[3], Hans-Ulrich Kauczor[1], Oliver Sedlaczek[1,3], and Felix T. Kurz[3]

[1]Department of Diagnostic and Interventional Radiology, Heidelberg University Hospital, Heidelberg, Germany, [2]Heidelberg University, Heidelberg, Germany, [3]Divison of Radiology, German Cancer Research Center, Heidelberg, Germany, [4]Divison of Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany

Keywords: Blood Vessels, Blood vessels

Motivation: Vessel size imaging, which provides a measure for the vessel radius, is usually performed by injection of contrast agent. Venous vessel radius imaging is also possible by exploiting hypercapnia and hyperoxia. However, these respiratory challenges need external devices such as special masks and monitors.

Goal(s): The question would be if we could measure vessel size wihtout contrast agent in a simple setup.

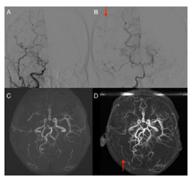
Approach: In this study, we employ a breath-hold task that doesn't need external devices to mimic hypercapnia for the measurement of venous vessel size.

Results: Mean venous vessel radii in GM and WM are 11.5±3 and 8.3±2 μm from initial tests.

Impact: Mean venous vessel radii during hypercapnia were 7.3±0.3 μm in GM and 6.6±0.5 μm in WM, respectively, from a previous study. Our results are close to these parameters. This study presents the feasibility of VSI using a breath-hold task.

1380 17:12

Superior Visualization of Moyamoya Disease Collaterals: A Comparative Analysis of 5.0T vs. 3.0T Time-of-Flight Magnetic Resonance Angiography



Yijun Zhou[1], Yuanren Zhai[2,3,4,5], YuXin Yang[6], Shuo Chen[7], Ke Xue[6], Dong Wang[7], Mingli Li[1], Jun Ni[8], Dong Zhang[2,3,4,5], Yining Wang[1], and Feng Feng[1]

[1]Department of Radiology, State Key Laboratory of Complex Severe and Rare Diseases, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China, [2]Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing, China, [3]China National Clinical Research Center for Neurological Diseases, Beijing, China, [4]Department of Neurosurgery, Beijing Hospital, National Center of Gerontology, Beijing, China, [5]Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, Beijing, China, [6]MR Collaboration, United Imaging Research Institute of Intelligent Imaging, Beijing, China, [7]United Imaging Research Institute of Intelligent Imaging, Beijing, China, [8]Department of Neurology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

Keywords: Blood Vessels, Blood vessels, 5.0-T magnetic resonance angiography

Motivation: Limited studies have scrutinized the capability of MRI in evaluating collateral circulation in Moyamoya Disease (MMD), with 3.0T TOF MRA often lacking the necessary precision.

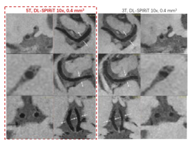
Goal(s): To systematically compare the effectiveness of 5.0T and 3.0T TOF MRA in depicting the complex vascular networks in MMD patients.

Approach: A retrospective study on 21 MMD patients was performed using both 5.0T and 3.0T MRI systems, focusing on the visibility of moyamoya vessels, leptomeningeal anastomoses, and basal ganglia signal intensity.

Results: The study found that 5.0T MRA significantly outperforms 3.0T in visualizing the fine details of MMD's vascular architecture.

Impact: The introduction of 5.0T MRA into clinical practice could revolutionize the imaging landscape for Moyamoya Disease, offering superior diagnostic clarity and aiding in the precise evaluation of cerebrovascular collateral networks, which is critical for surgical planning and patient prognosis.

1381 17:24



Accelerating whole brain vessel wall imaging of isotropic 0.4 mm3 on 5T by 10-fold using deep learning reconstruction

Sen Jia[1], Jiaying Zhao[2,3], Lei Zhang[1], Jing Cheng[1], Zhuoxu Cui[2], Ye Li[1], Xin Liu[1], Hairong Zheng[1], and Dong Liang[1,2]

[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institute of Advanced Technology, Shenzhen, China, [2]Research Center for Medical AI, Shenzhen Institute of Advanced Technology, Shenzhen, China, [3]University of Chinese Academy of Sciences, Beijing, China

Keywords: Vessel Wall, Atherosclerosis

Motivation: Whole brain vessel wall imaging (VWI) of isotropic 0.4 mm^3 on 3T can’t utilize higher than 5-fold acceleration to reduce the scan time due to insufficient signal-to-noise.

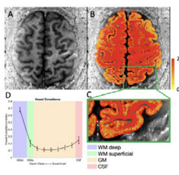
Goal(s): To achieve 10-fold accelerated whole brain VWI of isotropic 0.4 mm^3 on the 5T scanner with a 48-channel transmit receive head coil.

Approach: Deep learning (DL) reconstruction equipped with 3D convolution neural network was developed to alleviate the nonuniform noise amplified by SPIRiT reconstruction and the B1 inhomogeneity of 5T scanner.

Results: The proposed DL SPIRiT reconstruction achieves 10-fold accelerated intracranial VWI scan on 5T in 6 minutes and give better VWI quality than 3T.

Impact: This work develops a 10-fold accelerated whole brain vessel wall imaging of isotropic 0.4 mm^3 in 6 minutes using deep learning (DL) unrolled SPIRiT reconstruction on the 5T scanner equipped with a 48-channel transmit receive head coil.

1382 17:36



Assessing Cerebral Microvascular Compliance with High-Resolution VASO MRI at 7T

Fanhua Guo[1], Chenyang Zhao[1], Qinyang Shou[1], Xingfeng Shao[1], and Danny JJ Wang[1]

[1]University of Southern California, Los Angeles, CA, United States

Keywords: Vascular, Cardiovascular, vessel compliance, white matter, laminar, deep white matter

Motivation: Compliance of the cerebral microvasculature is critical for brain hemodynamics but remains challenging to measure due to the complex cerebral vascular architecture and limitations in imaging technology.

Goal(s): This study aims to utilize high-resolution VASO MRI across cardiac cycles to quantify microvascular compliance at 7T.

Approach: Vascular compliance (VC) was defined as the ratio of CBV changes to changes in blood pressure across a cardiac cycle, which was proportional to the change in rCBV.

Results: The middle layer of grey matter exhibits lower VC than superficial and deep layers. While higher VC was observed in the white matter (WM), especially deep WM.

Impact: The proposed high-resolution VASO MRI offers a promising noninvasive method for estimating cerebral microvascular compliance.

1383 17:48

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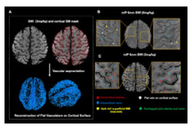


In vivo mapping of the intra-cortical vasculature and layer-specific changes in $\Delta\chi$ and $\Delta R2^*$ of human cerebral cortex using USPIO-MRI at 7T

Chenyang Li[1,2,3], Yongsheng Chen[4], Sagar Buch[4], Zhe Sun[1,2,3], Li Jiang[1,2], Marco Muccio[1,2], E. Mark Haacke[4,5], and Yulin Ge[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [3]Vilcek Institute of Graduate Biomedical Sciences, New York University Grossman School of Medicine, New York, NY, United States, [4]Department of Neurology, Wayne State University School of Medicine, Detroit, MI, United States, [5]Department of Radiology, Wayne State University School of Medicine, Detroit, MI, United States

Keywords: Blood Vessels, Blood vessels

Motivation: In vivo imaging of intra-cortical vessels of human brain, including penetrating arteries, veins and capillary density are still scarce.

Goal(s): To reconstruct the in vivo intra-cortical vessels of the human brain and estimate the cortical layer-specific changes in susceptibility (χ) in the presence of superparamagnetic iron oxides.

Approach: With aid of Ferumoxytol at 7T, high resolution gradient echo imaging was implemented to reconstruct pre-/post-SWI, R2* and χ maps.

Results: Intra-cortical penetrating arteries and veins can be differentiated by pre- and post-contrast SWI. Changes in R2* and χ revealed variations reflective of capillary density across different layers, which is in agreement with histological findings.

Impact: This study provides in vivo imaging characterization of intra-cortical vessels of human brain using high-resolution Ferumoxytol-enhanced SWI at 7T. Utilizing changes in R2* and χ enables us delve deeper into the laminar distribution of capillary density across various cortical layers.

Oral

The Damaged Heart: Too Thick, Inflamed or Infiltrated

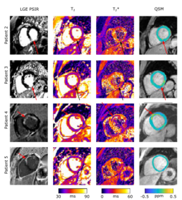
Room 331-332 | Thursday 16:00 - 18:00 | *Moderators:* Masaki Ishida & Tevfik Ismail

16:00 Introduction

Christopher François

Mayo Clinic, MN, United States

1384 16:12



Cardiac QSM for the Detection of Intra-Myocardial Haemorrhage: an Initial Experience

Andrew Tyler[1], Matthew Li Kam Wa[1], Anmol Kaushal[1], Filippo Bosio[1], Pier Giorgio Masci[1], and Sébastien Roujol[1]

[1]Biomedical Engineering and Imaging Science, King's College London, London, United Kingdom

Keywords: Myocardium, Susceptibility

Motivation: T_2*-contrast is not-specific to iron in the heart, with edema having a competing and contradictory effect to iron. Quantitative susceptibility mapping (QSM) may improve identification of intra-myocardial haemorrhage (IMH), through greater specificity to iron.

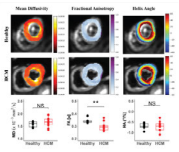
Goal(s): To present our initial experience of using QSM for the assessment of IMH.

Approach: 10 patients were scanned with QSM, 5 without myocardial infarcts to perform AHA-segmental analysis and 5 with scar to demonstrate the identification of IMH with QSM.

Results: The mean AHA-segment susceptibility was 0.00±0.02ppm and precision 0.05±0.03ppm in the non-infarct-group. Four of the patients with scar had IMH, which was successfully identified with QSM.

Impact: Cardiac quantitative susceptibility mapping successfully visualized intra-myocardial haemorrhage in four patients, and found no haemorrhage in one further patient, in agreement with the gold standard T_2/T_2* techniques.

1385 16:24



Assessing the microstructural integrity of the myocardium in hypertrophic cardiomyopathy using diffusion tensor imaging and strain analysis.

Oumaima Laghzali[1,2,3], Shi Chen[1], Danielle Kara[1], Thomas Garrett[1], Min-Chi Ku[1,2,3], and Christopher Nguyen [1,4,5]

[1]Cardiovascular Innovation Research Center, Heart Vascular Thoracic Institute, Cleveland Clinic, Cleveland, OH, United States, [2]DZHK (German Centre for Cardiovascular Research), partner site Berlin, Berlin, Germany, [3]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [4]Imaging Institute, Cleveland Clinic, Cleveland, OH, United States, [5]Department of Biomedical Engineering, Case Western Reserve University & Cleveland Clinic, Cleveland, OH, United States

Keywords: Myocardium, Cardiomyopathy, microstructure, diffusion, strain.

Motivation: Although functional integrity is preserved in most hypertrophic cardiomyopathy (HCM) patients, the microstructure is continuously and silently changing.

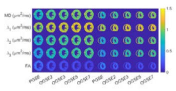
Goal(s): To better comprehend the myocardial response, we need to characterize diffusion changes between healthy and disease state.

Approach: We quantitatively investigate the relationship between myocardial strain and diffusion tensor imaging (DTI)-derived metrics in HCM. We assessed diffusion and strain in HCM and healthy patients using a new investigational MR system with ultra-high-performance gradients.

Results: HCM subjects exhibited lower anisotropy values that correlated with strain analysis indicative of early microstructural disarray.

Impact: Our results highlight the contribution of microstructural anisotropy in HCM development. Even in the absence of detectable mechanical deficiencies, diffusion myocardial mapping is an adjunct tool for managing the disease, aiding treatment planning, and bridging clinical outcomes with research findings.

1386 16:36



Time-dependent diffusion discriminates healthy and hypertrophic mouse hearts ex vivo

Maryam Afzali[1,2], Leah Khazin[1], Richard J Foster[1], Lars Mueller[1], Sam Coveney[1], Sven Plein[1], Erica Dall'Armellina[1], Nadira Y Yuldasheva[1], Jürgen E Schneider[1], and Irvin Teh[1]

[1]Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, United Kingdom, [2]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, Cardiff, United Kingdom

Keywords: Myocardium, Heart, Cardiac diffusion MRI, time-dependent diffusion, free-gradient waveforms, tensor-valued diffusion encoding

Motivation: Oscillating gradient spin-echo (OGSE) diffusion MRI provides information about the cardiac microstructure that is complementary to conventional pulsed gradient spin echo (PGSE).

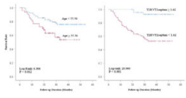
Goal(s): Using gradient waveforms with different frequencies enables the assessment of diffusion at sub-cellular length scales.

Approach: OGSE diffusion tensor imaging (DTI) was applied in the ex vivo mouse heart to investigate the ability of OGSE to disentangle hypertrophic from healthy hearts.

Results: Our results show that hypertrophic hearts exhibited significantly different OGSE parameters (8 of 10) compared to control hearts. These and DTI observations are in agreement with expected microstructural changes.

Impact: Gradient waveforms with different frequencies enable the assessment of diffusion at sub-cellular length scales. OGSE may potentially serve as an imaging biomarker, to enhance the specificity of measurements with DTI.

1387 16:48



Prognostic value of dark right ventricular blood pool sign on myocardial T2 mapping in patients with dilated cardiomyopathy

Hui Zhou[1], Yajuan Li[2,3], Huiting Zhang[4], and Xiaoming Bi[5]

[1]Radiology, Xiangya Hospital Central South University, Changsha, China, [2]Radiology, Xiangya Hospital, Central South University, Changsha, China, [3]Radiology, Yiyang Central Hospital, Yiyang, China, [4]Scientific Marketing, Siemens Healthineers Ltd, Wuhan, China, [5]MR Collabration, Siemens Healthineers, Los Angeles, CA, United States

Keywords: Heart Failure, Cardiovascular

Motivation: The evaluation of surrogate markers of cardiopulmonary status may provide risk stratification and prognostication in patients with dilated cardiomyopathy.

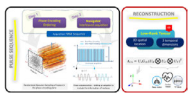
Goal(s): To investigate the prognostic value of the dark right ventricular blood pool (RVBP) sign on T2 mapping by CMR.

Approach: T2 mapping was used to measure T2 values of septum, RV and LV blood pool images in DCM patients and healthy controls.All patients were followed to record major adverse cardiac events (MACEs).

Results: The sign of dark-RVBP on T2 mapping was found in 31.3% (42/134) of DCM patients. The ratio of T2RV/T2LV seemed to be an independent predictor for MACEs in DCM patients.

Impact: The sign of dark-RVBP on T2 mapping by CMR was associated with hard clinical events with prognostic information independent of and incremental to myocardial strain parameters.

1388 17:00



Whole Heart, Whole Cardiac Cycle, Motion-Resolved, 3D T2*-Mapping Reveals Myocardial T2* Differences Between Wild-Type and HCM Mice

Shahriar Shalikar[1], Archana Malagi[2], Xingmin Guan[3], Yuheng Huang[3,4], Oumaima Laghzali[1,5], Chia-Chi Yang[2], Rohan Dharmakumar[6], Sonia Waiczies[1], Thoralf Niendorf[1,5,7], Hsin-Jung Yang[2], and Min-Chi Ku[1,5]

[1]Berlin Ultrahigh Field Facility (B.U.F.F.), Max Delbrueck Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany, [2]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]School of Medicine, Indiana University, Indianapolis, IN, United States, [4]Department of Bioengineering, University of California- Los Angeles (UCLA), Los Angeles, CA, United States, [5]DZHK (German Centre for Cardiovascular Research), Berlin, Germany, [6]Krannert Cardiovascular Research Center, Indiana University, Indianapolis, IN, United States, [7]Experimental and Clinical Research Center, Charité—Universitätsmedizin Berlin, Berlin, Germany

Keywords: Myocardium, Animals, Relaxometry, T2*, Motion-resolved, Low-rank-tensor, Multi-echo

Motivation: To explore various stages of myocardial pathophysiology and improve prediction and interception of disease progression by capturing myocardial T_2* variations across cardiac cycle.

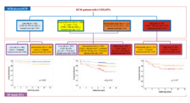
Goal(s): To establish a framework that operates independently of ECG- and respiratory-gating, enabling cinematic, whole-heart myocardial T_2*-mapping in mouse models.

Approach: A tailored framework was developed using modified Multi-Gradient-Echo (MGE) sequence and Low-Rank-Tensor (LRT) reconstruction technique. *In vivo* study was performed.

Results: Our preliminary findings demonstrate the feasibility of flow-compensated, free breathing, fully ungated, cardiac motion-resolved, whole heart and whole cardiac cycle coverage CINE imaging and T_2* mapping in healthy and diseased mice heart.

Impact: The differences in myocardial T_2* obtained for wild-type mice and HCM model provide a new metric $\Delta T_2{*}_{,rel}$ for myocardial tissue characterization, and springboard to inform on the different stages of myocardial pathophysiology and improve prediction and interception of disease progression.

1389 17:12 CMR Imaging-Based Risk Stratification for Patients with Dilated Cardiomyopathy and Severe Left Ventricular Dysfunction



Di Zhou[1], yining Wang[1], and Minjie Lu[1,2]

[1]Fuwai Hospital, Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing, China, [2]Fuwai Hospital, Beijing, China

Keywords: Myocardium, Cardiomyopathy

Motivation: Dilated cardiomyopathy (DCM) patients with severely reduced left ventricular ejection fraction of≤35% face a high risk of sudden cardiac death and heart failure events.

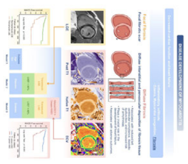
Goal(s): We aimed to refine a risk stratification model based on cardiac magnetic resonance imaging for DCM patients with LVEF≤35%, and to enhance clinical decision-making and ultimately, patient outcomes.

Approach: A retrospective analysis was conducted on 1272 DCM patients divided into a development cohort and an internal validation cohort, as well as a prospective validation cohort (n=301).

Results: Both LGE and LAVi are independently risk factors for predicting survival in a large cohort of patients with DCM and LVEF≤35%.

Impact: Our novel risk stratification may assist in timely interventions such as implantation of implantable cardioverter-defibrillator, heart transplantation, implementation of left ventricular assist devices, or referral for HF specialty care, ultimately leading to improved outcomes for DCM patients with LVEF≤35%.

1390 17:24 T1 Mapping and Extracellular Volume Fraction in Patients with Suspected Acute Myocarditis: A Prognosis Study



Yining Wang[1,2], Kelvin Chow[3], Jing An[4], Shihua Zhao[1], and Minjie Lu[1,5]

[1]Fuwai Hospital, Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing, China, [2]Chinese Academy of Medical Sciences (CAMS) and Peking Union Medical College (PUMC), Beijing, China, [3]Siemens Healthineers, Los Angeles, CA, United States, [4]Siemens Shenzhen Magnetic Resonance Ltd., Shenzhen, China, [5]Key Laboratory of Cardiovascular Imaging (Cultivation), Chinese Academy of Medical Sciences, Beijing, China

Keywords: Inflammation, Infiltration, Heart

Motivation: The prognostic value of T1 mapping and extracellular volume fraction (ECV) in acute myocarditis has not yet been supported by high-quality, evidence-based medicine.

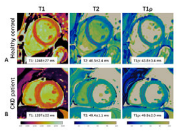
Goal(s): To investigate the prognostic value of T1 mapping and ECV in patients with acute suspected myocarditis.

Approach: Patients meeting the recommended clinical criteria for suspected myocarditis were enrolled. The potential value for predicting MACE was explored using Cox proportional hazards models.

Results: Patients with MACE showed higher global native T1 and ECV z scores and were more likely to have tissue changes in interventricular septum. Quantitative mapping parameters have incremental prognostic value beyond clinical variables and conventional CMR parameters.

Impact: Our study reveals the prognostic predictive ability of native T1 and ECV in myocarditis. The application of mapping techniques will further contribute to the understanding of the pathophysiology of heart disease and will guide the development of effective therapeutic approaches.

1391 17:36 Assessment of Cardiomyopathy at Different CKD Stages using Free-breathing Simultaneous Myocardial T1, T2 and T1ρ Mapping: Initial Experience



Zhenfeng Lyu[1,2], Sha Hua[3], Yiwen Gong[3], Peng Hu[1,2], and Haikun Qi[1,2]

[1]School of Biomedical Engineering, ShanghaiTech University, Shanghai, China, [2]Shanghai Clinical Research and Trial Center, Shanghai, China, [3]Department of Cardiovascular Medicine, Ruijin Hospital Lu Wan Branch, Shanghai Jiao Tong University School of Medicine, Shanghai, China

Keywords: Myocardium, Cardiovascular, Quantitative Imaging

Motivation: Chronic kidney disease (CKD) leads to significantly increased risk of cardiovascular death, highlighting the need for a non-contrast and non-invasive method to detect potential cardiomyopathy.

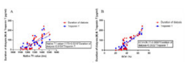
Goal(s): To evaluate the performance of cardiac multi-parametric mapping in assessing cardiomyopathy in CKD patients.

Approach: A recently proposed free-breathing multi-parametric mapping (FB-MultiMap) technique was employed to obtain myocardial T1, T2 and T1ρ maps of CKD patients. The parametric values were compared between healthy controls, stage 2, and stage 3-5 CKD patients.

Results: Myocardial T1, T2 and T1ρ exhibit significant differences between early-stage and moderate-to-end-stage CKD patients, indicating their potential for assessing the progression of cardiomyopathy in CKD.

Impact: FB-MultiMap may serve as an effective and easy-to-use tool for early diagnosis and monitoring of cardiomyopathy in CKD, potentially improving the outcome of CKD patients.

1392 17:48 Association of duration of dialysis and myocardial damage in end-stage renal disease patients: assessed by cardiovascular magnetic resonance



Zhiyue Wang[1], Haodong Guo[2], Fei Liu[2], Xiaoping Wang[2], Haige Li[2], and Weiyin Vivian Liu[3]

[1]Radiology, the Second Affiliated Hospital of Nanjing Medical University, Nanjing, China, [2]the Second Affiliated Hospital of Nanjing Medical University, Nanjing, China, [3]GE Healthcare, MR Research China, Beijing, China

Keywords: Myocardium, Cardiovascular

Motivation: Explore relationship between cardiac image and duration of dialysis.

Goal(s): To evaluate myocardial damage using CMR in end-stage renal disease (ESRD) patients undergoing hemodialysis and further explore its relationship with duration of dialysis.

Approach: Patients with long- and short-term dialysis were included. CMR parameters (native T1 value and ECV) and two biochemical results (brain pro-natriuretic peptide and troponin T) were compared.

Results: Native T1 value, ECV, brain pro-natriuretic peptide and troponin T were significant different in two groups. Multiple linear regression analysis showed that native T1 value and ECV were independently associated with duration of dialysis and troponin T.

Impact: Quantification of myocardial fibrosis in ESRD is challenging. CMR imaging is useful in the detection of cardiac damage. Longer durations of dialysis may lead to poor outcomes. Our purpose was to explore relationship between cardiac image and duration of dialysis.

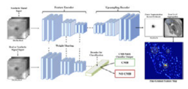
Oral

Translation of AI into the Clinic

Summit 2 | Thursday 16:00 - 18:00 | *Moderators:* Morteza Esmaeili & Efrat Shimron

1393 16:00

Improved ex-vivo cerebral microbleed detection using self-supervised learning with fuzzy segmentation



Grant Nikseresht[1], Arnold Evia[2], David A. Bennett[2], Julie A. Schneider[2], Gady Agam[1], and Konstantinos Arfanakis[2,3]

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Keywords: Diagnosis/Prediction, Aging, Ex-Vivo Applications, Brain, Microbleeds

Motivation: Accurate and efficient detection of cerebral microbleeds (CMBs) on postmortem MRI is necessary for MR-pathology studies on the relationship between CMBs and cerebral small vessel disease (SVD).

Goal(s): The development and improvement of an automated detection framework for identifying cerebral microbleeds (CMBs) on MRI scans of community-based older adults.

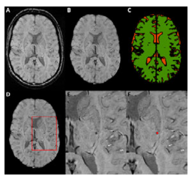
Approach: Fuzzy segmentation, a novel self-supervised auxiliary task based on CMB data synthesis, is proposed for pre-training a CMB detection model alongside other state-of-the-art SSL methods.

Results: Self-supervised pre-training with fuzzy segmentation and rotation prediction led to an 11% increase in average precision for automated CMB detection on postmortem MRI.

Impact: This study demonstrates a new state-of-the-art for postmortem CMB detection performance using self-supervised learning. Automated CMB detection on postmortem MRI will enable future MR-pathology studies into the links between CMBs and neuropathology observed at autopsy such as cerebral amyloid angiopathy.

1394 16:12

Cerebral microbleed detection on susceptibility weighted imaging using solely artificial training data



Jonathan A. Disselhorst[1,2,3], Caroline Hall[4], Punith B Venkategowda[5], Alessandra Griffa[4], Vincent Dunet[2], Tobias Kober[1,2,3], Gilles Allali[4], and Bénédicte Maréchal[1,2,3]

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Keywords: Diagnosis/Prediction, Machine Learning/Artificial Intelligence, microbleed, ARIA, SWI

Motivation: Cerebral microbleeds (CMBs) are small brain hemorrhages detectable with MRI associated with conditions like cerebral amyloid angiopathy. As their detection can be difficult, automated methods are needed for quick and precise detection and localization of CMBs.

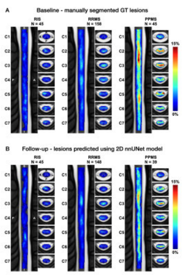
Goal(s): To propose an algorithm to detect CMBs.

Approach: A neural network was trained on SWI/T2* images, with artificial bleeds generated and added during training. The model's performance was tested on an independent test set with actual CMBs.

Results: Despite the absence of real CMBs in the training data, the simulated bleeds provided sufficient information to train a model with good performance in the independent test set.

Impact: We propose an algorithm that can help with the tedious radiological task of detecting cerebral microbleeds in the brain. We further demonstrate that a model trained solely on simulated bleeds can effectively detect actual microbleeds in real MRI data.

1395 16:24



Automatic segmentation of spinal cord multiple sclerosis lesions across multiple sites, contrasts and vendors

Pierre-Louis Benveniste[1,2], Jan Valošek[1,2,3,4], Michelle Chen[1], Nathan Molinier[1,2], Lisa Eunyoung Lee[5,6], Alexandre Prat[7,8], Zachary Vavasour[9], Roger Tam[9], Anthony Traboulsee[10], Shannon Kolind[10], Jiwon Oh[5,6], and Julien Cohen-Adad[1,2,11,12]

[1]NeuroPoly Lab, Institute of Biomedical Engineering, Polytechnique Montreal, Montréal, QC, Canada, [2]Mila - Quebec AI Institute, Montréal, QC, Canada, [3]Department of Neurosurgery, Faculty of Medicine and Dentistry, Palacký University Olomouc, Olomouc, Czech Republic, [4]Department of Neurology, Faculty of Medicine and Dentistry, Palacký University Olomouc, Olomouc, Czech Republic, [5]Department of Medicine (Neurology), University of Toronto, Toronto, ON, Canada, [6]BARLO Multiple Sclerosis Centre & Keenan Research Centre, St. Michael's Hospital, Toronto, ON, Canada, [7]Department of neuroscience, Université de Montréal, Montréal, QC, Canada, [8]Neuroimmunology research laboratory, University of Montreal Hospital Research Centre (CRCHUM), Montréal, QC, Canada, [9]School of Biomedical Engineering, University of British Columbia, Vancouver, BC, Canada, [10]Departments of Medicine (Neurology), Physics, Radiology, University of British Columbia,, Vancouver, BC, Canada, [11]Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montréal, QC, Canada, [12]Centre de Recherche du CHU Sainte-Justine, Université de Montréal, Montréal, QC, Canada

Keywords: Diagnosis/Prediction, Multiple Sclerosis, Deep Learning, Segmentation, Spinal Cord

Motivation: Longitudinal analysis of spinal cord multiple sclerosis (MS) lesions is clinically relevant for the early diagnosis and monitoring of MS progression.

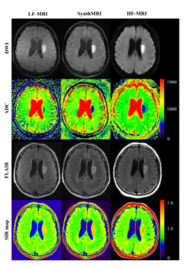
Goal(s): Develop a deep learning tool for the automatic segmentation of MS spinal cord lesions on PSIR and STIR images from multiple sites.

Approach: A nnUNet model was trained and tested on the baseline data and applied to follow-up scans to create lesion distribution maps.

Results: We demonstrated the utility of the model to map the spatio-temporal distribution of MS lesions across MS phenotypes. The model is packaged into an open-source software.

Impact: Automatic segmentation of spinal cord lesions in large cohorts helps to identify signatures of MS phenotypes for ultimately improving prognosis and optimizing treatment for people with MS.

1396 16:36



Detection and Quantification of Acute Ischemic Lesions using Deep Learning-Based Super-resolution Portable Low-Field-Strength MRI

Yueyan Bian[1], Long Wang[2], Jin Li[1], Xiaoxu Yang[1], Erling Wang[1], Yingying Li[1], Chen Zhang[3], Lei Xiang[4], and Qi Yang[1,5]

[1]Department of Radiology, Beijing Chaoyang Hospital, Beijing, China, [2]Subtle Medical, Shanghai, China, [3]MR Research Collaboration, Siemens Healthineers, Beijing, China, [4]Department of Radiology, Beijing Chaoyang Hospital, Shanghai, China, [5]Laboratory for Clinical Medicine, Capital Medical University, Beijing, China

Keywords: AI/ML Image Reconstruction, Ischemia

Motivation: The diagnostic performance of portable low-field-strength MRI (LF-MRI) is constrained by low spatial-resolution and signal-to-noise ratio.

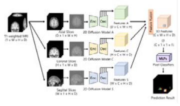
Goal(s): To evaluate the performance in detecting and quantifying ischemic lesions among SynthMRI, LF-MRI and real high-field-strength MRI (HF-MRI).

Approach: We created a deep learning-based model to generate the synthetic super-resolution (3T) MRI (SynthMRI) based on LF-MRI (0.23T). We evaluated the performance in detecting and quantifying ischemic lesions among SynthMRI, LF-MRI and HF-MRI.

Results: SynthMRI demonstrated high sensitivity in detecting the number and locations of ischemic lesions. Moreover, SynthMRI exhibited strong correlations with HF-MRI in the quantitative assessment of ischemic lesions, and significantly higher than portable LF-MRI.

Impact: Synthetic super-resolution MRI images overcome the limitations of low spatial resolution and signal-to-noise ratio in portable low-field-strength MRI. It has the potential to replace high-field-strength MRI images in the neuroimaging of AIS, enabling portable low-field-strength MRI examinations with comparable performance.

1397 16:48 [3D Segmentation of Subcortical Brain Structure with Few Labeled Data using 2D Diffusion Models]



Jihoon Cho[1,2], Hyungjoon Bae[3], Xiaofeng Liu[2], Fangxu Xing[2], Kyungeun Lee[3], Georges El Fakhri[4], Van Wedeen[2], Jinah Park[1], and Jonghye Woo[2]

[1]School of Computing, Korea Advanced Institute of Science and Technology, Daejeon, Korea, Republic of, [2]Department of Radiology, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States, [3]Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, Republic of, [4]Yale School of Medicine, New Haven, CT, United States

Keywords: Diagnosis/Prediction, Brain

Motivation: Deep learning-based segmentation methods have shown promising results; however, they require a large number of segmentation labels for training, which is very costly to obtain, especially for 3D labels.

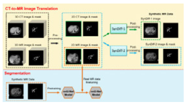
Goal(s): Our goal is to achieve promising 3D segmentation results with few labels by exploiting the ability to capture semantic information from 2D diffusion models trained without labels.

Approach: We train simple pixel classifiers using features extracted from 2D diffusion models that have been trained with slices from three orthogonal orientations.

Results: In our experiments on the Human Connectome Project database, our proposed method outperformed conventional segmentation methods in a few labeled scenarios.

Impact: Our proposed method for segmenting subcortical brain structures can be readily applied to pre-trained diffusion models with only a few labeled data, while also generating paired segmentation labels for the images produced by diffusion models.

1398 17:00 [Enhancing Deep Learning-Based Liver Vessel Segmentation on MRI with Image Translation Techniques]



Yanbo Zhang[1], Ali Bilgin[2,3], Sevgi Gokce Kafali[4,5], Brian Toner[3], Timo Delgado[4,5], Eze Ahanonu[3], Deniz Karakay[3], Wenqi Zhou[4,5], Sabina Mollus[6], Stephan Kannengießer[6], Vibhas Deshpande[7], Sasa Grbic[1], Maria Altbach[3], and Holden H. Wu[4,5]

[1]Siemens Healthineers, Princeton, NJ, United States, [2]Department of Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States, [3]Department of Medical Imaging, University of Arizona, Tucson, AZ, United States, [4]Department of Radiological Sciences, David Geffen School of Medicine, University of California Los Angeles, Los Angeles, CA, United States, [5]5Department of Bioengineering, University of California Los Angeles, Los Angeles, CA, United States, [6]Siemens Healthineers, Erlangen, Germany, [7]Siemens Healthineers, Malvern, PA, United States

Keywords: AI Diffusion Models, Segmentation, Liver Vessel Segmentation

Motivation: To improve liver vessel segmentation on MRI under annotation constraints.

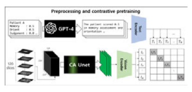
Goal(s): Apply an advanced unpaired image translation technique, SynDiff, to create synthetic MR images from CT data.

Approach: By incorporating vessel masks in the translation process, the optimized SynDiff models generated synthetic images that facilitated more effective pretraining of segmentation models.

Results: Validated across multiple pretraining settings, the refined SynDiff approach surpassed the standard nnU-Net and other pretraining-based methods, substantially improving liver vessel segmentation performance.

Impact: This study remarkably advances liver vessel segmentation on MRI, demonstrating that synthetic data can effectively augment limited datasets, leading to improved model performance. It has great potential for broader applications in medical image analysis.

1399 17:12



Multimodal Approach for CDR : Vision-Language Integration for Enhanced Clinical Dementia Rating Classification in Alzheimer's Disease

Joonhyeok Yoon[1], Minjun Kim[1], Sooyeon Ji[1], Chungseok Oh[1], Hwihun Jeong[1], Kyeongseon Min[1], Jonghyo Youn[1], Taechang Kim[1], Hongjun An[1], Juhyung Park[1], and Jongho Lee[1]

[1]Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of

Keywords: Analysis/Processing, Alzheimer's Disease, multimodal, language-text

Motivation: The diagnosis of Alzheimer's disease (AD) considers not only clinical symptoms but also various data sources, including MR imaging.

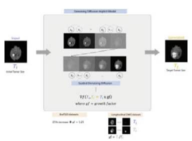
Goal(s): In this study, we used a multimodal approach to integrate both language and vision information to improve the performance of clinical dementia rating classification network.

Approach: We used contrastive pre-training with language and vision data pairs; then trained a classifier, freezing the pre-trained network during classifier training.

Results: The results show that the integrated model achieved the highest accuracy. In addition, the contrastive learning process improved the performance of the vision encoder with guidance of abundant linguistic information.

Impact: With multimodal training, we successfully integrated both vision and language information and yielded the best results with integrated model. Also, multimodal training enhanced vision encoder's performance. When limited language information was provided, the complementary information from visual information was greater.

1400 17:24



Predicting Anatomical Tumor Growth in Pediatric High-grade Gliomas via Denoising Diffusion Models

Daria Laslo[1], Maria Monzon[1], Divya Ramakrishnan[2], Marc von Reppert[2], Schuyler Stoller[3], Ana Sofia Guerreiro Stücklin[4], Nicolas U. Gerber[4], Andreas Rauschecker[5], Javad Nazarian[4], Sabine Mueller[5], Catherine Jutzeler[1], and Sarah Brueningk[1]

[1]ETH Zurich, Zurich, Switzerland, [2]Yale University, New Haven, CT, United States, [3]École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [4]Kinderspital Zurich, Zurich, Switzerland, [5]University of California San Francisco, San Francisco, CA, United States

Keywords: AI Diffusion Models, Machine Learning/Artificial Intelligence, Oncology, Cancer, DMG, Diffuse Midline Glioma

Motivation: Pediatric diffuse midline gliomas are associated with a poor prognosis, leaving radiotherapy as standard of palliative care. Personalized radiation regimes could maximize the benefit for the patient, and consequently improve clinical outcomes.

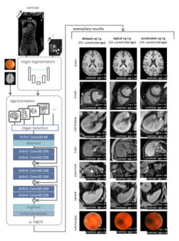
Goal(s): This study explores a state-of-the-art computer vision method to predict the anatomical growth of tumors which could inform tailored radiotherapy treatments.

Approach: A denoising diffusion implicit model is employed to generate realistic, high-quality magnetic resonance imaging scans of enlarged tumor sizes starting from a baseline image.

Results: Our proof-of-concept study demonstrates promising results on an external longitudinal pediatric dataset, highlighting the method's potential to realistically predict visual tumor growth.

Impact: We demonstrate realistic predictions of anatomical (pediatric) brain tumor growth using a generative denoising diffusion implicit model. This enables personalized predictions of tumor growth trajectories to guide localized therapies such as geometric dose shaping for radiotherapy delivery.

1401 17:36



MRI-based Biological Age Estimation for Multiple Organs in the UK Biobank Cohort

Veronika Ecker[1,2], Marcel Früh[1], Bin Yang[2], Sergios Gatidis[1], and Thomas Küstner[1]

[1]University Hospital of Tübingen, Tübingen, Germany, [2]University of Stuttgart, Stuttgart, Germany

Keywords: Analysis/Processing, Aging, Biological Age

Motivation: MRI is a valuable tool for providing health-related information, including visualizing age-associated changes. Aging is influenced by chronic diseases, and assessing the true organ-specific biological age is essential for accurate diagnosis.

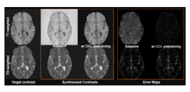
Goal(s): Development of an organ-specific age estimation for investigation in large imaging cohort with associated non-imaging information.

Approach: While prior studies focused on age estimation from non-imaging data or single organs, we propose a multi-organ age estimation framework, operating on brain, cardiac, and abdominal MRIs, and OCT scans.

Results: Our results prove the feasibility of imaging-based organ age estimation and initiate further investigations to identify risk factors for accelerated aging.

Impact: Reliable imaging-based estimation of biological age in multiple organ systems facilitates research efforts to identify risk factors of accelerated aging, advancing the goal of age-related phenotyping.

1402 17:48



Learning to synthesize MR contrasts using a self-supervised constrained contrastive learning approach

Lavanya Umapathy[1,2], Li Feng[1,2], and Daniel K Sodickson[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University Grossman School of Medicine, New York, NY, United States

Keywords: Analysis/Processing, Machine Learning/Artificial Intelligence

Motivation: Although deep learning frameworks have been widely used in all aspects of the MR imaging pipeline, the effect of learning tissue-specific information from MR images in improving model performance needs to be understood.

Goal(s): We demonstrate the utility of a self-supervised contrastive learning framework that uses multi-contrast information to improve synthesis of T1w and T2w images.

Approach: A deep learning model is pretrained to learn T1 and T2 information from a set of multi-parametric MR images.

Results: A contrast synthesis framework was developed using few examples of contrast mapping. Embedding relevant contrast information during pretraining synthesized images with improved MSE, SSIM, and PSNR.

Impact: Multi-contrast information can be leveraged by self-supervised deep learning models to understand underlying tissue characteristics and synthesize new MR contrast-weighted images. This demonstrates the wider applicability of embedding tissue-specific information in improving different aspects of the MR imaging pipeline.

Member-Initiated Session

Steps on the Path to Clinical Translation: An International Perspective

Nicoll 3 Thursday 16:00 - 18:00 *Moderators:* Po-Wah So

(no CME credit)

16:00 Introduction

16:05 A Radiologist's Perspective

Pek-Lan Khong

National University of Singapore, Singapore

16:20 A Research Radiographer's Perspective

Shawna Farquharson

National Imaging Facility, University of Queensland, St. Lucia, Australia

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16:35 A Clinical Physicist's Perspective

Matthew Grech-Sollars

University College London, London, United Kingdom

16:50 A Metrologist's Perspective
Christoph Kolbitsch
Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany

17:05 A Research Scientist's Perspective
Dan Ma
Case Western Reserve University, Cleveland, OH, United States

17:20 Panel Discussion & Survey

Member-Initiated Session
Pushing the Boundaries of Diffusion MRI Across Field Strengths & Gradient Performance

Room 325-326 | Thursday 16:00 - 18:00 | *Moderators:* Santiago Coelho

(no CME credit)

16:00 Industry Perspective on Where Low-, Mid- & High-Field Systems & High Performance Gradient Technologies Sit Along the Translational Pipeline
Rebecca Ramb
Siemens Healthineers

16:17 High Performance Gradient System Applications: Brain & Prostate
Ante Zhu
GE Healthcare - Technology & Innovation Center

16:34 High Performance Diffusion MRI in the Prostate: New Opportunities & Potential for Clinical Translation
Malwina Molendowska
Lund University

16:51 Diffusion Imaging Across Field & Gradient Strengths
Dan Wu[1], Jianmin Yuan[2]
Zhejiang University, China[1], United Imaging Healthcare, China[2]

17:08 Opportunities for Ultra-High Field Diffusion MRI in the Brain
An Joseph Vu
UCSF

17:25 Panel Discussion

Plenary Session
Closing Plenary

Plenary Hall (Hall 603-604) | Thursday 18:15 - 19:15

18:15 Mansfield Lecture: Ethical Issues in MRI AI Research
Mark Schweitzer[1]

[1]Wayne State School of Medicine, United States

18:45 Closing Remarks
Margaret Hall-Craggs[1]

[1]University College Hospital, United Kingdom